

# Comparison of patellar versus hamstring tendon autografts in arthroscopic anterior cruciate ligament reconstruction: A 6-month follow-up of a randomized clinical trial

Alireza Sadeghpour, Adel Ebrahimpour<sup>1</sup>, Bahamin Attar, Zahra Azizian<sup>2</sup>

Department of Orthopaedic Surgery, Shohada Hospital, Tabriz University of Medical Sciences, Tabriz, <sup>1</sup>Department of Orthopaedic Surgery, Shahid Beheshti University of Medical Sciences, <sup>2</sup>Iran University of Medical Sciences, Tehran, Iran

**Background:** The purpose of this study was to compare the outcomes of anterior cruciate ligament (ACL) reconstruction using the patellar versus hamstring tendon (HT) autograft. **Materials and Methods:** In this randomized clinical trial, fifty patients undergoing arthroscopic ACL reconstruction were randomized into two equal groups: Those treated with either autogenous patellar tendon grafts (PT group) or HT group grafts. All patients were reviewed immediately after surgery, at 6 and 12 weeks after surgery, and then at 6 months using the International Knee Documentation Committee evaluation form. Infection, severity of pain (visual analog scale), duration of rehabilitation, and clinical and magnetic resonance imaging (MRI) findings were assessed at the 6-month follow-up. Positive pivot shift and Lachman test were considered clinical signs and symptoms of treatment failure. In addition, the absence of the ACL or transverse ACL rather than the posterior oblique ligament is an MRI finding that indicates treatment failure. **Results:** Comparing changes in pain and range of motion (ROM) in patients first and 6 months after therapy show that pain had been relieved significantly ( $P < 0.001$ ) and ROM dramatically changes ( $P < 0.001$ ). The average rehabilitation period in the PT group was  $13.2 \pm 2.08$  weeks whereas in the HT group, it was  $9.28 \pm 2.26$  weeks. A significant difference was seen between the two groups in terms of the rehabilitation period ( $P < 0.001$ ). No significant difference was found in the normal ROM between the groups ( $P = 0.32$ ). When the pain severity was considered, a significant difference was found between the PT group and the HT group ( $P < 0.001$ ). The HT group patients had less knee pain than did the PT group patients. No significant difference in infection rates was seen between two groups ( $P = 0.66$ ). **Conclusion:** Considering the better outcomes of HT reconstructions for the two parameters of pain severity and rehabilitation period, we consider HTs to be the ideal graft choice for ACL reconstructions.

**Key words:** Anterior cruciate ligament, autogenous graft, hamstring tendons, patellar tendons

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## INTRODUCTION

The anterior cruciate ligament (ACL) tear is one of the most common knee injuries that almost always happens to athletes. A torn ACL can lead to knee instability, which may prevent an athlete from returning to sports and may limit even normal activities.<sup>[1]</sup> Both surgical and nonsurgical treatments can be used to fix a torn ACL.<sup>[2]</sup> ACL reconstruction is a surgical procedure prescribed

for restoring knee stability and strength after an ACL injury. In recent years, ACL reconstruction has become prevalent among sport procedures, and it is estimated that approximately 100,000 of these types of procedures are performed each year.<sup>[3,4]</sup>

Multiple surgical procedures exist for ACL reconstruction; however, currently, the arthroscopically assisted technique is one of the most common surgical procedures performed to reconstruct this ligament.<sup>[5]</sup>

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**Address for correspondence:** Associate Professor. Adel Ebrahimpour, Department of Orthopaedic Surgery, Shahid Beheshti University of Medical Sciences, Tehran, Iran. E-mail: [Adelebrahimpour@gmail.com](mailto:Adelebrahimpour@gmail.com); [adel.ebrahimpour@yahoo.com](mailto:adel.ebrahimpour@yahoo.com); [e.ebrahimpour@sbm.ac.ir](mailto:e.ebrahimpour@sbm.ac.ir)

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Despite the fact that these surgeries are performed frequently, there is still some debate over choosing a suitable graft for ACL reconstruction.<sup>[6-9]</sup> The patellar tendon (PT) and hamstring tendon (HT) have become the most popular graft choices for ACL reconstruction.<sup>[10]</sup> Both PT and HT grafts have been widely supported,<sup>[11,12]</sup> and studies have reported little difference between the two graft types. Some studies found better knee stability in patients with PT grafts,<sup>[13]</sup> and others found that patellofemoral pain was lower in patients with HT grafts compared to PT grafts.<sup>[7,14]</sup> Certain investigations have demonstrated that patients with HT grafts had less morbidity, especially in terms of pain on kneeling.<sup>[15]</sup> Concerns about the disadvantages of PT autografts due to complications, such as damaging the knee extensor, patellar fracture, ligament rupture, and infrapatellar contracture, have led to increased interest in HT tendons.<sup>[16]</sup> However, procedures using HT grafts come with potential complications. Hamstring techniques may result in more problems in terms of fixation and tunnel widening compared to PT techniques.<sup>[17]</sup> Plenty of studies compare the clinical outcomes of these two grafts. However, considerable controversy still exists regarding the use of appropriate grafts in ACL reconstructions, as most of these works are low-quality studies and are of low-evidence bases.<sup>[18]</sup> Therefore, the current study was designed to compare the results of ACL reconstruction using PT tendons versus HT tendons in the Iranian population.

## MATERIALS AND METHODS

In this prospective age-sex matched clinical trial, 50 patients undergoing arthroscopic ACL reconstruction were allocated to two equal groups: the PT group or the HT group. The exclusion criteria for the randomized trial consisted of the previous knee deformities, previous rupture of the ACL, other associated ligament injuries, and systemic diseases. All of the participants were referred to the orthopaedic clinic of Shohada Hospital, Tabriz, Iran, from 2013 to 2016. The patients were divided into two equal groups: the PT group included patients treated with autogenous PT grafts, and the HT group included patients treated with HT grafts. Of the fifty patients evaluated in this work, 34 (68%) were men, and 16 (32%) were women. The mean age of the participants was  $28.8 \pm 3.4$  years (range of 22-37). All surgery was performed by the same surgeon. Both procedures were arthroscopically assisted. All participants were assessed clinically and underwent knee magnetic resonance imaging (MRI). Patients were assessed immediately after surgery, at six and 12 weeks after surgery, and then at 6 months using the International Knee Documentation Committee evaluation form.<sup>[19]</sup> Infection, the severity of pain (visual analog scale [VAS]), duration of rehabilitation, and clinical and MRI findings were assessed at the 6-month follow-up. Positive pivot shift and Lachman test were considered clinical signs

and symptoms of treatment failure. The absence of the ACL or transverse ACL rather than the posterior oblique ligament is an MRI finding that indicates treatment failure. The assessment at 6 months was done by a single orthopedist, who was blinded to the groupings of the patients. We could not blind the patients due to ethical issues.

Data were collected using standard questionnaires whose validity and reliability were assessed. Finally, the results were compared with each other.

## Statistical analysis

Continuous variables were reported as means (standard deviations) or as medians with total and interquartile (25<sup>th</sup> – 75<sup>th</sup> percentile) ranges. Categorical data are presented as number (percentage).

All tests applied were two-sided, and a significance level of 0.05 was considered statistically significant. All statistical analysis was performed with the statistical software SPSS 16.0.0. (SPSS Inc., Chicago, IL, USA). The Shapiro–Wilk test was used to examine the normality assumption of the continuous variables. To compare the baseline demographics and clinical characteristics of the two groups, two independent sample *t*-tests or Mann–Whitney U-tests for continuous variables and the Pearson’s Chi-square test for nominal variables were applied.

## Ethical considerations

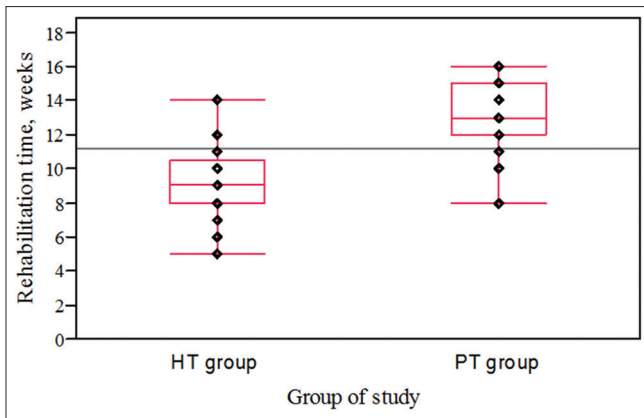
Ethical approval was obtained according to the procedures required for this descriptive and analytic study. All of the principles of medical ethics were taken into consideration at all stages of the investigation (TCTR20170303001).

## RESULT

Fifty patients (25 patients in the PT group and 25 patients in the HT group) were included in this study. The baseline demographic and clinical characteristics of the study participants are summarized in Table 1. The two groups did not differ significantly in the age and individuals [Table 1].

The mean rehabilitation time was significantly lower in the HT group in comparison with the PT group [ $P < 0.0001$ ; Figure 1].

Twenty-one patients in the PT group (84%) and 23 patients in the HT group (92%) had full range of motion (ROM), with no significant difference between the two groups [ $P = 0.67$ ; Table 1]. The median VAS score (as a measure of pain severity) was significantly lower in the HT group than in the PT group following ACL reconstruction [ $P = 0.001$ ; Table 1 and Figure 2]. Four patients (16%) in the PT group and three patients (12%) in the HT group experienced



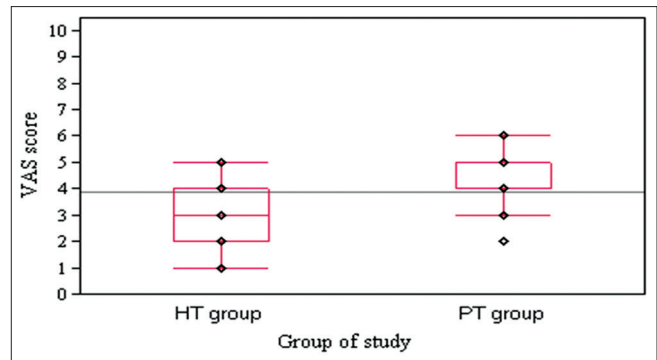
**Figure 1:** Rehabilitation time (in weeks) in the two study groups. Patellar tendon autograft; hamstring tendon group, group of patients treated with hamstring tendon graft

**Table 1: Baseline demographic and clinical characteristics of the study groups**

	PT group (n=25)	HT group (n=25)	P
Age, year			0.72
Mean (SD)	28.36 (4.07)	28.00 (2.72)	
Gender (%)			1.00
Male	17 (68)	17 (68)	
Female	8 (32)	8 (32)	
Rehabilitation time, weeks			<0.0001
Mean (SD)	13.00 (2.08)	9.28 (2.26)	
Range of motion first time			0.73
Full (%)	3 (12)	5 (20)	
Partial (%)	22 (88)	20 (80)	
Range of motion after 6 months (%)			0.67
Full	21 (84)	23 (92)	
Partial	4 (16)	2 (8)	
VAS score first time			0.001
Median; IQR; range	7; (4-8); (5-7)	5; (3-7); (5-7)	
VAS score after 6 month			0.001
Median; IQR; range	5; (2-6); (4-5)	3; (1-5); (2-4)	
MRI failure (%)	7 (28)	4 (16)	0.31
Clinical failure (%)	5 (20)	3 (12)	0.70
Mechanism of injury (%)			0.71
Trauma	5 (20)	4 (16)	
Nontrauma	20 (80)	21 (84)	

Data are expressed as n (%), unless otherwise stated. PT group = Group of patients treated with patellar tendon autograft; HT group = Group of patients treated with hamstring tendon graft; VAS = Visual analog scale; IQR = Interquartile range (25<sup>th</sup>-75<sup>th</sup> percentiles); SD = Standard deviation; MRI = Magnetic resonance imaging

infection. The infection rate did not differ significantly between the two groups ( $P = 0.68$ ). The result of the knee MRI was normal in all patients within the 1<sup>st</sup> days after surgery. At week 6 of the study, seven patients (28%) in the PT group and four patients (16%) in the HT group experienced MRI failure, with no statistically significant difference between the two groups ( $P = 0.31$ ). Clinical failure was observed in five patients (20%) in the PT group and in three patients (12%) in the HT group. The two



**Figure 2:** Visual analog scale for pain evaluation in the two study groups, patellar tendon autograft; hamstring tendon group, group of patients treated with hamstring tendon graft

groups did not differ significantly in the clinical failure of patients ( $P = 0.70$ ). The two groups were similar in the mechanism of injury [Tables 2 and 3].

Comparing changes in pain and ROM in patients first and 6 months after therapy show that pain had been relief significantly ( $P < 0.001$ ) and ROM dramatically changes ( $P < 0.001$ ).

## DISCUSSION

Many debates have taken place on the most appropriate grafts to use for the treatment of ACL injuries. Our randomized controlled trial demonstrated that little difference existed between the two groups of patients undergoing ACL reconstruction with PT grafts or HT grafts.

Our observations revealed that both PT and HT groups had biomechanical complications in tibial motions, which concur with the results of the study by Dargel *et al.*<sup>[20]</sup>

We observed no statistically significant difference between the gender and knee joint dislocation rate in the two groups. Early studies by Gobbi *et al.*<sup>[21]</sup> also demonstrated that gender could not be a factor in the use of either PT grafts or HS grafts. Kartus *et al.* furthermore reported that age and gender did not influence the postoperative complications of ACL reconstruction, such as anterior pain or problems related to ROM.<sup>[22]</sup>

The pain was an important factor for showing the differences between the two grafts in our work. Our results showed a significant difference between the two groups in terms of pain severity. The patients of the HT group had significantly less pain than did those in the PT group.

The results of the study by Shaieb *et al.*<sup>[17]</sup> found no significant difference overall between the two groups in terms of return to sports, reduction in activity, jumping, etc. An important consideration in the study by Shaieb *et al.* is that the evaluation

**Table 2: Comparing range of motion, pain and infection before and after 6 months in patellar tendon graft**

Patellar group	Baseline	After 6 months	P
Range of motion, n (%)			
Full	3 (12)	21 (84)	0.001
Partial	22 (88)	4 (16)	
Pain (VAS score), mean (SD)	7.12 (1.122)	4.48 (1.64)	0.001
Infection (%)	0	4 (16)	0.68

VAS = Visual analogue scale; SD = Standard deviation

**Table 3: Comparing range of motion, pain and infection before and after 6 months in Hamstring tendon graft**

Hamstring group	Baseline	After 6 months	P
Range of motion, n (%)			
Full	5 (20)	23 (92)	0.001
Partial	20 (80)	2 (8)	
Pain VAS score, mean (SD)	6.16 (1.88)	3.28 (1.13)	0.001
Infection (%)	0	3 (12)	0.68

VAS = Visual analog scale; SD = Standard deviation

was performed with a minimum follow-up of 6 months, and it was impossible to assess common complications, such as osteoarthritis or long-term pain, after surgery. Our investigation was also performed with a follow-up of 6 months, which was consistent with recent studies. We also found no difference between the two groups in terms of any knee abnormalities detected by MRI at 6 months.

Most of the studies revealed no significant difference in ROM between the groups.<sup>[7,8,10]</sup> In our investigation, the ROM was lower in the PT group compared to the HT group. However, overall, no statistically significant difference was observed between the groups following either PT or HT reconstruction. The majority of studies reported no significant differences in strength between these two groups in terms of both flexion and extension.

However, Feller *et al.* reported that extension deficits were greater in the PT group than in the HT group.<sup>[10]</sup>

The rehabilitation time is a recovery period that is aimed at enhancing and restoring the functional ability of the affected joint.<sup>[23]</sup> The PT group's patients had longer rehabilitation periods than did the HT group's patients. These findings are in line with the previous studies. We found no statistically significant difference in infection rates with the use of PTs compared with HTs. This may be the result of the prophylactic antibiotic prescribed in the two groups before their procedures.

In recent years, a large number of studies have compared the results of ACL reconstruction using either PT grafts or HT grafts. In general, these studies showed that both grafts resulted in excellent outcome scores at the 1–5 years

period.<sup>[24-29]</sup> However, several studies showed better outcomes for ACL reconstruction with the HT graft.<sup>[8]</sup> Corry *et al.* also reported less kneeling pain in patients treated with HT grafts compared to PT grafts.<sup>[30]</sup> Reports on meta-analyses related to the choice of the graft used for ACL reconstruction demonstrated that although both graft types provided satisfactory outcomes, PT reconstruction led to higher postoperative activity levels, and greater static stability than did hamstring reconstruction.<sup>[31]</sup>

One of the limitations of this study was the relatively small sample size. Another limitation was the short-term follow-up period. Since many trials have found significant differences in long-term follow-up, increasing the duration of follow-up may result in such differences.

## CONCLUSION

Both PT and HT grafts appear to have satisfactory results in terms of knee symptoms and function. However, considering the better outcomes of HT reconstructions for the two parameters of pain severity and rehabilitation period, we consider HTs to be the ideal graft choice for ACL reconstructions.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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