



Outcomes of Anterior Cruciate Ligament Reconstruction in Patients with Associated Anterolateral Ligament Injury

Resultados da reconstrução do ligamento cruzado anterior em pacientes com lesão associada do ligamento anterolateral

João Paulo Fernandes Guerreiro^{1,2} Larissa Baldow Rosa³ Ellen Liceras Gonçalves⁴
Amon Ramysés Rodrigues Curcio⁴ Paulo Roberto Bignardi¹ Marcus Vinicius Danieli^{1,2}

¹ Faculdade de Medicina, Pontifícia Universidade Católica do Paraná (PUCPR) – Campus Londrina, Londrina, PR, Brazil

² Hospital de Ortopedia Uniort.e, Londrina, PR, Brazil

³ Orthopedics and Traumatology Department, Faculdade de Medicina, Pontifícia Universidade Católica do Paraná (PUCPR) Campus Londrina, PR, Brazil

⁴ Orthopedics and Traumatology Service, Hospital Evangélico de Londrina, Londrina, PR, Brazil

Address for correspondence João Paulo Fernandes Guerreiro, PhD, Avenida Higienópolis 2.600, Londrina, PR, Brazil, Zip Code 86050170. (e-mail: drjoaopauloguerreiro@gmail.com).

Rev Bras Ortop 2024;59(3):e397–e402.

Abstract

Objective To evaluate if there is a significant difference in the outcomes of isolated anterior cruciate ligament (ACL) reconstruction in patients with or without associated anterolateral ligament (ALL) injury.

Methods We conducted a retrospective cross-sectional study through the analysis of medical records and the application of the questionnaires of the Lysholm Knee Scoring Scale and the International Knee Documentation Committee (IKDC) Subjective Knee Form to patients undergoing isolated ACL reconstruction.

Results The 52 participants included were divided into two groups: 19 with associated ALL injury and 33 with no associated ALL injury. None of the patients with associated ALL injury suffered an ACL rupture, and 21.1% presented injuries to other knee structures after surgery. Among the patients with no associated injury, 6.1% suffered ACL rupture, and 18.2% presented injuries to other structures after surgery ($p = 0.544$). Return to activities at the same level as that of the preoperative period occurred in 60% of the patients with associated ALL injury and in 72% of those with no associated injury ($p = 0.309$). The mean score on the Lysholm Knee Scoring Scale was of 81.6 points in patients with associated ALL injury, and of 90.1 in those with no associated injury ($p = 0.032$). The mean score on the IKDC Subjective Knee Form was of

Keywords

- ▶ anterior cruciate ligament
- ▶ anterolateral ligament
- ▶ articular ligaments
- ▶ knee

Work developed at the Hospital de Ortopedia Uniort.e, Hospital Evangélico de Londrina, and School of Medicine, Pontifícia Universidade Católica do Paraná (PUCPR) – Câmpus Londrina, Londrina, Paraná, Brazil.

received
August 21, 2023
accepted
November 6, 2023

DOI <https://doi.org/10.1055/s-0044-1785516>.
ISSN 0102-3616.

© 2024. The Author(s).

This is an open access article published by Thieme under the terms of the Creative Commons Attribution 4.0 International License, permitting copying and reproduction so long as the original work is given appropriate credit (<https://creativecommons.org/licenses/by/4.0/>).
Thieme Revinter Publicações Ltda., Rua do Matoso 170, Rio de Janeiro, RJ, CEP 20270-135, Brazil

70.3 points in patients with associated ALL injury and of 76.7 in those with no associated injury ($p = 0.112$).

Conclusion There was no statistically significant difference regarding graft injuries or new injuries to other structures, satisfaction with the operated knee, or the score on the IKDC Subjective Knee Form. Return to activity was similar in the groups with and without associated ALL injuries. The scores on the Lysholm Knee Scoring Scale were better, with a statistically significant difference in the group with no associated ALL injuries.

Resumo

Objetivo Avaliar se há diferença significativa nos resultados da reconstrução isolada do ligamento cruzado anterior (LCA) em pacientes com e sem lesão associada do ligamento anterolateral (LAL).

Métodos Foi realizado um estudo transversal retrospectivo com análise de prontuários e aplicação da Escala de Pontuação do Joelho de Lysholm e do Formulário Subjetivo de Joelho do International Knee Documentation Committee (IKDC) a pacientes com reconstrução isolada do LCA.

Resultados Os 52 participantes incluídos foram separados em 2 grupos: 19 com lesão associada do LAL e 33 sem lesão associada. Nenhum paciente com lesão associada do LAL sofreu rerruptura do LCA, e 21,1% tiveram lesões em outras estruturas do joelho após a cirurgia. Entre os pacientes sem lesão associada, 6,1% sofreram rerruptura do LCA, e 18,2% tiveram lesões em outras estruturas após a cirurgia ($p = 0,544$). O retorno às atividades no mesmo nível do que no pré-operatório foi observado em 60% dos pacientes com lesão associada do LAL e em 72% daqueles sem lesão associada ($p = 0,309$). Na Escala de Pontuação do Joelho de Lysholm, os pacientes com lesão associada do LAL obtiveram média de 81,6 pontos, e os sem lesão associada, média de 90,1 pontos ($p = 0,032$). No Formulário Subjetivo de Joelho do IKDC, os pacientes com lesão associada do LAL obtiveram média de 70,3 pontos, e os sem lesão associada, média de 76,7 pontos ($p = 0,112$).

Conclusão Não foi observada diferença estatística significativa quanto a lesões do enxerto ou novas lesões de outras estruturas, satisfação com o joelho operado ou pontuação no Formulário Subjetivo de Joelho do IKDC. O retorno às atividades foi semelhante nos grupos com e sem lesão associada do LAL, e os resultados na Escala de Pontuação do Joelho de Lysholm foram melhores, com diferença estatística significativa no grupo sem lesão associada do LAL.

Palavras-chave

- ▶ joelho
- ▶ ligamento anterolateral
- ▶ ligamentos articulares
- ▶ ligamento cruzado anterior

Introduction

Anterior cruciate ligament (ACL) injuries are common, and their incidence increases among the physically-active population, with significant consequences for the quality of life, activity index, joint stability, functionality, and risk of development of osteoarthritis.¹ However, even though surgical reconstruction is the treatment of choice, the success rate is influenced by patient- or graft-specific risk factors.^{1,2}

In recent years, several studies^{3,4} have sought to better characterize the anterolateral complex of the knee to minimize such risks and seek more effective treatment; the anterolateral ligament (ALL) has a critical stabilizing function for internal knee rotation, along with the ACL. Injuries to the ACL and ALL present worse postoperative outcomes

compared with those of surgical ACL reconstruction alone due to the need to associate extra-articular procedures with intra-articular reconstruction.^{5,6}

Based on this information, the present study retrospectively analyzed the outcomes of isolated ACL reconstruction in groups of patients with ACL injury associated or not with ALL injuries.

Materials and Methods

The present study was conducted after approval by the institutional Ethics in Research Committee (CAAE-61209722.0.0000.0020) and after the participants signed an informed consent form, and it follows resolution no. 466/2012 of the Brazilian National Health Council and the Declaration of Helsinki.

We performed an analysis of medical records and applied the questionnaires of the Lysholm Knee Scoring Scale and of the International Knee Documentation Committee (IKDC) Subjective Knee Form in their Portuguese versions^{7,8} to all patients undergoing isolated ACL reconstruction by the same knee surgery group in 2019.

The study included patients with at least two years of follow-up, who had magnetic resonance imaging (MRI) scans performed in the acute phase of the injury (up to three weeks after the initial sprain) and underwent surgery within the first three months after the injury. Patients who refused to participate in the research or were unable to be contacted were excluded.

In the medical records, we collected data on sex, date of birth, date of injury, date of preoperative MRI scan, date of surgery, and operated side. The selected patients were interviewed and filled out the questionnaires. Initially, the participants answered whether they had a new injury to the ACL or to another structure that required surgery on the same knee. Those who did not have new injuries were asked about their satisfaction level with the surgery (very satisfied, satisfied, somewhat satisfied, or dissatisfied) and return to sports (better than before, the same as before, worse than before, or unable to return). In addition, they answered the Lysholm Scale and IKDC functional questionnaires.^{7,8} Patients with new injuries were excluded from this stage because they did not meet the criterion of a minimum two years of postoperative follow-up.

Statistical Analysis

The analysis of the qualitative variables used the Chi-squared (χ^2) or the Fisher exact test. For the quantitative variable the Shapiro-Wilk normality test. Then, the Mann-Whitney test for non-normal data and the *t*-test for variables with

Gaussian distribution. The results were analyzed through the IBM SPSS Statistics for Windows (IBM Corp., Armonk, NY, United States) software, version 23.0, with a confidence level of 5% for all tests applied.

Results

From the initial sample of 221 patients undergoing ACL reconstruction, we included 103 participants with MRI scans performed within the first 3 weeks who underwent surgery within 3 months after the injury. We excluded 1 patient who refused to participate in the research and 50 patients with incomplete medical records and whom we were unable to contact. The 52 participants evaluated were divided into 2 groups according to the presence or absence of ALL injuries before ACL reconstruction surgery (→ Fig. 1).

The mean age of the patients was of 33.3 years for those with an associated ALL injury and of 38 years for those with no associated ALL injury. The sample was predominantly male, with 73.7% of male patients with an ALL injury and 87.9% of male subjects with no ALL injury. Regarding new injuries after 2 years, none of the patients with an ALL injury presented a new ACL injury, and 21.1% of patients had injured another knee structure (meniscus, cartilage, or another ligament). In patients without an ALL injury, 6.1% had a new ACL injury, and 18.2% injured another structure (→ Table 1).

The mean age of the patients with no new knee injury was of 34.4 years among those with an associated ALL injury and of 39.6 years in those with no associated injuries. The sample remained predominantly male, with 73.3% of male patients with an ALL injury and 84% of male subjects with no ALL injury. As for satisfaction with the operated knee, most participants from both groups were very satisfied, including

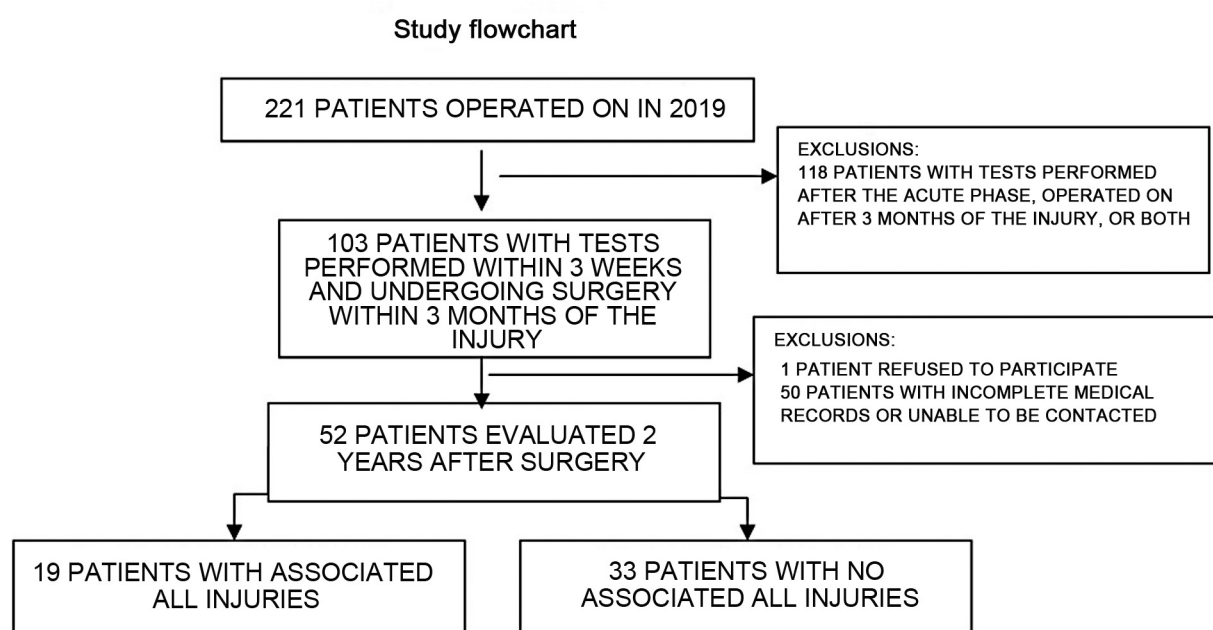


Fig. 1 Study flowchart. Abbreviation: ALL, anterolateral ligament.

Table 1 Age, sex, and new injuries

Variable	With ALL injury (n = 19)	Without ALL injury (n = 33)	p-value
Age (years): mean ± SD	33.3 ± 8.8	38 ± 10.4	0.243
Male sex: n (%)	14 (73.7)	29 (87.9)	0.260
New knee injury: n (%)			
- Yes, new ACL injury	0 (0)	2 (6.1)	0.544
- Yes, in another structure	4 (21.1)	6 (18.2)	
- No new injury	15 (78.9)	25 (75.8)	

Abbreviations: ACL, anterior cruciate ligament; ALL, anterolateral ligament; SD, standard deviation.

Table 2 Satisfaction, return to sports, and functional scores

Variable	With ALL injury (n = 19)	Without ALL injury (n = 33)	p-value
Age (years): mean ± SD	34.4 ± 9.4	39.6 ± 10.5	0.118
Male sex: n (%)	11 (73.3)	21 (84)	0.444
Satisfaction: n (%)			
- Very satisfied	7 (46.7)	13 (52)	0.367
- Satisfied	5 (33.3)	10 (40)	
- Somewhat satisfied	3 (20)	1 (4)	
- Dissatisfied	0 (0)	1 (4)	
Return to activities: n (%)			
- Better than before	2 (13.3)	3 (12)	0.309
- Same as before	9 (60)	18 (72)	
- Worse than before	4 (26.7)	2 (8)	
- Unable to return	0 (0)	2 (8)	
Lysholm Knee Scoring Scale: mean ± SD	81.6 ± 18.6	90.1 ± 15.5	0.032
IKDC Subjective Knee Form: mean ± SD	70.3 ± 15.4	76.7 ± 14.3	0.112

Abbreviations: ACL, anterior cruciate ligament; ALL, anterolateral ligament; IKDC, International Knee Documentation Committee; SD, standard deviation.

46.7% with an ALL injury and 52% with no ALL injury ($p = 0.367$).

Regarding return to activities, 60% of the patients with ALL injuries and 72% of those without them ($p = 0.309$) resumed them at the same level as in the preoperative period.

As for the functional questionnaires, the mean score on the Lysholm Scale was of 81.6 points among patients with an ALL injury, and of 90.1 points in those with no ALL injury ($p = 0.032$), and the mean IKDC score was of 70.3 points in patients with an ALL injury and of 76.7 points in subjects with no ALL injury ($p = 0.112$) (► **Table 2**).

Discussion

Analyzing the new ACL graft injury rate, the present study we did not observe significant differences or the need for new surgeries in patients with or without associated ALL injuries. However, some studies^{6,9,10} have shown that an associated injury increases the rates of ACL graft rupture and reoperation. However, a large retrospective study¹¹ with combined reconstruction did not reveal a significant difference concerning isolated ACL reconstructions. The disadvantages of

associated injury and advantages of combined reconstruction would result from the anatomical and biomechanical properties of the ALL in terms of rotational stabilization of the knee along with the ACL. Cadaveric studies^{12–14} have shown that recovery of knee biomechanics and kinetics to preinjury levels only occurs in combined reconstructions of associated injuries.

Some researchers^{14–18} consider the presence of a higher criterion for increased risk of ACL rerupture, that is, postoperative positive residual pivot, or two minor criteria for increased risk of reinjury as an indication for combined reconstruction. However, to date, there has been no standardization of the indications for extra-articular ALL reconstruction associated with intra-articular ACL reconstruction, with several authors^{3,5,14–18} highlighting the need for more robust studies on the topic.

Regarding functional results and postreconstruction patient satisfaction, most studies^{10,14–23} show objective and/or subjective improvement with combined reconstruction. Nevertheless, there is still much controversy in the literature, with most studies showing no statistically significant difference, except regarding the presence of joint hypermobility

associated with significant knee rotational instability, in which combined reconstruction has led to better patient satisfaction.^{10,16,17,19,21} As far as the return to daily activities and sports, combined reconstruction has resulted in functional improvement, especially in populations with knee hypermobility.¹⁵⁻¹⁷ However, there is still no objective consensus regarding the benefits of combined reconstruction. The IKDC and Lysholm functional scores show better results, but these improvements are only statistically relevant in a few studies.^{6,9,10,16,19-21,23} We observed better IKDC scores after isolated ACL reconstructions in patients with no associated ALL injury, but without statistically significant difference, and significantly better Lysholm scores in patients undergoing isolated reconstruction with no associated ALL injuries.

Since the ALL is a recently characterized structure, the literature clearly shows the need for longer follow-up to determine the presence or absence of long-term benefits from combined ALL and ACL reconstruction with prospective, randomized, controlled clinical studies with a large number of patients.^{1,9,14-16,20,24,25}

The present study has certain important limitations. As a retrospective study, there is a risk of some biases typical of a non-prospective study. A higher number of cases would be the best option to increase the power of the statistical analysis and demonstrate potential differences between the groups. We had 221 patients operated on during the period and included in the study. However, only 103 underwent imaging exams and surgery at the times considered ideal, and we were unable to contact 51 patients. The mean age of the patients in the present study (33.3 years) was above the mean age observed in similar studies (24 years)¹¹

Conclusion

Patients undergoing ACL reconstruction with and without an associated ALL injury presented no difference regarding the rates of new injuries or new surgery. Both groups presented similar results regarding satisfaction with the knee, IKDC score, and return to activities. The Lysholm score was better in patients with no associated ALL injury.

Authors' Contributions:

Each author contributed individually and significantly to the development of the article. JPFG wrote and reviewed the article, analyzed the results, developed the statistical analysis, participated in the intellectual conception of the study, and coordinated the entire project; LBR collected data, analyzed the results, and wrote and reviewed the article; ELG and ARRC collected data, and wrote and reviewed the article; PRB analyzed the results and developed the statistical analysis; and MVD: reviewed the article and participated in the intellectual conception of the study.

Financial Support

The authors declare that they did not receive funding from agencies in the public, private, or not-for-profit sectors for the conduction of the present study.

Conflict of Interests

The authors have no conflict of interests to declare.

References

- Siegel L, Vandenakker-Albanese C, Siegel D. Anterior cruciate ligament injuries: anatomy, physiology, biomechanics, and management. *Clin J Sport Med* 2012;22(04):349-355
- Webster KE, Feller JA, Leigh WB, Richmond AK. Younger patients are at increased risk for graft rupture and contralateral injury after anterior cruciate ligament reconstruction. *Am J Sports Med* 2014;42(03):641-647
- Sonnery-Cottet B, Daggett M, Fayard JM, et al. Anterolateral Ligament Expert Group consensus paper on the management of internal rotation and instability of the anterior cruciate ligament-deficient knee. *J Orthop Traumatol* 2017;18(02):91-106
- Helito CP, Helito PVP, Leão RV, Demange MK, Bordalo-Rodrigues M. Anterolateral ligament abnormalities are associated with peripheral ligament and osseous injuries in acute ruptures of the anterior cruciate ligament. *Knee Surg Sports Traumatol Arthrosc* 2017;25(04):1140-1148
- Ferretti A, Monaco E, Redler A, et al. High Prevalence of Anterolateral Ligament Abnormalities on MRI in Knees With Acute Anterior Cruciate Ligament Injuries: A Case-Control Series From the SANTI Study Group. *Orthop J Sports Med* 2019;7(06):2325967119852916
- Sobrado MF, Giglio PN, Bonadio MB, et al. Outcomes After Isolated Acute Anterior Cruciate Ligament Reconstruction Are Inferior in Patients With an Associated Anterolateral Ligament Injury. *Am J Sports Med* 2020;48(13):3177-3182
- Peccin MS, Ciconelli R, Cohen M. Specific questionnaire for knee symptoms - the "Lysholm Knee Scoring Scale": translation and validation into Portuguese. *Acta Ortop Bras* 2006;14(05):268-272
- Metsavaht L, Leporace G, Riberto M, de Mello Sposito MM, Batista LA. Translation and cross-cultural adaptation of the Brazilian version of the International Knee Documentation Committee Subjective Knee Form: validity and reproducibility. *Am J Sports Med* 2010;38(09):1894-1899
- Gunaydin B, Turgut A, Sari A, et al. Does anterolateral ligament rupture affect functional outcomes in patients who underwent an anterior cruciate ligament reconstruction? *Int J Surg* 2019; 65:25-31
- Saithna A, Daggett M, Helito CP, et al. Clinical Results of Combined ACL and Anterolateral Ligament Reconstruction: A Narrative Review from the SANTI Study Group. *J Knee Surg* 2021;34(09):962-970
- Thaunat M, Clowez G, Saithna A, et al. Reoperation Rates After Combined Anterior Cruciate Ligament and Anterolateral Ligament Reconstruction: A Series of 548 Patients From the SANTI Study Group With a Minimum Follow-up of 2 Years. *Am J Sports Med* 2017;45(11):2569-2577
- Willinger L, Athwal KK, Holthof S, Imhoff AB, Williams A, Amis AA. Role of the Anterior Cruciate Ligament, Anterolateral Complex, and Lateral Meniscus Posterior Root in Anterolateral Rotatory Knee Instability: A Biomechanical Study. *Am J Sports Med* 2023; 51(05):1136-1145
- Inderhaug E, Stephen JM, Williams A, Amis AA. Biomechanical Comparison of Anterolateral Procedures Combined With Anterior Cruciate Ligament Reconstruction. *Am J Sports Med* 2017;45(02):347-354
- Kraeutler MJ, Welton KL, Chahla J, LaPrade RF, McCarty EC. Current Concepts of the Anterolateral Ligament of the Knee: Anatomy, Biomechanics, and Reconstruction. *Am J Sports Med* 2018;46(05):1235-1242
- Lau BC, Rames J, Belay E, Riboh JC, Amendola A, Lassiter T. Anterolateral Complex Reconstruction Augmentation of Anterior Cruciate Ligament Reconstruction: Biomechanics, Indications, Techniques, and Clinical Outcomes. *JBJ Rev* 2019;7(11):e5

- 16 Toker MB, Erden T, Toprak A, Taşer ÖF Does anterolateral ligament internal bracing improve the outcomes of anterior cruciate ligament reconstruction in patients with generalized joint hypermobility? *Ulus Travma Acil Cerrahi Derg* 2022;28(03):320–327
- 17 Sonnery-Cottet B, Thauinat M, Freychet B, Pupim BH, Murphy CG, Claes S. Outcome of a Combined Anterior Cruciate Ligament and Anterolateral Ligament Reconstruction Technique With a Minimum 2-Year Follow-up. *Am J Sports Med* 2015;43(07):1598–1605
- 18 Lutz C. Role of anterolateral reconstruction in patients undergoing anterior cruciate ligament reconstruction. *Orthop Traumatol Surg Res* 2018;104(1S):S47–S53
- 19 Yin J, Yang K, Zheng D, Xu N. Anatomic reconstruction of the anterior cruciate ligament of the knee with or without reconstruction of the anterolateral ligament: A meta-analysis. *J Orthop Surg (Hong Kong)* 2021;29(01):2309499020985195
- 20 Kunze KN, Manzi J, Richardson M, et al. Combined Anterolateral and Anterior Cruciate Ligament Reconstruction Improves Pivot Shift Compared With Isolated Anterior Cruciate Ligament Reconstruction: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Arthroscopy* 2021;37(08):2677–2703
- 21 Helito CP, Camargo DB, Sobrado MF, et al. Combined reconstruction of the anterolateral ligament in chronic ACL injuries leads to better clinical outcomes than isolated ACL reconstruction. *Knee Surg Sports Traumatol Arthrosc* 2018;26(12):3652–3659
- 22 Lee DW, Kim JG, Kim HT, Cho SI. Evaluation of Anterolateral Ligament Healing After Anatomic Anterior Cruciate Ligament Reconstruction. *Am J Sports Med* 2020;48(05):1078–1087
- 23 Lee DW, Kim JG, Cho SI, Kim DH. Clinical Outcomes of Isolated Revision Anterior Cruciate Ligament Reconstruction or in Combination With Anatomic Anterolateral Ligament Reconstruction. *Am J Sports Med* 2019;47(02):324–333
- 24 Santoso A, Anwar IB, Sibarani T, et al. Research on the Anterolateral Ligament of the Knee: An Evaluation of PubMed Articles From 2010 to 2019. *Orthop J Sports Med* 2020;8(12):2325967120973645
- 25 Saithna A, Helito CP, Vieira TD, Sonnery-Cottet B, Muramatsu K. The Anterolateral Ligament Has Limited Intrinsic Healing Potential: A Serial, 3-Dimensional-Magnetic Resonance Imaging Study of Anterior Cruciate Ligament-Injured Knees From the SANTI Study Group. *Am J Sports Med* 2021;49(08):2125–2135