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A comparison of functional outcome between bioabsorbable interference screw and endobutton fixation on femur in arthroscopic anterior cruciate Ligament reconstruction

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Abstract
Introduction: Arthroscopic Anterior Cruciate Ligament [ACL] reconstruction is very commonly done procedure in recent times {1}. The graft fixation methods vary from aperture fixation [Interference screws] to suspensory fixation methods [Endobutton]. This is a Prospective non randomised clinical study of arthroscopic ACL reconstruction comparing the functional results between aperture fixation and suspensory fixation.
Material and methods: Two groups of 10 patients who underwent autogenous hamstring ACL reconstruction with a minimum of 1 year follow up evaluation were included in the study. The aperture fixation group underwent bioabsorbable interference screw fixation at both femoral and tibial tunnels. The suspensory fixation group underwent endobutton fixation on the femoral side and biointerference screw on tibial side. Both group patients were examined prior to surgery and at 3 months, 6 months and 1 year. They were compared for functional outcome with Tegner Lysholm knee score.
Observation and results: There was significant improvement in functional outcome in both the groups for base and at 3 months, also for 3 months and 6 months but for 6 months to 1 year Group 2 is almost significant.
Conclusion: In our prospective study of comparison of functional outcomes between aperture fixation and suspensory fixation on femur in arthroscopic ACL reconstruction which were evaluated by using Tegner Lysholm knee score over a period of 1 year, suspensory fixation was found to be better. However, further long term studies involving large series of cases would throw more light on this information.

Keywords: Bioabsorbable interference screw, endobutton fixation, comparison, arthroscopic anterior

Introduction
Arthroscopic Anterior Cruciate Ligament [ACL] reconstruction is a very commonly done procedure in recent times [1]. The graft fixation methods vary from aperture fixation [Interference screws] to suspensory fixation methods [*Endobutton*] and trans condylar fixation *[Rigid fix*] [2]. ACL graft fixation has been proposed to exert an essential influence on mechanical behaviour of the graft, though the biomechanics of the final construct will be determined by multiple factors [2]. Femoral fixation of the quadrupled hamstring graft is the key element to a durable ACL reconstruction [2]. There are many options available to achieve it [2]. The objective of this study was to compare the functional outcome after bioabsorbable screw and suspensory fixation method on femur and bioabsorbable screw on tibial end in ACL reconstructions done by using hamstring auto graft.

Aim of the study
Functional assessment of ACL reconstruction in two different femoral fixation methods by using interference screw and Endobutton.

Material and methods
This was a prospective nonrandomised study on a continuous series of 20 patients operated on for ACL rupture, using hamstring tendon auto graft by two different technique of femoral fixation methods i. e bioabsorbable screw and Endobutton by the same surgical team, from

January -1- 2014 to January- 1 -2015 at ESIC Medical College and model hospital, Rajajinagar.

Inclusion criteria

1. Diagnosed to have complete ACL tear clinically and radiologically.
2. Age group 15 to 55 years.
3. Examined by single surgeon.
4. Radiological ACL deficient knee confirmed by MRI.
5. Associated Menisci injuries

Fig 1: MRI Image showing tear of ACL

Exclusion Criteria

1. Observed chondral lesions that could modify the post op rehabilitation protocol.
2. Collaterals and /or PCL injuries.
3. Chronic ACL insufficiency with osteoarthritis.
4. Infection
5. Bilateral knee injuries.
6. Associated tibial plateau fractures.
7. Age above 55 yrs.
8. Previously operated knee.

All the patients were assessed clinically and confirmed on MRI. History of instability in the forms of sense of knee giving away, positive lachmann's test and anterior drawer test were criteria based on which the patients were considered for surgery.

All the patients were examined under anaesthesia. A positive Lachmann with soft end point and pivot shift test with glide or clunk were present in all patients. A data sheet containing mechanism of injuries, clinical and radiological examination findings with Tegner Lysholm score was completed.

Initially all the cases underwent diagnostic arthroscopy through standard anterolateral portal and ACL tear was confirmed.

Fig 2: Arthroscopic Picture of Torn ACL

Patients in group 1- First ten patients received bioabsorbable screws both proximally and distally.

Patients in group 2-Second ten received suspensory fixation [Endobutton] proximally and bioabsorbable screw distally.

After getting informed consent from the patients, arthroscopic ACL reconstruction with hamstring tendon grafts which were fixed proximally by bioabsorbable screw or endobutton and distally by bioabsorbable screws were undertaken.

Surgical technique-The hamstring tendon was harvested through a 4cm long incision 3cm distal to joint line and 2 cm medial to tibial tuberosity. Both the semitendinosus and gracilis were harvested and prepared on the graft board with whip stitch by no 2 ethibond and quadrupled. All were two portal technique single bundle ACL reconstruction with quadruple hamstring graft harvested from same side. In first ten patients fixation was achieved by both proximally and distally by bioabsorbable screws. In second ten patients fixation by proximally by endobutton and distally by bioabsorbable Interference screws. The femoral tunnel was made through trans portal. The tibial tunnel was done by an elbow aimer. The femoral side quadruple graft was fixed by bioabsorbable screws in first ten patient and in next ten by endobutton. The tibial side by bioabsorbable screws in all patients.

Fig 3: Picture of graft preparation

Fig 4: Arthroscopic picture of knee showing ACL reconstruction

Post operatively knee immobilised in full extension with long knee brace, quadriceps, foot and knee exercise started on the second day, all patients underwent standardized rehabilitation protocol. Partial weight bearing was allowed for 10 to 14 days and full weight bearing by 2 to 3 weeks with range of motion, half squat. Stair climbing, cycling and jogging were allowed progressively and they were regularly followed up at 3, 6 and at 12th month.

In addition to clinical, anterior drawer test and lachman, radiological evaluations and functional outcomes were assessed by Tegner Lysholm score at, 3months, 6months and 1year follow up. The Tegner Lysholm knee score calculated for 1Limp, 2Support, 3pain, 4instability, 5locking, 6swelling,

7stair climbing and 8 squatting. Each of these sections further divided based on question aries and given score [eg 1 Pain a)none 5 b)slight or periodical 3 c)severe and constant 0].

Results

Of the 20 patients, all were men [95%] except one female [5 %] in the age group of 16 to 53. Mean age in group 1 was 31.7 and in 2nd group was 33.

Right [5] and left knee [5] were involved equally in group 1.

In group 2, [7] 70% were right knee only [3] 30%were left knee.

The mode of injury in majority was Twisting injury during activities 10 [50%] and RTA 8 [40%].

Additional injuries in group -1 Two had medial meniscus tear and two had lateral meniscus. In group 2 Two had medial meniscus tear.

At follow up Group 1 mean Tegner lysholm knee scores at pre, 3, 6 and 12 month follow up were 74.2, 73.7, 93.5 and 92.5 respectively.

Group 2 The mean Tegner lysholm knee score were74, 74, 94 and 98 respectively.

Both the groups were comparable with respect to pre-operative variables.

In each group, there was significant improvements in functional outcomes over successive follow-ups. The comparison of functional outcomes between the two groups statistically same for base and 3month and for 3month and 6 month but for group 2 it is almost significant for 6 months and one year whereas it is not for group 1.

Fig 5: Follow up x ray X ray was taken in all patients at 3 months, six months and one year follow up.

Table 1: Basic data of study patients

Biointe reference screw	Endobutton
10[50%]	10[50%]
31.7	33
[22-42]	[16-53]
1month -3 years	1month-4 years

Number of patients [%]
Mean age of patients
[Range in years]
Time from injury to surgery

The minimum time of injury to index procedure was 1 month were as maximum was 4 years.

Fig 6: At 1 year follow up

Friedman Test and Wilcoxen Signed Rank Test for Post Hoc Analysis considering Bonferroni Adjustment as follows:

Descriptive Statistics

	N	Min.	Max.	Mean	Std. Deviation
AGE	20	16	53	32.35	8.506
Valid N (listwise)	20				

Group = 1
Descriptive Statistics[a]

	N	Min.	Max.	Mean	Std. Deviation
AGE	10	22	42	31.70	6.482
Valid N (listwise)	10				
a. Group = 1					

Group = 2
Descriptive Statistics[a]

	N	Min.	Max.	Mean	Std. Deviation
AGE	10	16	53	33.00	10.477
Valid N (listwise)	10				
a. Group = 2					

Group = 1
Descriptive Statistics[a]

	N	Mean	Std. Deviation	Min.	Max.
TLSCORE_PRE	10	74.20	2.936	69	77
TLSCORE_3M	10	73.70	2.406	68	76
TLSCORE_6M	10	93.50	3.028	90	100
TLSCORE_1YR	10	92.50	2.635	90	95
a. Group = 1					

Friedman Test
Ranks[a]

	Mean Rank
TLSCORE_PRE	1.65
TLSCORE_3M	1.35
TLSCORE_6M	3.50
TLSCORE_1YR	3.50
a. Group = 1	

Test Statistics[a,b]

N	10
Chi-Square	25.021
Df	3
Asymp. Sig.	.000
a. Group = 1	
b. Friedman Test	

Note: p-value=.000 hence there is a statistical difference between the scores of three readings

Group = 2

Descriptive Statistics[a]					
	N	Mean	Std. Deviation	Min.	Max.
TLSCORE_PRE	10	74.20	2.974	69	77
TLSCORE_3M	10	74.40	1.174	73	76
TLSCORE_6M	10	94.00	2.789	90	100
TLSCORE_1YR	10	98.00	2.582	95	100
a. Group = 2					

Friedman Test
Ranks[a]

	Mean Rank
TLSCORE_PRE	1.60
TLSCORE_3M	1.40
TLSCORE_6M	3.10
TLSCORE_1YR	3.90
a. Group = 2	

Test Statistics[a,b]	
N	10
Chi-Square	26.040
Df	3
Asymp. Sig.	.000
a. Group = 2	
b. Friedman Test	

Note: p-value=.000 hence there is a statistical difference between the scores of three readings for group 2 also

Abbreviations
ACL Anterior cruciate ligament
BPTB Bone patellar tendon bone
ACLR Anterior cruciate ligament reconstruction

Discussion
ACL tear is commonly treated arthroscopically by using hamstring autograft or bone patellar tendon bone [BPTB] graft [3, 4]. The use of hamstring graft has become increasingly popular. This is because the ultimate tensile strength of the quadruple graft is as high as 4108 N with a stiffness of 807 N [3]. Donor site morbidities like patellar fracture, patellar tendon rupture, quadriceps weakness and anterior knee pain as seen in patellar BPTB graft are considerably lessened with hamstring graft [5]. Noyes *et al* demonstrated that the stiffness of a semitendinosus graft is nearly equal to that of the ACL, while BPTB grafts are approximately 3.76 times stiffer than the ACL [3]. Thus a four strand hamstring graft appears to be stronger than comparable BPTB grafts and closer to linear stiffness of the anterior cruciate ligament.
There are mainly two types of fixation devices used in ACLR in bone tunnels:
A) Aperture fixation means the fixation of a graft at the opening of the bone tunnel like interference screws [Intrafix] etc, and B) suspensory fixation of the graft that is remote from the intra-articular space. Aperture graft fixation device includes a screw, post, and washer, etc, Whereas suspensory fixation of graft is done using sutures suspended from a femoral fixation device like an Endobutton (Smith & nephew) or Transfix (Arthrex). The main purpose of these devices is to provide a secure fixation so that the graft gets proper healing into the tunnel. This further helps in starting early range of motion exercise and weight-bearing and hence, the early return to sports without any loss of fixation. The choice of fixation of the graft varies from screws to cortical fixation like Endobutton and rigid fix [5]. Several techniques are in use, with success rates of between 65% and 90% [6]. The use of interference screws for graft fixation is considered to provide higher fixation strength as compared with other devices such as staples or buttons [7, 8].The choice of fixation devices for ACLR is mostly surgeon –dependent [9]. Hakimi, *et al*. [9] found that in the UK the hamstring femoral fixation was done with a suspension device in 79% and interference screw in 18%. Of those using a suspension device, the Endobutton was most common (48%), followed by Transfix (26%) and Rigid Fix (19%). Tibial fixation was most commonly achieved by interference screw (57%) followed by intra fix (30%). Kim, *et al*. concluded that the type of graft fixation device did not affect the clinical outcome and stability [10].
The Endobutton is commonly used and is relatively in-expensive. The point of fixation lies some distance from the joint. There is a nylon material present between the graft and button. This technique is prone to drill tunnel enlargement, possibly so called bungee effect [11 12]. Also windshield wiper effect is also associated [11 12].This suspensory fixation has been associated with high failure load and tunnel widening due

to graft-related micro motions in to the bony tunnel and anterior joint laxity [13].

The choice of interference screw material has seen a recent change in the use pattern, from metal screws to biodegradable screws. Ma, *et al* [14]. Found no difference between metal and biodegradable screw usage clinically. Noticeable tunnel widening was seen in both groups, especially on the femoral side.

In our study we have used inter ferrence screw and Endobutton. Both modes of fixation of ACL reconstruction are associated with improved function and satisfaction of patients as indicated by Lysholm score and anterior drawer test after surgery. However by considering the Tegner Lysholm score magnitudes of both the groups we feel the group 2 Endobutton fixation is better clinically as compared group 1 because the score is statistically same for base and at 3 months and for 3 months and 6 months between the groups but for group 2 it is almost significant for 6 months to 1 year where as it is not for group 1 interference screw fixation.

The Limitations of the study are small number of patients (20) and short duration of one year. Besides we have applied the Tegner Lysholm score for evaluation of the patients outcome and did not use other methods of scoring systems

Conclusion

In our study, we prospectively compared the functional outcomes after doing ACL reconstruction by hamstring graft which were fixed by using bio interference screws and suspensory fixation with Endobutton at femur and bioabsorbable screw at tibia. Functional assessment was done on basis of Tegner Lysholm score. The endobutton fixation yielded better outcome in terms of instant stability of the graft and functional outcome at the end of one year. Larger population and longer periods of follow up are recommended. We are currently awaiting longer term results to verify whether or not these early results persist.

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