

Evaluation of the Relative Frequency of Preinjury Activity Recovery in Anterior Cruciate Ligament Replacement Patients: A Cohort Study

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Abstract

Background: Anterior cruciate ligament (ACL) injury has an incidence of 0.05–0.08 per thousand. An inappropriate treatment plan could lead to articular cartilage damage and early knee osteoarthritis. Some surgical reconstruction techniques use different graft types; all of them try to restore the patient's preinjury activity levels. The current study aims to evaluate the efficacy of ACL reconstruction (ACLR) using an autologous hamstring tendon.

Materials and Methods: This is a retrospective one-center cohort study performed on consecutive patients with an ACL injury who underwent ACLR using semitendinosus and gracilis autograft. The postsurgical activity and fear were measured using Marx scale and Tampa scale of kinesiophobia, respectively, during a follow-up of 18 months.

Results: From a total of 76 patients included in our study, 40.8% were female. The mean age of the participants was 26.25-year-old. Five patients from those with kinesiophobia (12.5%) and 34 patients from those with no-kinesiophobia (94%) returned to the preinjury activity level (P value < 0.001). Marx scale six months after the surgery was significantly lower than the score before the surgery, but as expected, it improved during the 18-month follow-up.

Conclusion: The current study showed that kinesiophobia reduces the rate of return to preinjury levels. Maybe, overcoming this fear will help these patients to reach better results. However, we suggest implementing further trials in larger sample sizes before reaching a solid conclusion.

Keywords: Activities, anterior cruciate ligament reconstruction, autografts, kinesiophobia

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INTRODUCTION

As the exact amount of anterior cruciate ligament (ACL) injuries worldwide is unknown, as a benchmark, we know that approximately more than 250,000 occur in the United States and about 65% of them cumulate over time to undergo reconstructive surgery.^[1] ACL injuries have an incidence of

0.05 and 0.08 per thousand exposures in males and females, respectively.^[2] The ACL could be damaged through contact and noncontact mechanisms. Noncontact mechanisms are more prevalent (70–80% of all cases) and are mainly a result of decelerations, direction changes, and landings from a jump.

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The tearing of ACL often presents with varying symptoms, ranging from a feeling of tearing at the site to a pop sensation and effusions in the region. It could result in the hindrance of returning to previous sporting activity.^[3]

ACL injuries cause knee instability, and inappropriate treatment might bring about other knee component injuries, articular cartilage damage, and, at last, early osteoarthritis.^[4-6] The treatment of ACL injury involves nonoperative management (which comprises proper and timely standard rehabilitation programs) and surgical ACL reconstruction (ACLR). The reconstruction is usually performed in subjects with symptoms and moderate to high functional demand. There are some graft types used for ACLR, including autografts (more commonly: hamstring tendon, bone-patella tendon-bone, and quadriceps tendon), allografts, and synthetic grafts.^[7] More recently, the controversial primary repair technique with the advantage of preserving the patient's double-bundle ACL has been brought to attention.^[8]

Though reconstruction surgery has several benefits, it has some complications also. Sepúlveda *et al.*^[9] revealed that even among athletes who undergo standard rehabilitation, 35–45% do not return to function at preinjury levels. Another study found that after ACLR, almost 82% of the study subjects had returned to some sports activity, 63% had returned to their preinjury levels, and 63% had achieved competitive fitness levels.^[10] One of the major downsides to ACLR is the chances of ACL reinjury. In a study by Wiggins *et al.*,^[11] it has been found that total reinjury rates have been calculated to be at 15%. It has been estimated that ipsilateral rates stand at 7% and contralateral rates at 8%.

Furthermore, there is a big question about when an athlete must return to strenuous and high-level sports activity. It has been found that a repeat ACL injury has been reported to be seven times higher in people who returned to high-level knee-pivoted activities earlier than nine months after ACL reconstructive surgery in comparison to the group who have returned after nine months.^[12] Return to play also may depend on the sports activity and mechanism involved. It has been said that pivoting-oriented activities may increase contralateral ACLR surgeries.^[13]

As mentioned above, ACL injury is quite common among active young populations. It proves to be a challenge both in decisions on approach and the prognosis of return to prior activity levels. Therefore, in this study, we aim to assess the rate of return to preinjury physical activity, kinesophobia, and various factors that could play a vital role in aiding the ability of patients to fully recuperate with minimal sequelae and identify factors that could inhibit their complete recovery and restoration to prior-to-surgery activity levels.

MATERIALS AND METHODS

Study design and setting

This retrospective cohort study was undertaken in a university hospital (affiliated with Isfahan University of Medical Sciences, Isfahan, Iran) from 2017 to 2018. The targeted group was the patients referred to the hospital with ACL, posterior

cruciate ligament (PCL), or meniscus injury and underwent reconstruction surgery. One orthopedic surgeon performed the surgery, and the data were collected by one individual first-year orthopedic resident. These data were then extracted from the patients' medical records and analyzed. The follow-up sessions were held during 18 months after the surgery for each patient. The study was performed in concordance with the Declaration of Helsinki and its later amendments. The study protocol was accepted by the Isfahan University of Medical Sciences Research Committee and certified by the Ethics Committee (IR.MUI.MED.REC.1399.392).

Participants

The study was performed on patients aged 18-40 years old who were referred with ACL, PCL, or meniscus injury and underwent reconstruction surgery from April 2017 to April 2018. We only included patients with autologous hamstring grafts who completed each follow-up session eighteen months after the surgery (at 0, 2, 6, 12, and 18 months). Patients outside the age range mentioned above, with specific comorbidities that could prove influential in the outcome, those who underwent revision surgeries, and those who had not provided consent or were unwilling to participate in the study were excluded.

For patients who had a meniscus or PCL injury at the same time, the diagnosis of their injury was based on the preoperative radiology report of the MRI, and according to the diagnosis of the orthopedic surgeon, these patients did not need surgical intervention in the field of meniscus or PCL injury (for example, a tiny meniscal injury, bone bruising, or edema of the origin, insertion, or mid substance of the PCL). Patients who required surgical intervention including partial meniscectomy or total meniscectomy or reconstruction of PCL or other knee ligaments in the treatment process were excluded from the study. In fact, the meniscus or PCL injuries of our studied patients were so minor that they did not require surgical intervention. (We added the above information to the method section and highlighted it.)

Variables and measurements

The demographic data, including age, gender, body mass index (BMI), visual analog scale (VAS), type of injury, and description of surgery (surgical report), were documented in medical records by a first-year orthopedic resident. Similarly, the same resident gathered the follow-up information, like Marx scale and Tampa scale of kinesophobia (TSK), and completed the patients' records. Afterward, and during the study, we extracted all these data from the hospital system files for statistical analysis.

Marx Activity Rating Scale (MARS)

Marx scale is a reliable and valid tool to measure patients' activity levels with knee disorders.^[14] It consists of four domains: running, cutting, deceleration, and pivoting. Based on the frequency, each of these domains gains a score from 0 to 4.

Tampa scale of kinesophobia

The TSK is another reliable and valid tool that assesses the fear of movement, fear of physical activity, and fear avoidance. It consists of 17 items; each of the questions' scores could range

from 1 to 4, so the final scores range from 17 to 68.^[15] The least kinesophobia has been attributed to a score of 17, and the most amount to 68. A score equal to or more than 37 is also considered positive kinesophobia.

Surgical method

We used semitendinosus and gracilis tendons as autografts. After inserting tibial and femoral tunnels in proper positions, an autograft was inserted in the tunnels from the tibia to the femur. Then tension of the graft was checked, and a screw of proper size was applied to the tibial tunnel. All the positions were checked by arthroscopy and fluoroscopy if needed. Physiotherapy protocols were started the day after surgery, and routine follow-up was done.

Outcomes

The primary outcome of this essay was to study the relationship between Marx scale outcome and TSK. Estimation of the rate of return to preinjury levels of physical activity in patients with a knee injury who underwent reconstruction surgery, the recovery time (back to preinjury physical activity) using Marx scale and TSK, and investigation of the potential relationship between demographic data and these scores were from the secondary results.

Study size and statistical methods

In this study, we included all patients with knee injury underwent reconstructive surgery in Kashani hospital in 2017 and 2018. We used the following formula to calculate the sample size:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

In this formula, Z is equal to 1.96, P is equal to 40%, and d is equal to 11%. A total of 76 patients were included in the study. However, due to the elimination of cases according to the entry and exit criteria, we selected a larger number of patients for initial examination to enter the study.

Our statistical analysis was undertaken using the IBM SPSS software (version 27). The categorical variables were described using count and frequency, and the continuous variables using mean and standard deviations. The categorical variables within the two groups were compared using the Chi-square test. Analysis of variances (ANOVA) was used to see the differences between more than two groups. The independent t -test was used to compare the means of continuous variables. We used a paired t -test to see the differences between the baseline Marx scale or TSK changes and each time point. To evaluate the time \times treatment interactions, we implemented a two-factor repeated-measure independent t -test.

RESULTS

Baseline characteristics

We included 76 patients who underwent knee arthroscopy for the final analysis from a total of 76 patients screened for the study. As shown in Table 1, 31 patients were female (40.8%),

the mean age was 26.25-year-old (SD: 4.82), and the mean BMI was 21.86 kg/m² (SD: 1.43). The most common injury type was isolated ACL rupture (24 cases; 31.6%), followed by combined ACL and medial meniscus rupture (20 cases; 26.3%). ANOVA showed no significant difference between the types of injury based on gender and BMI. On the other hand, elderly age was related to complex injury (rupture of ACL, PCL, medial meniscus, and lateral meniscus). Two complex injuries occurred, and both needed arthrotomy besides arthroscopy. The mean Marx scale before the injury was 15.44 (SD: 0.72). Kinesophobia was present in 40 patients (52.6%).

Primary outcome

Of those patients who had kinesophobia (40 patients), only five patients (12.5%) returned to the preinjury activity level, while 35 patients did not. On the other hand, in those who have no kinesophobia (36 patients), 34 patients experienced an improvement in Marx scale, although the score did not change in two patients. Fisher's exact test showed that the difference was significant (P value < 0.001). Based on the type of injury (sport injury or car accident), there was no significant difference between the TSK and Marx scale between the two groups (P > 0.05).

Secondary outcomes

Marx scale six months after the surgery was significantly lower than the score before the surgery (mean difference: -6.64, SD: 1.74, t : -33.12, df: 75, P value < 0.001), but as expected, it improved during the 18-month follow-up (mean difference: -2.65, SD: 2.16, t : -10.67, df: 75, P value < 0.001) [Figure 1]. Elderly ages had a negative correlation with the baseline Marx scale (Pearson's correlation: -0.467, P value: 0.000). Likewise, age had a negative effect on Marx scale at 18 months, but it was not significant (P value: 0.524). It was seen that becoming older positively affected the six-month Marx scale, which was not substantial too (P value: 0.587). As shown in Table 2, no significant correlation was shown between Marx scale, gender,

Table 1: Demographic data of patients

Gender	Number	Percentage
Female	31	40.8
Male	45	59.2
Injury type		
Isolated ACL	24	31.6
MM + ACL	20	26.3
Isolated MM	10	13.2
LM + ACL	10	13.2
LM + MM + ACL	6	7.9
LM	4	5.2
LM + MM + ACL + PCL	2	2.6
	Mean	SD
Age	26.25	4.82
BMI	21.86	1.43
Marx scale	15.44	0.72

ACL: anterior cruciate ligament; MM: medial meniscus; LM: lateral meniscus; PCL: posterior cruciate ligament; SD: standard deviation; BMI: body mass index

VAS, or BMI. We also did not find a significant relationship between TSK and age, gender, VAS, or BMI.

DISCUSSION

In this retrospective cohort study, we found that the Marx scale's improvement, an indicator of a return to the preinjury activity levels, had a relationship with TSK. The recovery rate was significantly higher in those who did not experience kinesophobia and vice versa. The results also revealed that elderly ages are associated with lower Marx scale; however, we found no significant correlation between return to preinjury activity levels and age.

We have to keep in mind that the main goals of timely and proper management of ACL rupture are primarily restoring knee function and ensuring psychological barriers and apprehensions toward returning to play are minimized, hence providing a better quality of life for the affected individual. It is widely known that ACLR results are not very favorable and may have poorer outcomes than we have so far come to know.^[16] The rate of return to play in a group of athletes in a study has been reported to be around 45%.^[17] It has been reported that some of the said participants had returned to play for specific periods and ceased to continue after a while. This statement indicates the importance of the need to identify key factors that hinder the process of return to preinjury activity levels and return-to-sports from preventing further mental deterioration and the burden of chronic disease.^[18]

The main culprits responsible for low success rates in return to preinjury sports involve biomechanical and kinetic factors, mainly poor quadriceps femoris strength and asymmetry, weaker knee function, and maladapted biomechanics, which have been

observed in patients both short term and long term post their rehabilitations.^[19-22] One of the main factors of low success rates of return to preinjury level of activity may be psychological readiness and fear of reinjury as caused by lower confidence in the ability to initiate activity at high levels.^[23,24] In a study performed by Webster *et al.*,^[25] it has been reported that in the younger male sex, especially the ones who have returned to some preinjury sports, the functional outcome and clinically valid test scores post-ACLR were better. In our study, we have similarly found that age and baseline Marx scale were negatively correlated.

In a study by Czuppon *et al.*,^[26] it has been suggested that successful return to sports is influenced by multifactorial agents, namely lower fear of reinjury (kinesophobia), better patient morale and confidence in the preoperative state, better knee functionality (better tibial rotation, better quadriceps strength), better scores in the tests that assess the activity levels (Marx scale), and less effusion and pain as reported by the patient. Abbott *et al.*^[27] found that psychomotor training could prove pivotal in better outcomes and reducing functional disability for up to 3 years postsurgery by modifying flawed psychological and motor patterns, resulting in a significant decrease in kinesophobia. In a study by Ardern *et al.*,^[28] it has been found that the reason for the inability to return to preinjury activity levels as reported by the participants was poor knee functionality, inability to trust the knee, and fear of occurrence of reinjury. The same study said the most important factor associated with successful return to preinjury activity levels post ACLR was the psychological readiness to return to sport, measured by the ACL -return to sport after injury scale. They also found that age, sex, and preinjury activity levels were not correlated with successful return to preinjury levels. Rehabilitation techniques can also play significant roles in an effective return to preinjury activity levels. Progressive overload is the cornerstone of traditional rehab techniques, and recently, newer rehabilitation methods have been introduced. In a cohort study by Failla *et al.*,^[29] it has been reported that a rehabilitation regimen that combines preoperative rehab (consisting of neuromuscular training along with progressive strength training) with an individually tailored postoperative rehab program had the most remarkable outcome in terms of function and successful return to sports post-ACLR over two years.

It has been said that incorporating sports rehabilitation plans into principles of psychologically informed practice would yield better results in the rehab outcomes to overcome a fear of reinjury and, therefore, a better chance of a return to preinjury activity levels. One way of such practice would be to use self-reporting questionnaires. We have to keep in mind the proper application of questionnaires; timing and choosing the correct type of questionnaire among the existing ones are of high importance, too.^[30] Future and more studies are needed to further assess various factors that could affect return to sports and return to activity. This could help identify patients at higher risk and even help raise their chances of returning to prior activity levels.

With regard to clinical relevance, our study is of importance as it is among the few that have assessed the relationship between

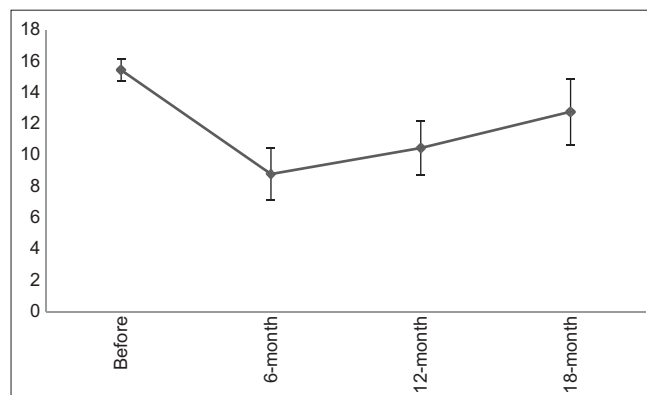


Figure 1: The Marx scale changes during the study

Table 2: Reported *P* value of possible correlations

Variables	Gender	BMI	Elderly ages	VAS
Injury type	0.182	0.119	0.036	0.168
Return to activity	0.616	0.518	0.897	0.426
Kinesophobia	0.285	0.441	1.000	0.363

BMI: body mass index; VAS: visual analog scale

kinesophobia and return to preinjury activity levels and also the demographic association to return to activity post-ACLR. We could have benefitted from having a bigger sample size with more variety in the variables assessed. It also must be noted that our study encountered some limitations; first, as it is a retrospective study, it limits the data available to us due to errors in logging in data. We do not have much information on the baseline and preinjury activity and sports levels as they were self-reported, so an appropriate comparison over time could not be made.

CONCLUSION

The current study showed that kinesophobia reduces the rate of return to the preinjury levels. On the other hand, the improvement rate was higher in those with no kinesophobia. Maybe, overcoming this fear will help these patients to reach better results. However, because of the limitation, we suggest implementing further trials in larger sample sizes before reaching a conclusion.

Ethics approval and consent to participate

The authors declare that they have obtained consent from patients. Patients have given their consent for their images and other clinical information to be reported in the journal. Patients understand that their names will not be published and due efforts will be made to conceal their identity but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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