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RESEARCH ARTICLE

FUNCTIONAL OUTCOME OF TRANSTIBIAL VS TRANSPORTAL DRILLING TECHNIQUES IN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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ABSTRACT

Background: It is a randomized prospective clinical study to determine the functional outcome of trans-tibial and anteromedial portal techniques in ACL reconstruction. The contribution of the present study to the literature would be to confirm or refute an actual clinical advantage of the technically difficult anteromedial portal technique over the easier, more popular and well established trans-tibial technique.

Materials and Methods: A minimum of 60 patients with ACL tears and undergoing arthroscopic ACL reconstructive surgery from a period within May 2013 to December 2014 were studied by using a standard Proforma and clinical evaluation pre and post op by an independent observer. A detailed clinical examination was done. Patients were interviewed with respect to subjective symptoms like joint stability, pain, impact on their professional life.

Conclusion: After analyzing the results of our study it was concluded

1. Arthroscopic ACL Reconstruction using transtibial and transportal techniques of femoral tunneling are both effective modalities of treatment in patients with ACL deficient knees
2. The transportal technique gives superior results in terms of knee IKDC, Lysholm and Pain on VAS scores.
3. The transportal technique has a better functional outcome than the transtibial technique.

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INTRODUCTION

Anterior Cruciate ligament injuries are one ofthe most common injuries of the knee. ACL reconstruction, as treatment for ACL injuries, has come a long way since it was first performed by Mayo-Robson in 1895. Despite a multitude of surgicaltechniques and fixation devices being at the surgeon's disposal, thechoice of the optimal surgical method is still unclear. A frequent cause for failure after ACLreconstruction has been the incorrect placement of bone tunnels, especially on the femoral side. The most commonly employedtechnique of femoral tunnel placement, the trans-tibial technique, has been reported not to provide anatomical placement offemoral tunnel and result in rotational instability. Cadaveric andradiographic studies have confirmed that drilling the femoral tunnelthrough anteromedial portal allows a more anatomical placement ofthe tunnel and higher rotational stability than does the trans-tibialtechnique. However clinical results of trans-tibial and anteromedialportal techniques are still controversial. A recent literature reviewshowed improved short term results with anteromedial portaltechnique but no difference in terms of clinical functions betweenthe two techniques at mid and long term follow up. Howeverthe meta-analysis was based on indirect comparison of non-homogenous studies. Very few other studies are available providingdirect comparison between these two techniques. The study is a randomizedprospective clinical study to determine the functional outcomeof trans-tibial and anteromedial portal techniques in ACL reconstruction. The contribution of the present study to theliterature would be to confirm or refute an actual clinical advantageof the technically difficult anteromedial portal technique over theeasier, more popular and well established trans-tibial technique.

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Aims and Objectives

To determine the functional outcome of transtibial vs. transportal drilling techniques in ACL reconstruction with respect to

- Knee stability
- Pain/Discomfort
- Range of movement of affected knee

Ability to return to previous routine activities

Anatomy

The anterior cruciate ligament is composed of longitudinally oriented bundles of collagen tissue arranged in fascicular subunits within larger functional bands. The ligament is surrounded by synovium, thus making it extrasynovial.[1] The anterior cruciate ligament inserts on the tibial plateau, medial[2] to the insertion of the anterior horn of the lateral meniscus in a depressed area anterolateral to the anterior tibial spine. The tibial attachment site is larger and more secure than the femoral site. The ligament is 31 to 35 mm in length and 31.3 mm2 in cross section. The primary blood supply to the ligament is from the middle geniculate artery, which pierces the posterior capsule and enters the intercondylar notch near the femoral attachment. Additional supply comes from the retropatellar fat pad via the inferior medial and lateral geniculate arteries. This source plays a more important role when the ligament is injured. The osseous attachments of the anterior cruciate ligament contribute little to its vascularity.[3] The posterior articular nerve, a branch of the tibial nerve, innervates the anterior cruciate ligament. Histological study[4] has revealed nerve fibers of the size most consistent with transmitting pain in the intrafascicular spaces. Mechanoreceptors also have been identified on the surface of the ligament, mostly at the insertions of the ligament (especially femoral), well beneath the external synovial sheath.

Biomechanics

The anterior cruciate ligament is the primary restraint to anterior tibial displacement, accounting for approximately 85% of the resistance to the anterior drawer test when the knee is at 90 degrees of flexion and neutral rotation. Selective sectioning of the anterior cruciate ligament has shown that the anteromedial band is tight in flexion, providing the primary restraint, whereas the posterolateral bulky portion of this ligament is tight in extension. The posterolateral bundle provides the principal resistance for hyperextension. Tension in the anterior cruciate ligament is least at 30 to 40 degrees of knee flexion. The anterior cruciate ligament also functions as a secondary restraint on tibial rotation and varus-valgus angulation at full extension. In vivo, it is an oversimplification to limit the description of anterior cruciate ligament function to the function of its two fiber bundles. In fact, similar to the fibers in all ligaments, those in the anterior cruciate ligament are recruited differently on the basis of every subtle three-dimensional change in the position of the joint. The normal anterior cruciate ligament has been shown to carry loads throughout the entire range of flexion and extension of the knee. Consequently, the anterior cruciate ligament can fail differently at different loads, depending on the position of the bones and the direction in which the loads are applied at the time of injury.

MATERIALS AND METHODS

IKDC scale

The IKDC rating scale has 2 components a subjective questionnaire and an objective evaluation.

Subjective IKDC score

The subjective IKDC score is a questionnaire with different subjective factors such as symptoms, sports activities, ability to carry out daily activities, etc are evaluated

Symptoms*

*Grade symptoms at the highest activity level at which you think you could function without significant symptoms, even if you are not actually performing activities at this level.

What is the highest level of activity that you can perform without significant knee pain?
4= Very strenuous activities like jumping or pivoting as in basketball or soccer
3= Strenuous activities like heavy physical work, skiing or tennis
2= Moderate activities like moderate physical work, running or jogging
1= Light activities like walking, housework or yard work
0=Unable to perform any of the above activities due to knee pain

During the past 4 weeks, or since your injury, how often have you had pain?

	10	9	8	7	6	5	4	3	2	1	0	
Never												Constant

3. If you have pain, how severe is it?

	10	9	8	7	6	5	4	3	2	1	0	
No pain												Worst pain imaginable

4.During the past 4 weeks, or since your injury, how stiff or swollen was your knee? 4=Not at all
3=Mildly
2=Moderately
1=Very
0=Extremely

5.What is the highest level of activity you can perform without significant swelling in your knee?
4=Very strenuous activities like jumping or pivoting as in basketball or soccer
3=Strenuous activities like heavy physical work, skiing or tennis
2=Moderate activities like moderate physical work, running or jogging
1=Light activities like walking, housework, or yard work
0=Unable to perform any of the above activities due to knee swelling

6.During the past 4 weeks, or since your injury, did your knee lock or catch?
0=Yes 1=No

7.What is the highest level of activity you can perform without significant givingway in your knee?
4=Very strenuous activities like jumping or pivoting as in basketball or soccer
3=Strenuous activities like heavy physical work, skiing or tennis

2=Moderate activities like moderate physical work, running or jogging
1=Light activities like walking, housework or yard work
0=Unable to perform any of the above activities due to giving way of the knee

Sports activities

8.What is the highest level of activity you can participate in on a regular basis?
4=Very strenuous activities like jumping or pivoting as in basketball or soccer
3=Strenuous activities like heavy physical work, skiing or tennis
2=Moderate activities like moderate physical work, running or jogging
1=Light activities like walking, housework or yard work
0=Unable to perform any of the above activities due to knee

9.How does your knee affect your ability to:

Function

10.How would you rate the function of your knee on a scale of 0 to 10 with 10 being normal, excellent function and 0 being the inability to perform any of your usual daily activities which may include sports?

	Not difficu lt at all	Minimally difficult	Moderately difficult	Extremely difficult	Unable to do
	4	3	2	1	0
a. Go up stairs					
b. Go down stairs					
c. Kneel on the front of your knee					
d. Squat					
e. Sit with your knee bent					
f. Rise from a chair					
g. Run straight ahead					
h. Jump and land on your involved leg					
i. Stop and start quickly					

Current function of your knee

	10	9	8	7	6	5	4	3	2	1	0	
No limitation												Can't perform daily activity

Table

GROUPS	A (normal)	B (nearly normal)	C (abnormal)	D (severely abnormal)
1.Effusion	None	Mild (<25cc)	Moderate (25-60cc)	Severe (tense knee)
2.Ligament examination				
a.Lachman test	-1 to 2mm	3 to 5mm (1+)	6 to 10mm (2+)	>10mm (3+)
b.Pivot shift	Equal	Glide	Gross	Marked
3.Passive motion defect				
a.Lack of extension	<3°	3 to 5°	6 to 10°	>10°
b.Lack of flexion	0 to 5°	6 to 15°	16 to 25°	>25°

*Group grade: The lowest grade within a group determines the group grade

Table 2

Limp (5 Points)		Pain (25 Points)		
None	5______	None		25____
slight or periodical	3______	Inconstant and slight during severe exertion		20 ____
Severe and constant	0______	Marked during severe exertion		15 ____
Support (5 Points)		Marked on or more than 2 km	after walking	10____
None	5______	Marked on or less than 2 km	after walking	5____
Stick or crutch	2______	Constant		0____
Weight-bearing impossible	0______	Swelling (10 Points)		
Locking (15 points)		None		10___
No locking and no catching sensations	15____	On severe exertion		6____
Catching but no locking	10____	On ordinary exertion		2____
Locking	6_____	Constant		0____
Frequently	2_____	Stair climbing (10 points)		
Locked joint on examination	0_____	No impairment		10___

Instability (25 points)		Slightly impaired	6____
Never giving way	25____	One step at a time	2____
Rarely gives way except for athletic or other severe exertion	20____	Impossible	0____
Gives way frequently during athletic events or severe exertion	15____	Squatting (5 points)	
Occasionally in daily activities	10____	No problem	5___
Often in daily activities	5_____	Slightly impaired	4____
Every step	0_____	Not beyond 90 degrees	2____
		Impossible	0_____
Total	______		

The Subjective IKDC score was evaluated by summing the scores for the individual items and then transforming the score to a scale that ranges from 0 to 100.To calculate the final subjective IKDC score simply add the score of each item and divide by the maximum possible score which was 87. Subjective IKDC score = [Sum of items/Maximum possible score] x 100 The score is interpreted as a measure of function such that higher scores represent higher levels of function and lower levels of symptoms. A score of 100 is interpreted to mean no limitation with activities of daily living or sports activities and the absence of symptoms.

Objective IKDC scale

The objective IKDC scale has total 7 domains related to the knee, reflecting both impairment and disability. The worst grading for first 3 key domains – presence of effusion, knee range of motion and ligament stability– determines the eventual IKDC grade. Patients are graded in 4 different grades – A, B, C and D – normal, nearly normal, abnormal and severely abnormal respectively.

Lysholm score

The Lysholm knee score is a measure of knee function, symptoms and disability. This questionnaire is constituted of eight questions, with closed answers alternatives, of whichfinalscore is expressed nominally and ordinally, with a score ranging from 95 to 100 points regarded as “excellent”; 84 to 94 points, “good”, from 65 to 83 points, “fair”, and “poor” when values are equal or below 64 points.Recording of the Lysholm score was done preoperatively and postoperatively.

Excellent: 95 – 100; Good: 84 – 94; Fair: 65 – 83; Poor: < 64 Lachman’s test

The Lachman test can be useful if the knee is swollen and painful. The patient is placed supine on the examining table with the involved extremity to the examiner's side The involved extremity is positioned in slight external rotation and the knee between full extension and 15 degrees of flexion; the femur is stabilized with one hand, and firm pressure is applied to the posterior aspect of the proximal tibia, which is lifted forward in an attempt to translate it anteriorly. The position of the examiner's hands is important in doing the test properly. One hand should firmly stabilize the femur while the other grips the proximal tibia in such a manner that the thumb lies on the anteromedial joint margin. When an anteriorly directed lifting force is applied by the palm and the fingers, anterior translation of the tibia in relation to the femur can be palpated by the thumb. Anterior translation of the tibia associated with a soft or a mushy end point indicates a positive test result. When viewed from the lateral aspect, a silhouette of the inferior pole of the patella, patellar tendon, and proximal tibia shows slight concavity. With disruption of the anterior cruciate ligament, anterior translation of the tibia obliterates the patellar tendon slope. Pivot shift test-With the knee extended, the foot is lifted and the leg internally rotated, and a valgus stress is applied to the lateral side of the leg in the region of the fibular neck with the opposite hand. The knee is flexed slowly while valgus and internal rotation are maintained. With the knee extended and internally rotated, the tibia is subluxed anteriorly. As the knee is flexed past approximately 30 degrees, the iliotibial band passes posterior to the center of rotation of the knee and provides the force that reduces the lateral tibial plateau on the lateral femoral condyle. An isolated tear of the anterior cruciate ligament produces only a small subluxation; greater subluxation occurs when the lateral capsular complex or semimembranosus corner also is deficient. Severe valgus instability may make this test difficult to do because of lack of medial support. The pivot shift is tested while the knee is moved from extension to flexion, and the jerk test is elicited while the knee is moved from flexion to extension.
*Pre operatively all patients underwent an MRI scan of affected knee

Operative procedure

Arthroscopic technique

Under tourniquet control an initial diagnostic arthroscopy was performed first for every patient to evaluate the joint with respect to the status of ligaments, menisci, synovium and cartilage. Standard anteromedial and anterolateral portal incisions were made. The ruptured ACLwas examined with an arthroscopic probe, dissected, and debrided. The tibial footprint of theACL was left intact. The femoral footprint was also identified and minimally debrided.

Graft harvesting

An vertical 3 cm skin incision was made over the pes anserinus The superior border of the pes wasidentified with finger, the gracilis tendon was identified by rolling it with finger and fascia wasthen incised between gracilis and semitendinosus tendon. Thesemitendinosus tendon was harvested using a Right angled forceps and ethibond. The distal end of thetendon was cut with the knife; making sure to get the maximal length distallyincluding the periosteum. The fascial adhesions were released with the traction and by blunt finger dissectionand with combined action of pulling the tendon and pushing the tendon stripper, semitendinosus tendon was amputated at musculo-tendon junction. In a similar manner the tendon of the gracilis was harvested

Graft preparation

The tendons were then debrided of muscle tissue and facial adhesions, a quadrupled hamstring graft was prepared using bunnels technique of suturing with ethibond sutures, graft was then sized using a graft sizer, wand was then put in tension on a graft board with a tensioner.

Transtibial technique)

The tibial tunnelwas drilled first using ACL tibial jig set at 55 degree. Reaming was done to make the tibialtunnel of size dictated by the thickness of the graft. The centre of femoral tunnel was thenjust anterior to the residents ridge, at the footprint of the ACL. Femoral tunnel was then drilled according to the size of graft and after ensuring the length of atleast 20 mm of graft in the tunnel. The Endobutton CL size was selected depending upon overalllength/distance between intra articular femoral tunnel aperture and femoral cortex. The quadrupled looped hamstring graft was then pulled through the tibial tunnel into femoral tunnel over appropriate size Endobutton CL and then the button was flipped over the femoral cortex.

Trans Portal (TP) [Technique]

In this technique the standard anteromedial portal was made. Standard Tibial tunnel was reemed. While keeping knee in 70* degrees flexion and looking from the arthroscope in anterolateral portal, a guide wire was passed from anteromedial portal. Over this guide wire an appropriate cannulated drill bit was used to drill upto lateral femoral cortex. Femoral tunnel can be visualized, Beath pin was used topass suture loop of ethibond from Anteromedial portal through femoral tunnel and brought out the skin overlying lateral femoral cortex. Through this tibial tunnel a grasper was used to pull through the suture loop from inside the knee Over this suture loop the graft along with Endobutton CL was pulled through tibial and femoral tunnels. And then the Endobutton CL was flipped over the lateral femoral cortex

Fixation of graft on tibial side using a washer

After passage of the graft by either technique, the end of the graft which were coming out of tibial tunnel were pulled firmly and. The knee was then brought in full 30 degrees of flexion 30and 15 degree of internal roation and appropriate sized Washer was used to fix the graft in the tibial tunnel. The graft is checked in 90 degrees of flexion and full extension to check any impingement. The knee was cycled through full range of motion 10-12 times. Standard instrumentation of Smith and Nephew – USA was used. The wound and portal were closed using 2-0 vicryl and staples, standard antiseptic dressing was done and crepe bandage applied. The tourniquet was deflated after application ofa compression bandage ROM brace in full extension was applied post operatively

Post Operative Rehab Protocol-

0 -2 weeks:

Goals:

- Reduce knee swelling and pain
- Achieve full extension
- 90 degree flexion
- Gait training
- Exercises-Ankle pumps, Static quadriceps strengthening, Heelslides, Static hamstring strengthening, Patella Mobilization, hamstring stretches.

2 – 4 weeks:

Goals:

- Full extension
- 0-120 degree flexion
- Full weight bearing walking
- Exercises:- Continue all the exercises of phase 1, SLR (straight leg raises), Standing Hamstring curls, Hip – flexion, extension, adduction and abduction Calf raises

1 - 2 months:

Goals:

- Full range of movement
- Normal gait
- No pain and swelling
- Exercises-Improved strength Leg press (double leg press) Mini squats (quarter) With light weights and high repetitions

2 – 4 months:

Goals:

- Full range of movement
- Independent ambulation without brace
- Improved strength
- Exercises: Continue strengthening exercises, Step ups, Proprioception training, Open chain exercises

4 – 6 months:

Goals:

- Development of strength and endurance
- Exercises: Static lunges, Single leg squats, Proprioception

6 months onwards:

- Increased strengthening exercises
- Light jogging
- Running up and down stairs
- Cutting and jumping
- Sports training
- Advanced balance exercises

Folllow up

Suture removal was done on 12th day, Patient was followed up 1 month post surgery, 3 months and 6months

RESULTS

Age

Treatment	N	Minimum	Maximum	Mean	Std. Deviation	Median	t value	p
TT	20	18	42	30.65	7.457	29.50	.192	.849
TP	20	21	44	30.20	7.374	28.50		NS
Total	40	18	44	30.43	7.324	29.00		

Duration of Injury (days)

Treatment	N	Minimum	Maximum	Mean	Std. Deviation	Median	Mannwhitney test Z	p
TT	20	24	365	151.45	135.387	120.00	.259	.795
TP	20	21	365	129.65	97.870	120.00		
Total	40	21	365	140.55	117.125	120.00		

		Treatment		Total
		TT	TP	
Sex	F	4	5	9
		20.0%	25.0%	22.5%
	M	16	15	31
		80.0%	75.0%	77.5%
Total		20	20	40
		100.0%	100.0%	100.0%

X2=.143p=.705, NS

		Treatment TT	Treatment TP	Total
Side	L	9 45.0%	9 45.0%	18 45.0%
	R	11 55.0%	11 55.0%	22 55.0%
Total		20 100.0%	20 100.0%	40 100.0%

		Treatment TT	Treatment TP	Total
Meniscal Injury	-	7 35.0%	8 40.0%	15 37.5%
	LM	4 20.0%	6 30.0%	10 25.0%
	MM	9 45.0%	6 30.0%	15 37.5%
Total		20 100.0%	20 100.0%	40 100.0%

X2=1.067p=.587, NS

		Treatment TT	Treatment TP	Total
Objective IKDC	A	9 45.0%	10 50.0%	19 47.5%
	B	11 55.0%	10 50.0%	21 52.5%
Total		20 100.0%	20 100.0%	40 100.0%

X2=.100p=.752, NS

Comparison within the group

Parameter: Lysholm %

		N	Mean	Std. Deviation	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	change (%)	
TT	Pre	20	58.70	16.394	51.03	66.37	57.41	t=8.52, p<0.001, HS
	Post	20	92.40	5.798	89.69	95.11		
TP	Pre	20	61.75	14.610	54.91	68.59	51.42	t=9.45, p<0.001, HS
	Post	20	93.50	4.395	91.44	95.56		

Parameter: Subjective IKDC %

		N	Mean	Std. Deviation	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	change (%)	
TT	Pre	20	64.66	7.882	60.97	68.35	45.00	t=15.73, p<0.001, HS
	Post	20	93.76	3.439	92.15	95.36		
TP	Pre	20	68.18	6.741	65.02	71.33	39.20	t=18.01, p<0.001, HS
	Post	20	94.90	2.847	93.57	96.23		

Comparison between the groups

Parameter		N	Mean change	Std. Deviation	change (%)	
Lysholm %	TT	20	29.095	8.274	57.41	t=0.375, p=0.709, NS
	TP	20	26.725	6.638	51.42	
Subjective IKDC %	TT	20	33.700	17.685	45.00	t=0.999, p=0.324, NS
	TP	20	31.750	15.019	39.20	

Conclusion

After analyzing the results it was concluded that

1. Arthroscopic ACL Reconstruction using transtibial and transportal techniques of femoral tunneling are both effective modalities of treatment in patients with ACL deficient knees
2. The transportal technique gives superior results in terms of knee IKDC, Lysholm and Pain on VAS scores.
3. The transportal technique has a better functional outcome than the transtibial technique.

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