

Original Research Article

Quantification of anterior translation of tibia over femur using Lachmeter in anterior cruciate ligament reconstruction with hamstring tendon autograft

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ABSTRACT

Background: The anterior cruciate ligament (ACL) is an important restraint on anterior tibial translation of the knee. Arthroscopic ACL reconstruction using hamstring tendon autograft is the most widely accepted surgical procedure for ACL insufficiency. This study is assessing the effect of ACL reconstruction by hamstring tendon autograft on the anteroposterior stability of the knee joint by measuring the side-to-side difference of anterior tibial translation using the Lachmeter. We are also assessing the functional outcome of the same surgery using international knee documentation committee (IKDC) score.

Methods: The study included 30 patients who were admitted for ACL reconstruction with hamstring tendon autograft. The side-to-side difference of anterior tibial translation was assessed by using Lachmeter preoperatively and postoperatively at the end of the 1st, 3rd, and 6th months. The IKDC score was assessed preoperatively and postoperatively at the end of 6th month.

Results: The mean Lachmeter value of respondents in the current study was 4.31 ± 0.56 mm during the preoperative period. Lachmeter values were 2.79 ± 0.42 mm, 2.09 ± 0.42 mm, and 1.29 ± 0.39 mm, respectively, at the end of the first, third, and sixth months postoperatively. Mean preoperative and postoperative 6th month IKDC scores were 55.83 ± 7.7 and 89.20 ± 5.3 respectively.

Conclusions: There is significant serial improvement in the side-to-side difference of anterior tibial translation in the 6 months of post operative period following ACL reconstruction using hamstring tendon autograft. The improved IKDC score from preoperative to postoperative level is also indicating a positive functional outcome.

Keywords: Knee arthroscopy, Lachmeter, Arthrometer, ACL injury, Hamstring tendon autograft

INTRODUCTION

Knee joint is one of the commonly injured joints in our body and the most commonly injured ligament in the knee joint is ACL. Due to ever increasing road traffic accidents and increased participation in sports activities there is an increase in the incidence of ligament injuries of the knee.

The ACL is an important restraint to anterior tibial translation and tibial rotation, thereby contributing to the overall stability of the knee.¹ If an ACL insufficiency remains untreated, meniscal tears and cartilaginous damage of the joint may occur secondarily.² Reconstruction of ligament is considered as the gold standard for the treatment of ACL insufficiency.

Arthroscopic reconstruction of the ACL using hamstring tendon autograft is a well-known and widely accepted surgical procedure.³ The use of hamstring tendon autograft has been perceived to have less post-operative graft site morbidities.⁴ The primary goal of an ACL reconstruction is to restore stability to the knee. Therefore, measurement of knee stability, especially antero-posterior stability (i.e., reduction in anterior tibial translation) is one of the most important determinants of success following an ACL reconstruction. In this study, we have tried to assess the effect of ACL reconstruction using hamstring tendon autograft on antero-posterior stability of knee joint by using Lachmeter (a type of arthrometer used to measure the anterior tibial translation accurately). The effect can be assessed by comparing the preoperative and postoperative values of side-to-side difference of anterior tibial translation. The strength of the grafted ligament may vary in each stage of graft incorporation to the patient's body. Hence, we have measured the knee stability at the end of 1st, 3rd and 6th months postoperatively.

In this study, we are also assessing the functional outcome of the same surgery by comparing the preoperative and postoperative values of IKDC score. IKDC scoring is the globally accepted scoring system to assess the functioning of the knee joint. In IKDC scoring, 10 questions are being asked to the patients about various knee symptoms and knee performance. The responses of questions are recorded in the form of grades. The higher the number of grades indicates better knee performance and lesser knee symptoms. The sum of all the grades is calculated (maximum value is 87) and it is transformed into a scale that ranges from 0 to 100.⁵ The postoperative IKDC score indicates functional outcome and overall patient satisfaction following the ACL reconstruction. We have compared the preoperative IKDC score to the postoperative IKDC score at the end of 6th month.

METHODS

A prospective longitudinal study was conducted in 30 patients admitted for arthroscopic ACL reconstruction with hamstring tendon autograft in Pushpagiri institute of medical sciences, Thiruvalla, after getting clearance from Institutional ethics committee and institutional research committee (No. PIMSRC/E1/388A/57/2021). The study was conducted during the period of February 2021 to March 2023. The primary objective of the study was 'to assess the effect of ACL reconstruction using hamstring tendon autograft on anterior translation of tibia over femur using Lachmeter during 6 months postoperative period in a tertiary care hospital in South Kerala'. Secondary objective of the study was 'to assess functional outcome following ACL reconstruction using hamstring tendon autograft by comparing preoperative and postoperative values of IKDC score among the study group'. Patients were selected based on inclusion and exclusion criteria after obtaining informed consent. Inclusion criteria includes patients in the age group of 18-40 years, those with partial or complete tear of ACL, no previous ligament

reconstruction performed and patients with healthy contralateral knee. Patients with bony avulsion injury, multi-ligamentous injury, advanced degenerative changes in the knee, and concurrent musculoskeletal conditions, such as hip or ankle injury, were excluded from the study. The diagnosis was made by thorough clinical examination and MRI evaluation. Preoperatively, anterior tibial translations of injured and uninjured knee were measured using Lachmeter. Side to side difference of anterior translation of tibia over femur was calculated by subtracting the measurement of uninjured knee from that of injured knee. IKDC score was also assessed after asking 10 standard questions to the patient about various knee symptoms and knee performance. All these patients underwent arthroscopic ACL reconstruction using hamstring tendon autograft. The side-to-side difference of anterior tibial translation was again measured at the end of 1st, 3rd and 6th months after the surgery. Functional outcome was evaluated by assessing IKDC score at the end of 6 months postoperatively. The paired sample t test was used to ascertain the correlation between preoperative and post operative Lachmeter values as well as IKDC scores ($p \leq 0.001$).

Method of using Lachmeter

Lachmeter is an accurate and scientifically accepted arthrometer used to measure anterior tibial translation precisely (manufactured by Lachmeter comp, Brazil).⁶ The patient was positioned in supine on an examination table. A bolster was placed under the thighs so that the knees remain at approximately 30° of flexion. The Lachmeter was positioned on the healthy leg with the proximal support/flap on the patella and the distal support on the distal tibia. The ATT (anterior tibial tuberosity) support was placed over the tibial tuberosity. The stem of the anterior tibial tuberosity support was pushed on it and the device was reset by pressing the zero button (Figure 1).

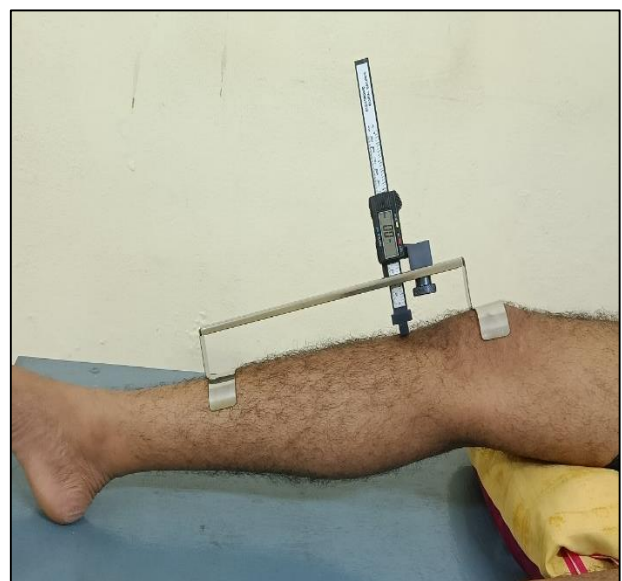


Figure 1: Correct positioning of Lachmeter.

Correct positioning of the stem on anterior tibial tuberosity and zero calibration were confirmed. One of the examiner's hands was placed on the proximal flap resting on the patella. With the other hand, relaxation of the hamstring muscle tendons was confirmed (Figure 2). Without tilting the Lachmeter or moving the measuring stem, with the other hand, the tibia pulled anteriorly to maximum limit. The measurement was taken from the digital calliper. Same test was performed on the affected leg and the measurement was taken. Then the side-to-side difference of anterior translation of tibia over femur was calculated.⁶ This value can be used to assess the anteroposterior stability of knee joint (Table 1).⁶



Figure 2: Method of measuring anterior tibial translation using Lachmeter.

Table 1: Interpretation of Lachmeter evaluation.⁶

Side to side difference (mm)	Interpretation
<3	No ACL injury
3-4	Partial ACL injury
>4	Complete ACL injury

RESULTS

The participants were in the age group of 18 to 40 years. The mean age of the population was 28±7.1 years. The majority of our study population was male (73%) (Figure 3). Among the 30 study patients, the left sided injury was the most common (60%) (Figure 4). Symptoms varied greatly in the study population. 90% of the patients had knee pain, 66.7% patients had instability symptoms and 26.6% of patients had swelling in knee (Figure 5). Among these patients with ACL injury, 40% had concurrent medial meniscal injury and 26.7% had concurrent lateral meniscal injury (Figure 6). There was serial improvement in the side-to-side difference of anterior tibial translation in the 6 months of post operative period (Table 2) (Figure 7). The paired sample t test was used to ascertain the correlation between preoperative and post operative values. Association was found to be statistically significant (p≤0.001). There was considerable improvement in IKDC

score 6 months after the surgery (Table 3). Paired sample t test was used to ascertain the correlation between preoperative and post operative IKDC values. The association was found to be statistically significant (p≤0.001).

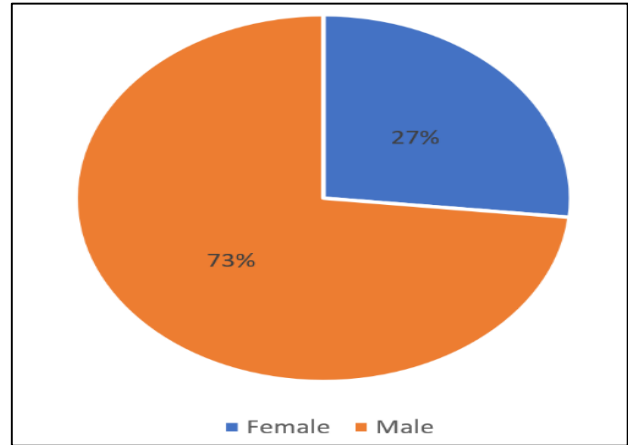


Figure 3: Gender distribution of patients.

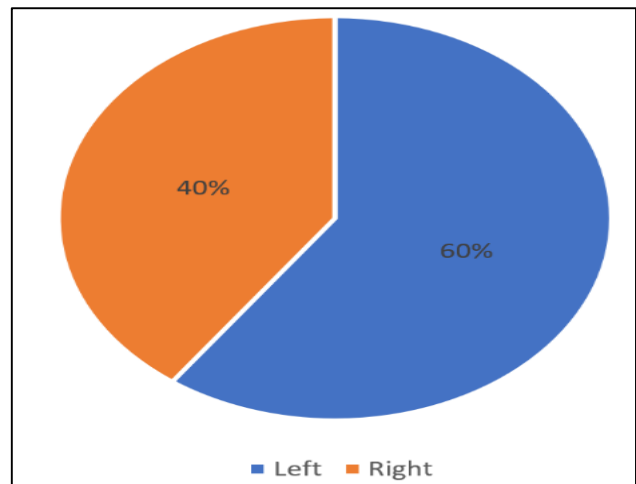


Figure 4: Side distribution of ACL injury.

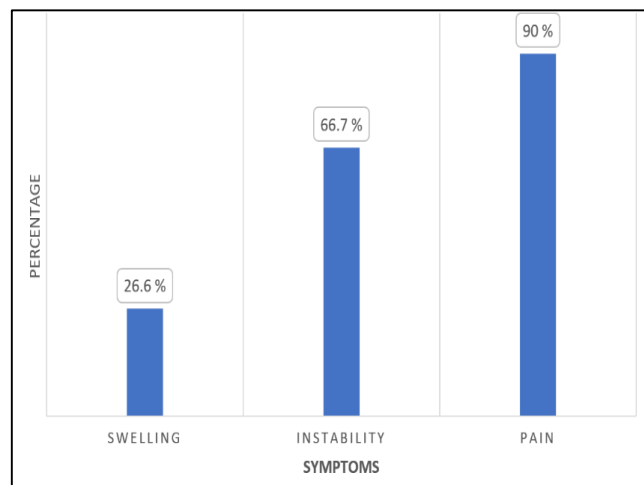


Figure 5: Symptoms of the patients.

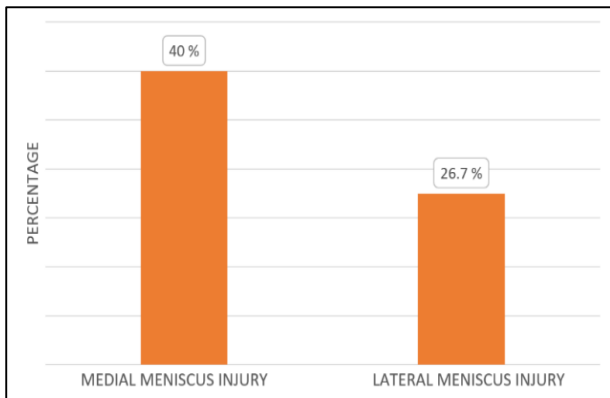


Figure 6: Patients with concurrent meniscal injury.

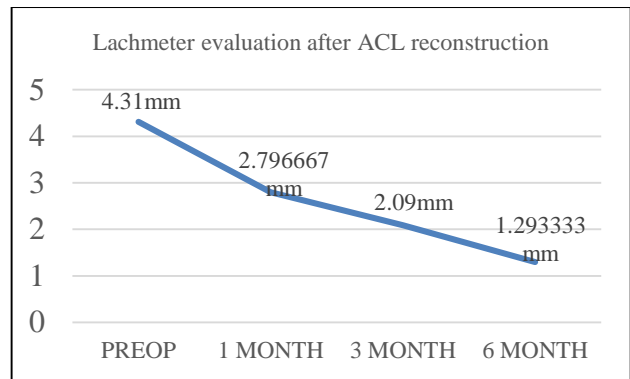


Figure 7: Change in side-to-side difference of anterior translation of tibia over femur over time.

Table 2: Lachmeter evaluation among study population.

Variables		Mean (mm)	N	SD	Std. error mean	P value
Pair 1	Pre-operative	4.310000	30	0.5671161	0.1035408	<0.001
	1 st month	2.796667	30	0.4270858	0.0779748	
Pair 2	Pre-operative	4.310000	30	0.5671161	0.1035408	<0.001
	3 rd month	2.090000	30	0.4229209	0.0772144	
Pair 3	Pre-operative	4.310000	30	0.5671161	0.1035408	<0.001
	6 th month	1.293333	30	0.3050532	0.0556948	

Table 3: IKDC score among study population.

Variables		Mean (mm)	N	SD	Std. error mean	P value
Pair 4	Pre operative	55.83	30	7.773	1.419	<0.001
	6 th month	89.20	30	5.397	0.985	

DISCUSSION

The ACL is an important restraint to anterior tibial translation and tibial rotation, thereby contributing to the overall stability of the knee. ACL can get injured by different mechanisms of abnormally excessive forces acting on the knee joint during sports activities and road traffic accidents. Most common mechanism of ACL injury is external rotation and abduction with knee in 90° flexion, which can commonly happen during sports activities like football.⁷ In this study the mean age group was 28±7.1 years, which was corresponded to physically active period and majority of patients were males (73.3%). A study done by Huegli et al on knee injuries showed similar findings.⁸ Males were more involved and most of them were in the age group 20-30 years. Out of 90 patients in a study conducted by RB Uppin et al the majority (78%) were men.⁹ The majority of the patients ranged in age from 20 to 40. Biologically females are prone for ACL injuries than males. Relatively smaller intercondylar notch, Lesser strength of ACL, smaller size of ACL, greater Q angle and hormonal factors are the biological reasons that make female knees prone for ACL injury.¹⁰ But, relatively lesser female participation in sports activities and physical activities in the locality of current study might be the

reason for higher male predominance in this study population.

Meniscal injuries can happen either immediately at the time of trauma or it can develop later (meniscal injuries secondary to ACL injury). Medial meniscus is more vulnerable to get injured than lateral meniscus. Relatively larger size of medial meniscus and lesser mobility due to intimate attachment to medial collateral ligament are the reasons for the same.¹¹

In this study, the preoperative Lachmeter value (side-to-side difference of anterior tibial translation) was 4.31±0.56 mm. Postoperative values were 2.79±0.42 mm, 2.09±0.42 mm, and 1.29±0.39 mm, respectively, at the end of first, third, and sixth months. This downward trend of values indicates that, the graft is getting stronger during this period. When preoperative and postoperative values were evaluated, Wen et al observed identical outcomes in the mean side to side difference.¹² Patients who underwent reconstruction using hamstring tendon autograft showed postoperative improvement in knee condition and a decrease in laxity at the end of 12 and 24 months. Over the course of two years, nearly all the study participants have recovered their normal knee function. Our results were comparable to this study even though we had a short

follow up for six months. In our study, participants' mean preoperative IKDC score was 55.83, which has improved to 89.20 at the end of 6th month of postoperative period. When pre-operative and post-operative IKDC scores were evaluated, Wen et al discovered comparable findings in their investigation. At the end of 12 and 24 months after surgery, patients who underwent reconstruction using a hamstring tendon autograft showed almost similar pattern of postoperative improvement in IKDC score.¹²

The average side-to-side difference on the KT-2000 maximal manual force test for the Lachman test following surgery was 1.67 ± 1.52 mm in a related study by Shahriar et al.¹³ The mean side to side difference value of 1.29 ± 0.30 mm observed in our study was comparable to this study.

Similar to our study, Singh et al evaluated the results of ACL reconstruction using the IKDC score. Preoperatively study found the mean IKDC score as 34.6 ± 1.9 which was lesser than that of the scores of patients under our study (55.83 ± 7.7). The mean IKDC was 38.475 ($SD \pm 2.2278$), 51.390 ($SD \pm 1.8954$), 58.475 ($SD \pm 1.4563$), 66.175 ($SD \pm 1.4596$) and 79.020 ($SD \pm 1.3073$, respectively at the end of 2nd week, 6th week, 10th week, 4th month and 6th month. In our study, the mean IKDC score at post operative six month was 89.20 ± 5.3 , which was comparable with study conducted by Singh et al.¹⁴

We could only include a small number of cases because this was a time limited study, therefore the sample size was relatively smaller. The procedures were carried out by various surgeons at the same facility, which might have resulted in a small variance in method. We were unable to assign these factors. Additionally, we could only keep track of the patients for six months after surgery. It takes at least 1-2 years after surgery to assess the patient to determine the precise functional outcome. Finally, it was important to take into account any other variables that may affect the course of the disease, such as lifestyle choices, BMI and co-morbidities.

CONCLUSION

This study showed that the study population who underwent ACL reconstruction using hamstring tendon autograft had a significant gradual lowering of mean side to side difference of anterior tibial translation, which was measured using Lachmeter during 6-months of postoperative period, suggesting significant improvement in anteroposterior knee stability. The increased IKDC score from preoperative to postoperative levels also indicating a positive functional outcome among patients underwent ACL reconstruction with hamstring tendon autograft.

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