Investigating the effective factors on rehabilitation in anterior cruciate ligament reconstruction based on Lysholm knee score

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ABSTRACT

Rupture of the anterior cruciate ligament (ACL) disturbs the stability of the knee, and increases the risk of subsequent meniscal damage and the risk of developing degenerative joint disease. Surgical ACL reconstruction (ACLR) is one of the most common orthopedic surgeries. This study aimed to investigate the effective factors on the rehabilitation rate in ACLR with hamstring autograft based on the Tegner activity scale (TAS) and Lysholm knee scoring scale (LKS) one year after the operation. In this descriptive-analytical study, 140 patients who underwent ACLR surgery with hamstring autograft were evaluated. Patients were evaluated based on TAS and LKS scores before and after the surgery and their responses were recorded. Then, the rehabilitation rate was calculated based on these two scales, and the association between the rehabilitation rate and pre-operative and post-operative parameters was investigated. Based on the findings, LKS scores after surgery were significantly associated with age, gender, education, injury mechanism, loss of full flexion ROM, analgesic consumption after surgery, surgical site infection, and BMI. Also, the LKS score was higher in people whose Tegner activity scale score was 8 before the injury. There was no significant association with smoking before surgery, hematoma at the graft site after surgery, knee meniscal lesions, and hemarthrosis formation during the first six hours of ACL injury. Determining the effective factors before and after surgery on the rehabilitation rate of patients undergoing ACLR who were treated with hamstring autograft may be useful in evaluating the rehabilitation rate of patients.

Keywords: Anterior cruciate ligament, Tegner activity scale, Lysholm knee scoring scale, Hamstring ligament, Autograft

Introduction

An anterior cruciate ligament (ACL) is one of the most important ligaments in the knee joint and adjusts the movement responses necessary to maintain the dynamic stability of the knee and the movement coordination of the lower limbs [1]. Treatments of ACL injuries include conservative and surgical treatments. Conservative treatment requires avoiding activities that cause knee instability and is based on long-term and intensive physiotherapy and lifestyle changes [2]. Surgical ACL reconstruction (ACLR) is one of the most common orthopedic surgeries and approximately 100,000 to 175,000 ACLRs are performed annually only in the United States [3-5]. ACLR is commonly performed and it is expected patients have a faster return to sports activities and even a return to daily activities [6]. Hamstring tendons remain a popular choice for autograft in ACLR. Several studies have shown that successful ACLR can be achieved with hamstring tendon autografts [7-10]. ACLR with the hamstring autograft has several advantages including biomechanical superiority, comparable strength to native ACL, soft tissue tunnel passage, accessibility and ease of harvest, and

personalized graft length and diameter. Although this technique is not without complications [11].

Increasing evidence has shown that hamstring autograft can have a more unfavorable outcome in younger, more active, and female patients [12, 13]. Also, the role of height, weight, body mass index (BMI), and lower limb size as predictors of hamstring tendon autograft success has been investigated [14].

Successful ACLR requires physical rehabilitation to help patients return to an active lifestyle. Several aspects of rehabilitation after ACLR have been investigated by level I and II clinical trials [15]. Recently due to the superior validity of data obtained from patient-reported questionaries, there is an increased focus on these rather than clinician-based evaluation [16]. Lysholm knee score (LKS) and Tegner Activity Scale (TAS) are the most used types [17]. The LKS scale is an eight-parameter standard scale that estimates the success rate of surgery and postoperative complications based on the patient's symptoms [18]. The Tegner Activity Scale (TAS) is a patient-reported scale that describes the level of work- and exercise-based activity in which the patient can participate. This scale aims to provide a standard method for determining pre-injury activity levels and post-injury activity levels that can be documented on a numerical scale [18].

Therefore, it seems that several factors before and after the operation, can play a role in the success and rehabilitation of ACLR. Since the proper selection of patients for ACLR, the surgeon's evaluation of the result of the operation based on demographic information and characteristics is very important. This study aimed to evaluate the effective factors on the rehabilitation rate in ACLR with hamstring autograft based on TAS and LKS scoring systems before and after the surgery.

Materials and Methods

This descriptive-analytical study was conducted on patients who underwent ACLR with hamstring autograft after ACL injury in Imam Khomeini and Arvand Hospitals, Ahvaz, Iran. Patients with bilateral ACL injury, multiple knee ligament injuries, radiographic or arthroscopic evidence of severe joint destruction due to osteoarthritis or any other destructive factor, history of any previous knee surgery, history of any fracture in the bones around and inside the knee, damage to other knee ligaments on the same side, patients who needed revision surgery, and patients suffering from knee inflammatory diseases were excluded from the study. From a study population of 167 individuals with ACLR, 140 cases were included in the study and 27 cases were excluded. Of excluded cases, five patients had fractures around the knee; seven cases had bilateral ACL injuries; three cases had multiple ligament injuries in the same knee; and 12 cases didn't follow up the study. Informed and written consent was obtained from all participants. This study was carried out after approval by the research council and the medical ethics committee of the Jundishapuor University of Ahvaz (IR.AJUMS.RES.1402.536) and in concordance with the declaration of Helsinki.

Clinical evaluation of patients before ACL reconstruction surgery was done by the surgeon under local or general anesthesia. Factors affecting rehabilitation before and after surgery were extracted from the patient's medical history. Preoperative parameters included age, gender, education, BMI, height, weight, injury mechanism (during exercise, work, accident, and fall), hematoma formation within the first 6 hours, history of loss of full flexion ROM, accompanying meniscal lesions, type of meniscal surgery in case of the lesion (meniscectomy, repair). Post-operative parameters included the duration of pain medication, the hematoma or swelling at the graft site, the history of infection at the surgical site, and the TAS before ACL injury. Then the patients were evaluated based on LKS scales one year after the operation and their responses were recorded. Then, the rehabilitation rate was calculated based on LKS scales, and the relationship between the rehabilitation rate and pre-operative, and post-operative parameters was investigated.

To collect data, TAS and LKS scoring scales were used. TAS is a 10-point scale that represents the highest current level of activity achievable by the patient was assessed by asking about the level of activity before the injury. The LKS questionnaire is a 100-point scale consisting of eight parameters, including limp, locking, pain, stair climbing, use of supports, instability, swelling, and squatting. Depending on the severity of the situation in each of these cases, the patient gets a score.

All ACLRs were performed identically by the senior author. Patients were allowed to perform knee joint movements up to 90 degrees the day after surgery and the second week, they started physiotherapy.

Number and percentage parameters were used to describe qualitative findings. Quantitative findings were presented as maximum, minimum, and mean standard deviation. T-test was used to evaluate factors affecting the rehabilitation of patients. Also, to check the correlation between quantitative factors such as age with rehabilitation scores, Pearson's correlation test was used. All these data will be analyzed by statistical analysis software SPSS version 24 and a *P-value* less than 0.05 will be considered as significance limit.

Results and Discussion

In the present study, we evaluated the association between several demographic and clinical factors with LKS in ACLR patients. Data regarding these analyses are shown in **(Table 1)**. Patients were divided into three groups based on age. A total of 21 patients were aged less than 25 years, 77 patients were aged between 25 and 40 years, and 42 patients were aged more than 40 years. The mean scores of the Lysholm knee scoring scale after one year had a significant relationship with the age of the patients (*P*=0.02). Also, post-HOC analysis showed that this score was significantly lower in patients aged more than 40 years old. Statistically, the Lysholm knee scoring scale was significantly higher in men compared to women (*P*=0.02). On the other hand, there was a significant association between the Lysholm knee scoring scale score and education, and people with a higher level of education had a higher LKS score (*P*=0.01). LKS scores

were also evaluated according to injury mechanism (injury during sports, work, accident, or fall) and it was found that there was a statistically significant relationship between LKS score and injury mechanism (*P*=0.008). In sports injuries, the LKS score was higher than other injuries. The LKS score was significantly higher in people without loss of full flexion ROM compared to people who had loss of full flexion ROM before surgery (*P*=0.04). Statistically, there was a significant association between the LKS score and the duration of analgesic consumption after surgery, and the LKS score was higher in

people who consumed fewer analgesics (*P*=0.005). There was a significant difference between the score of the Lysholm knee scoring scale with the presence of surgical site infection, and this score was higher in people without surgical site infection than in people with infection (*P*=0.007).

It was observed that there was a significant and inverse correlation between the Lysholm knee scoring scale and the patient's BMI, and with increasing BMI, the LKS score decreased significantly one year after surgery (R=-0.209, and *P*=0.01).

Table 1. Association of Lysholm knee scoring scale score one year after surgery with demographic and clinical characteristics of ACLR patients

Parameter		Number	Lysholm knee scoring scale one year after surgery		P-value
			mean	Standard deviation	
Age	Less than 25 years	21	83.43	12.937	
	25 to 40 years	77	83.53	11.833	0.02
	More than 40 years	42	77.50	11.254	
Gender	Male	112	82.75	12.160	0.02
	Female	28	77.54	10.922	
Education	Uneducated	7	71.86	13.692	
	Educated	89	80.90	12.221	0.01
	Graduated	44	84.91	10.552	
Injury mechanism	During sport	63	84.92	12.300	
	During work	36	81.67	10.139	0.008
	Accident	21	77.00	13.157	
	Fall	20	76.60	10.674	
Knee meniscal lesions	No lesions	45	82.71	12.24	
	Repaired	73	82.23	11.85	0.27
	Meniscectomy	22	77.91	12.24	
Hematoma formation in the first six hours	No	68	82.37	11.02	0.62
	Yes	72	81.8	13.02	
Loss of full flexion ROM before surgery	No	66	83.66	11.732	0.04
	Yes	74	79.52	12.149	
Analgesic consumption after the surgery	Less than 10 days	65	84.54	10.642	
	10 to 30 days	70	79.97	12.791	0.005
	More than 30 days	5	69.20	6.907	
Hematoma at the graft site	Yes	32	81.97	12.584	0.89
	No	108	81.63	11.970	
Surgical site infection	Yes	2	59.00	7.071	0.007
	No	138	82.04	11.822	
Smoking before surgery	Yes	29	81.07	13.164	0.75
	No	111	81.87	11.823	

Using the Mann-Whitney test, the association between the LKS score and the Tegner activity scale score before the injury was evaluated. Statistically, there was a significant difference between determining the LKS score and the Tegner activity scale score before the injury, and the LKS score was higher in people whose Tegner activity scale score was eight before the injury compared to others **(Table 2)**.

The Lysholm knee scoring scale had no significant relationship with smoking before surgery(*P*=0.75), hematoma at the graft site after surgery(*P*=0.89), knee meniscal lesions(*P*=0.27), and, hemarthrosis formation during the first six hours of ACL injury (*P*=0.62).

Table 2. Association of Lysholm knee scoring scale score one year after surgery with Tegner activity scale score before injury

Parameter	Tegner activity scale score before injury	Number	Mean	Standard deviation	P-value
Lysholm knee scoring scale one year after surgery	3	6	73.33	10.15	
	4	18	77.6	11.39	
	5	28	78.96	10.72	
	6	26	82.54	11.01	0.02
	7	57	84.37	12.42	
	8	3	96.67	2.88	
	9	2	78.00	24.04	

The present study was conducted to investigate the effective factors on the rehabilitation rate in ACLR surgery with hamstring autograft based on the Tegner activity scale and LKS eight parameters before and one year after the operation. Our results showed that there was an inverse and significant correlation between BMI and LKS variable.

The LKS score was significantly higher in patients with lower age, male gender, higher education, injury during sports, people without loss of full flexion ROM, less analgesic consumption after surgery, and people without surgical site infection. Also, the LKS score was higher in people whose Tegner activity scale score was 8 before the injury.

Briggs and colleagues in a study showed that LKS scores were not affected by age and gender. However, Tegner's activity level score was inversely correlated with age. Tegner's mean activity level was higher for men [19]. The findings of this study were inconsistent with the findings of the current study. In our study, the LKS score after surgery was statistically significantly related to age and gender. The different sample sizes in the two studies may be the cause of this discrepancy. These data can serve as an ideal tool when counseling patients about realistic expectations after surgery, based on age and gender. In another study, Demirdjian and colleagues studied a group of normal subjects aged 13 to 25 years but found no significant difference in Lysholm score based on gender [20]. In the study of Demirdjian *et al.* normal subjects were studied, but in the current study, patients with anterior cruciate ligament reconstruction were examined. On the other hand, similar to the findings of the current study, the results of Panagopoulos and colleagues reported that there is a significant correlation between LKS and BMI [21].

Kanneganti *et al.* in another study showed that there is a significant negative correlation between smoking and LKS [22]. In our study, there was no significant difference between LKS and preoperative smoking. In the study of Kannegati, the sample size was very limited and the small sample size may be the cause of this discrepancy. Current studies have demonstrated the negative impact of smoking on the outcomes of knee ligament surgery and suggested that smoking cessation would be beneficial for patients undergoing these procedures. The association between smoking and knee articular cartilage is unclear, although studies still show an overall negative effect, highlighting the need for further research [23].

The findings of Jaiswal *et al.* fundamentally linked the basic science and clinical mechanisms of cartilage repair. Visual arthroscopy findings, along with hyaline biopsies, showed that even in one year of follow-up, tissue repair was lower in smokers [24]. This finding suggests that smoking negatively affects the functional outcome after articular cartilage repair, but also leads to tissue repair macroscopically, based on arthroscopy appearance, and microscopically, based on the amount of hyaline cartilage formed postoperatively. Schmal and colleagues also reported that since at the molecular level, cartilage metabolism is affected by smoking, it is reasonable that the repaired tissue in smokers appears worse at the macroscopic and microscopic levels.

Considering the nutrition and metabolism of articular cartilage through synovial fluid interactions (plasma interstitial fluid expansion), it can be proposed that the negative vascular and cytokine effects of smoking similarly impair the health of articular cartilage after surgery [25].

In the study conducted by Leiter *et al.* it was shown that the prevalence and severity of knee osteoarthritis (OA) was higher in knees with cruciate ligament reconstruction at follow-up. Also, the mean Lysholm score and Tegner activity scale scores were significantly reduced since surgery [26]. The findings of this study are consistent with the results of the current study.

In a study, Fayard *et al.* reported that independent continuous variables such as age, BMI, and time from trauma to surgery and independent qualitative variables such as gender, exercise, preoperative IKDC score, preoperative axial shift, joint arthrosis, medial meniscal lesions, and lateral were one of the effective factors on the result of anterior cruciate ligament reconstruction [27].

Many studies emphasized the importance of cartilage and meniscal lesions on the outcome of anterior cruciate ligament reconstruction [28, 29]. Only Dahm *et al.* reported that the intraoperative finding of a medial meniscal lesion was a risk factor for poor outcomes. Although a trend for poorer outcomes for medial tibiofemoral cartilage lesions or patellofemoral ICRS grade three or four appeared, it was not significant [30]. In a systematic study by Kruse *et al.* aimed at rehabilitation after anterior cruciate ligament reconstruction, they reported no significant correlation between LKS score and time to return to work. They also expressed a significant relationship between LKS

and sports injuries [15]. The findings of this study were similar to the findings of our study.

One of the limitations of the study is the small sample size. It is suggested that more studies with a larger sample size be conducted to investigate the effective factors on the rehabilitation rate in the operation of anterior cruciate ligament reconstruction with hamstring autograft based on the Tegner activity scale and the eight parameters of the Lysholm knee scoring scale before and after the operation.

Conclusion

In general, the results of the study showed that there is a significant correlation between Lysholm knee scoring scale score after surgery and age, gender, BMI, level of education, mechanism of injury, history of loss of full flexion ROM before surgery, surgical site infection, duration of analgesia after surgery, and Tegner activity scale score. On the other hand, the Lysholm knee scoring scale had no significant relationship with smoking before surgery, hematoma at the graft site after surgery, meniscal lesions, and hemarthrosis formation during the first 6 hours of ACL injury. Determining effective factors before and after surgery on the rehabilitation rate of patients undergoing anterior cruciate ligament reconstruction who were treated with hamstring autograft plays an important role.

References

1. Gerami MH, Haghi F, Pelarak F, Mousavibaygei SR. Anterior cruciate ligament (ACL) injuries: A review on the newest reconstruction techniques. J Family Med Prim Care. 2022;11(3):852-6. doi:10.4103/jfmpc.jfmpc_1227_21

2. Rodriguez K, Soni M, Joshi PK, Patel SC, Shreya D, Zamora DI. Anterior cruciate ligament injury: Conservative versus surgical treatment. Cureus. 2021;13(12):e20206. doi:10.7759/cureus.20206

3. Park JG, Han SB, Lee CS, Jeon OH, Jang KM. Anatomy, biomechanics, and reconstruction of the anterolateral ligament of the knee joint. Medicina (Kaunas). 2022;58(6):786. doi:10.3390/medicina58060786

4. Familiari F, Palco M, Russo R, LaPrade RF, Simonetta R. How to avoid common complications in hamstrings harvest for anterior cruciate ligament reconstruction: A practical guide. Arch Bone Jt Surg. 2023;11(7):458-64. doi:10.22038/ABJS.2023.70676.3310

5. Musahl V, Nazzal EM, Lucidi GA, Serrano R, Hughes JD, Margheritini F, et al. Current trends in the anterior cruciate ligament part 1: Biology and biomechanics. Knee Surg Sports Traumatol Arthrosc. 2022;30(1):20-33. doi:10.1007/s00167-021-06826-y

6. Brinlee AW, Dickenson SB, Hunter-Giordano A, Snyder-Mackler L. ACL Reconstruction rehabilitation: Clinical data, biologic healing, and criterion-based milestones to inform a return-to-sport guideline. Sports Health. 2022;14(5):770-9. doi:10.1177/19417381211056873

7. Fakoor M, Sadoni H, Hosseini M, Bastan P. Statistical relationship between clinical and functional findings based on the Lysholm standard score on the success rate of ACL arthroscopic reconstruction surgery. Iran J Orthop Surg. 2020;18(3):83-8.

8. Hadi H, Bagherifar A, Tayebi F, Ansaria M, Shahsavaripour A, Qomashi I, et al. Anterior cruciate ligament reconstruction with hamstring tendons has no deleterious effect on hip extension strength. Arch Bone Jt Surg. 2019;7(3):278-83.

9. Kay J, Liotta ES, Sugimoto D, Heyworth BE. Assessment of return to sport after acl reconstruction with soft tissue autograft in adolescent athletes: Quadriceps versus hamstring tendon. Orthop J Sports Med. 2023;11(11):23259671231207113. doi:10.1177/23259671231207113

10. Pomenta Bastidas MV, Sastre S, Segur Vilalta JM, Rios J, Sabater M, Popescu D. Quadriceps tendon vs hamstring autograft in primary ACL reconstruction - A comparative study with minimum two-year follow-up. Acta Orthop Belg. 2022;88(2):347-54. doi:10.52628/88.2.7306

11. Samitier G, Vinagre G. Hamstring braid graft technique for anterior cruciate ligament reconstruction. Arthrosc Tech. 2019;8(8):e815-20. doi:10.1016/j.eats.2019.03.022

12. Macchiarola L, Pizza N, Patania V, Grassi A, Dal Fabbro G, Marcacci M, et al. Double-bundle non-anatomic ACL revision reconstruction with allograft resulted in a low revision rate at 10 years. Knee Surg Sports Traumatol Arthrosc. 2023;31(1):340-8. doi:10.1007/s00167-022-07151-8

13. Deng Z, Zheng Y, Deng Z, Lu C, Wu Y, Chen K, et al. Arthroscopic reconstruction of anterior cruciate ligaments with allograft: Single-tunnel single-bundle versus single-tunnel double-bundle techniques. J Orthop Traumatol. 2022;23(1):26. doi:10.1186/s10195-022-00649-4

14. Ifran NN, Mok YR, Krishna L. Tear rates of the ipsilateral ACL graft and the contralateral native ACL are similar following ACL reconstruction. J Knee Surg. 2022;35(3):308-11. doi:10.1055/s-0040-1713861

15. Kruse LM, Gray B, Wright RW. Rehabilitation after anterior cruciate ligament reconstruction: A systematic review. J Bone Joint Surg Am. 2012;94(19):1737-48. doi:10.2106/JBJS.K.01246

16. Chamorro-Moriana G, Perez-Cabezas V, Espuny-Ruiz F, Torres-Enamorado D, Ridao-Fernández C. Assessing knee functionality: Systematic review of validated outcome measures. Ann Phys Rehabil Med. 2022;65(6):101608. doi:10.1016/j.rehab.2021.101608

17. Huang H, Zhang S, Yi WA, Tegner Y, Yongjian WA, Jiang Y, et al. Reliability and validity of a chinese version of the Lysholm score and tegner activity scale for knee arthroplasty. J Rehabil Med. 2022;54:jrm00317. doi:10.2340/jrm.v54.2304

18. Itthipanichpong T, Moonwong S, Thamrongskulsiri N, Prasathaporn N, Kuptniratsaikul S, Tegner Y, et al. Validity and reliability of the thai versions of the Lysholm knee scoring scale and tegner activity scale. Orthop J Sports Med. 2023;11(2):23259671221149785. doi:10.1177/23259671221149785

19. Briggs KK, Steadman JR, Hay CJ, Hines SL. Lysholm score and tegner activity level in individuals with normal knees. Am J Sports Med. 2009;37(5):898-901. doi:10.1177/0363546508330149

20. Demirdjian AM, Petrie SG, Guanche CA, Thomas KA. The outcomes of two knee scoring questionnaires in a normal population. Am J Sports Med. 1998;26(1):46-51. doi:10.1177/03635465980260012401

21. Panagopoulos A, Billis E, Floros GR, Stavropoulos T, Kaparounaki E, Moucho M, et al. Cross-Cultural adaptation of the greek versions of the Lysholm knee scoring scale and tegner activity scale. Cureus. 2020;12(7):e9372. doi:10.7759/cureus.9372

22. Kanneganti P, Harris JD, Brophy RH, Carey JL, Lattermann C, Flanigan DC. The effect of smoking on ligament and cartilage surgery in the knee: A systematic review. Am J Sports Med. 2012;40(12):2872-8. doi:10.1177/0363546512458223

23. Gill CS, Sandell LJ, El-Zawawy HB, Wright RW. Effects of cigarette smoking on early medial collateral ligament healing in a mouse model. J Orthop Res. 2006;24(12):2141-9. doi:10.1002/jor.20234

24. Jaiswal PK, Macmull S, Bentley G, Carrington RW, Skinner JA, Briggs TW. Does smoking influence outcome after autologous chondrocyte implantation? A case-controlled study. J Bone Joint Surg Br. 2009;91(12):1575-8. doi:10.1302/0301-620X.91B12.22879

25. Schmal H, Niemeyer P, Südkamp NP, Gerlach U, Dovi-Akue D, Mehlhorn AT. Pain perception in knees with circumscribed cartilage lesions is associated with intra-articular IGF-1 expression. Am J Sports Med. 2011;39(9):1989-96. doi:10.1177/0363546511406851

26. Leiter JR, Gourlay R, McRae S, de Korompay N, MacDonald PB. Long-term follow-up of ACL reconstruction with hamstring autograft. Knee Surg Sports Traumatol Arthrosc. 2014;22(5):1061-9. doi:10.1007/s00167-013-2466-3

27. Fayard JM, Wein F, Ollivier M, Paihle R, Ehlinger M, Lustig S, et al. Factors affecting the outcome of ACL reconstruction in over-50-year-olds. Orthop Traumatol Surg Res. 2019;105(8S):S247-51. doi:10.1016/j.otsr.2019.09.011

28. Markus DH, Hurley ET, Mojica ES, Anil U, Kanakamedala A, Avila A, et al. Concentration of synovial fluid biomarkers on the day of anterior cruciate ligament (ACL)-reconstruction predict size and depth of cartilage lesions on 5-year follow-up. Knee Surg Sports Traumatol Arthrosc. 2023;31(5):1753-60. doi:10.1007/s00167-022-07045-9

29. Culvenor AG, Girdwood MA, Juhl CB, Patterson BE, Haberfield MJ, Holm PM, et al. Rehabilitation after anterior cruciate ligament and meniscal injuries: A best-evidence synthesis of systematic reviews for the OPTIKNEE consensus. Br J Sports Med. 2022;56(24):1445-53. doi:10.1136/bjsports-2022-105495

30. Dahm DL, Wulf CA, Dajani KA, Dobbs RE, Levy BA, Stuart MA. Reconstruction of the anterior cruciate ligament in patients over 50 years. J Bone Joint Surg Br. 2008;90(11):1446-50. doi:10.1302/0301-620X.90B11.21210