

Comparison of Outcome of Interference Versus Suspensory Fixation of Hamstring Tendon Autografts on Tibia During Arthroscopic Anterior Cruciate Ligament Reconstruction in a Tertiary Care Hospital

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Conflict of interest: Nil

Abstract

Background: Arthroscopic anterior cruciate ligament ACL reconstruction is a surgical procedure to restore the stability and function of the knee joint after an ACL rupture. Some previous studies have shown that the type of femoral fixation device can influence the risk of revision ACL reconstruction, but it is unclear whether the type of tibial fixation has an effect.

Aims and Objectives: The aim of this study was to compare suspensory and interference methods of tibial side fixation and compare their clinical outcomes after one year of follow-up.

Materials and Methods: This was a prospective study of the cohort with ACL insufficiency treated with arthroscopic assisted ACL reconstruction using autogenous quadrupled hamstring tendon graft using suspensory technique in one group and screw fixation in another group. The subjects were evaluated based on two factors: joint stability measure and functional outcome measure preoperatively as well as postoperatively after 1 year of surgery.

Results: There was no incidence of graft failure at 1 year follow-up. Post operative Lachman and Pivot Shift test showed no statistically significant difference at 1 year follow up. Functional outcome was assessed using IKDC score. Preoperative average score was 32.8 which improved to 78.1 at 1 year follow-up. However, the difference between two groups was found to be statistically non-significant.

Conclusion: In our study both the techniques of ACL fixation on tibial side i.e., interference screw and suspensory fixation showed comparable results in manual knee laxity tests, instrumental knee laxity tests using KT-1000, and functional outcome as assessed by IKDC scores.

Keywords: ACL reconstruction, Tibial fixation, Knee Injury

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Introduction

Tears of the anterior cruciate ligament (ACL) are one of the most common knee injuries [1]. Arthroscopic ACL reconstruction is a surgical procedure to restore the stability and function of the knee joint after an ACL rupture.

Reconstruction involves ACL graft preparation and its fixation to anatomical position in femur and tibia to mimic the most physiological positioning. Tibial fixation in ACL reconstruction is generally a point of less resistance than femoral fixation due to the lower density of the tibial bone and the parallel graft-fixation associated with the tunnel. This generates a sliding force that can cause early failure of the distal fixation [2]. Graft integration in the bone tunnel occurs around the 12th week [3], and early physical therapy rehabilitation is important for the clinical outcome of ACL reconstruction surgery. Therefore, secure fixation in the immediate postoperative period is essential to avoid displacement and impairment of the graft integration process [4].

Some previous studies have shown that the type of femoral fixation device can influence the risk of revision ACL reconstruction, but it is unclear whether the type of tibial fixation has an effect [5]. Today, most of hamstring tendon grafts are fixed with a suspensory device on the femoral side, with variable usage between suspensory and interference devices on the tibial side.

Aims and Objectives:

The aim of this study was to compare suspensory and interference methods of tibial side fixation and compare their clinical outcomes after one year of follow-up.

Materials and Methods:

This was a prospective study of the cohort with ACL insufficiency treated with arthroscopic assisted ACL reconstruction using autogenous quadrupled hamstring tendon graft using suspensory technique in

one group and screw fixation in another group. The study was performed at Department of Orthopaedics, American International Institute of Medical Science, Udaipur, Rajasthan over a period of 12 months from March 2020 to February 2021. 80 patients between 18 to 50 yrs. of age with clinically and radiologically proven ACL deficiency were included in the study. Patients with associated PCL, MCL, LCL and meniscal injuries greater than grade II injuries were excluded from the study. Patients with articular cartilage injuries, previous knee surgeries and bilateral ACL tears were kept out of the study. Patients were divided into two groups by computer generated random number table. In group A, 40 patients underwent ACL reconstruction with interference screw fixation on tibial side. Other 40 patients in group B underwent ACL reconstruction with suspensory fixation technique on tibial side. In both groups quadrupled semitendinosus autograft was utilized. In both the groups suspensory fixation was carried out on femoral side. All the patients were evaluated for functional outcome at the end of 1 year following the procedure. All the patients were operated upon by a single surgeon under standard conditions using a standard technique of ACL reconstruction. A standard rehabilitation protocol was followed in both the groups. The subjects were evaluated based on two factors:

1. Joint stability measure:

- Lachman test
- Pivot shift test
- KT 1000 arthrometer assessment
- Frequency of graft failure

2. Functional outcome measure:

- IKDC (International Knee Documentation Committee Score)

Results:

In this study 80 patients with clinically and radiologically proven ACL deficiency were included. There was a male predominance of 76%.

Both groups were comparable with respect to age, sex, and other demographic profile as shown in Table 1. In pre-operative period, all patients were evaluated using Lachman test, Pivot shift test and by KT1000 Arthrometer (compared with opposite knee) for joint stability. The differences between Interference group and Suspensory group were not significant as shown in Table 2,3 & 4. Preoperative IKDC score was calculated, and no statistically significant difference was

found between both groups as shown in Table 5.

There was no incidence of graft failure at 1 year follow-up. Post operative Lachman and Pivot Shift test showed no statistically significant difference at 1 year follow up as shown in Table 6 &7. Similarly, testing by KT-1000 Arthrometer after 1 year follow-up revealed no statistically significant difference between both groups as shown in Table 8. Functional outcome was assessed using IKDC score. Preoperative average score was 32.8 which improved to 78.1 at 1 year follow-up. However, the difference between two groups was found to be statistically non-significant as shown in Table 9.

Table 1: Demographic profile of patients

	No. of Patients	Age (years)		p-value	Weight (kg)		p-value
		Mean	SD		Mean	SD	
Interference Group	40	33.275	5.387	0.8742 (NS)	66.875	6.587	0.6005 (NS)
Suspensory Group	40	33.5	7.158		67.55	4.744	

Table 2: Pre operative Lachman test comparison

	Lachman Test (Grading)				p-value
	0	I	II	III	
Interference Group	0	0	25	15	0.8161 (NS)
Suspensory Group	0	0	26	14	

Table 3: Pre operative Pivot Shift test comparison

	Pivot Shift Test (Grading)				p-value
	0	I	II	III	
Interference Group	2	4	30	4	0.4689 (NS)
Suspensory Group	0	3	34	3	

Table 4: Pre operative KT1000 Arthrometer (compared with opposite knee) comparison

	KT1000 Arthrometer		p-value
	Mean (mm)	SD	
Interference Group	5.665	0.366	0.6773 (NS)
Suspensory Group	5.53	0.383	

Table 5: Preoperative IKDC score comparison

	IKDC Score		p-value
	Mean	SD	
Interference Group	33.016	3	0.6100 (NS)
Suspensory Group	32.672	3	

Table 6: Post operative Lachman test comparison

	Lachman Test (Grading)				p-value
	0	I	II	III	
Interference Group	23	17	0	0	0.8217 (NS)
Suspensory Group	22	18	0	0	

Table 7: Post operative Pivot Shift test comparison

	Pivot Shift Test (Grading)				p-value
	0	I	II	III	
Interference Group	30	10	0	0	0.0774 (NS)
Suspensory Group	36	4	0	0	

Table 8: Post operative KT1000 Arthrometer (compared with opposite knee) comparison

	KT1000 Arthrometer		p-value
	Mean (mm)	SD	
Interference Group	2.58	0.232	0.6838 (NS)
Suspensory Group	2.59	0.205	

Table 9: Post operative IKDC score comparison

	IKDC Score		p-value
	Mean	SD	
Interference Group	78.08	2.595	0.9601 (NS)
Suspensory Group	78.1	2.523	

Discussion:

The main goal of initial fixation in ACL reconstruction is to resist graft slippage until tendon to bone healing occurs. Stability of ACL grafts should be enough to withstand physiologic loads applied to the knee during activities of daily living. The graft fixation should also allow for the

application of accelerated rehabilitation protocols [2,6-7]. The native ACL resists an estimated load of 150 to 500 N during activities of daily living. The initial fixation of a soft-tissue graft should be able to resist this magnitude of load to be successful. A major concern with the use of hamstring autografts is that soft tissue

can take up to 12 weeks to heal in the osseous tunnel [6-8].

There is currently no gold standard for the fixation of soft tissue grafts for ACL reconstruction. There are 2 types of femoral fixation for ACL grafts in bone tunnels.

Direct fixation (aperture fixation) with interference screw, refers to compression of the soft tissue to allow direct contact healing between the graft and the bone surface without the development of a fibrous inter zone normally seen in non-anatomic fixation methods. The use of bio absorbable interference screws has the advantage of direct tendon-to-bone healing with acceptable initial biomechanical fixation strength. However, the micromotion between the graft and the interference screw within the tunnel during a cyclic loading may lead to a slipping of the graft and result in a secondary lengthening and loosening of the graft [7].

Indirect fixation (suspensory fixation) suspends the graft in the bone tunnel. Recent biomechanical studies have shown that the transfix device provides less laxity but greater stiffness and pull-out strength when compared to interference screw [7].

Manual laxity testing of all the patient in both the groups were carried out by Lachman test and Pivot shift test in this study. None of the patients in both groups had grade II or III laxity postoperatively. Post-operatively at 1 year follow up, 30 cases in interference group and 36 cases in suspensory group had negative Pivot shift test. Thus, manual laxity tests performed at 1 year follow-up in all the patients in both the groups did not show statistically significant difference between interference screw and suspensory method of fixation in our study.

In our study, testing by KT-1000 Arthrometer after 1 year follow-up revealed no statistically significant difference between both groups. Two studies investigated the anteroposterior

knee stability of the operative knee using the KT-1000 arthrometer [9-10] and one study [11] used the Rolimeter. All the studies stated that knee stability improved significantly postoperatively, but no significant difference between groups was noted.

In our study, IKDC score improved from 32.8 to 78.1 at 1 year follow-up. However, the difference between two groups was found to be statistically non-significant. Greif et al [12] studied the clinical outcomes of quadriceps tendon autograft with femoral/tibial cortical suspensory fixation versus tibial interference screw fixation in 124 patients. They concluded that at the end of 2 year follow up both groups had clinically comparable subjective outcome with no statistically significant difference in IKDC scores. Similar studies [10,13-14] have noted significant postoperative improvement in both groups; however, no significant between-group difference was found in postoperative score measurement. [15]

Conclusion:

In our study both the techniques of ACL fixation on tibial side i.e., interference screw and suspensory fixation showed comparable results in manual knee laxity tests, instrumental knee laxity tests using KT-1000, and functional outcome as assessed by IKDC scores. The clinical result in this study clarified that both methods of fixation are safe and effective. However further studies are needed with larger group and longer follow up to confirm these findings.

References:

1. Gianotti SM, Marshall SW, Hume PA, et al. Incidence of anterior cruciate ligament injury and other knee ligament injuries: a national population-based study. *J Sci Med Sport* 2009; 12(6): 622–627.
2. Brand J, Weiler A, Caborn DN, Brown CH, Jr, Johnson DL. Graft fixation in

- cruciate ligament reconstruction. *Am J Sports Med.* 2000; 28:761–74.
3. Rodeo SA, Arnoczky SP, Torzilli PA, Hidaka C, Warren RF (1993) Tendon-healing in a bone tunnel. A biomechanical and histological study in the dog. *J Bone Joint Surg Am* 75(12):1795–1803.
 4. Eguchi A, Ochi M, Adachi N, Deie M, Nakamae A, Usman MA. Mechanical properties of suspensory fixation devices for anterior cruciate ligament reconstruction: comparison of the fixed-length loop device versus the adjustable-length loop device. *Knee* 2014;21(03):743–748.
 5. Rahardja R, Love H, Clatworthy MG, Monk AP, Young SW. Suspensory Versus Interference Tibial Fixation of Hamstring Tendon Autografts in Anterior Cruciate Ligament Reconstruction: Results from the New Zealand ACL Registry. *Am J Sports Med.* 2022 Mar;50(4):904-911.
 6. Hoher J, Livesay G, Ma C, Withrow J, Fu F, Woo S. Hamstring graft motion in the femoral bone tunnel when using titanium button/polyester tape fixation. *Knee Surg Sports Traumatol Arthrosc.* 1999; 7:215– 9.
 7. Mishra AK, Datta B, Singh VB, Gogoi B, Rai SK, Kashid M. Clinical comparison between femoral transfixation and bioscrew fixation using hamstring tendon graft for ACL reconstruction. *Int J Res Orthop* 2017;3:1099-103
 8. Scheffler SU, Sudkamp NP, Gockenjan A, Hoffman RF, Weiler A. Biomechanical comparison of hamstring and patellar tendon graft anterior cruciate ligament reconstruction techniques: the impact of fixation level and fixation method under cyclic loading. *Arthroscopy.* 2002; 18:304-15.
 9. Mayr R, Smekal V, Koidl C, Coppola C, Eichinger M, Rudisch A, Kranewitter C, Attal R. ACL reconstruction with adjustable-length loop cortical button fixation results in less tibial tunnel widening compared with interference screw fixation. *Knee Surg Sports Traumatol Arthrosc* 2019;28(4):1036–44
 10. Monaco E, Fabbri M, Redler A, Gaj E, De Carli A, Argento G, et al. Anterior cruciate ligament reconstruction is associated with greater tibial tunnel widening when using a bioabsorbable screw compared to an all-inside technique with suspensory fixation. *Knee Surg Sports Traumatol Arthrosc.* 2018;27(8):2577–84.
 11. Benea H, d'Astorg H, Klouche S, Bauer T, Tomoaia G, Hardy P. Pain evaluation after all-inside anterior cruciate ligament reconstruction and short term functional results of a prospective randomized study. *Knee.* 2014;21(1):102–6.
 12. Greif DN, Shallop BJ, Allegra PR, Cade WH 2nd, Minesinger KE, Luxenburg D, Kaplan LD, Baraga MG. A Comparison of Two-Year Anterior Cruciate Ligament Reconstruction Clinical Outcomes Using All-Soft Tissue Quadriceps Tendon Autograft with Femoral/Tibial Cortical Suspensory Fixation Versus Tibial Interference Screw Fixation. *Arthroscopy.* 2022 Mar; 38(3):881-891
 13. Darmal, D. I., Khan, A., Ahmad, D. S., & Gowani, A. Frequency of Type II Diabetes Mellitus in ST Segment Elevated MI patients presented to French Medical Institute for Mothers and Children: A Cross Section Study. *Journal of Medical Research and Health Sciences,* 2022;5(6), 2023–2038.
 14. Volpi P, Bait C, Cervellin M, Denti M, Prospero E, Morengi E, et al. No difference at two years between all inside transtibial technique and traditional transtibial technique in anterior cruciate ligament reconstruction. *Muscles Ligaments Tendons J.* 2014;4(1):95–9.

15. Desai VS, Anderson GR, Wu IT, Levy BA, Dahm DL, Camp CL, et al. Anterior cruciate ligament reconstruction with hamstring autograft: a matched cohort comparison of the all-inside and complete Tibial tunnel techniques. *Orthop J Sports Med.* 2019;7(1):2325-2332. doi:10.1177/0898010118820297.