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Study of Fixation of Auto Graft in Anterior Cruciate Ligament Reconstruction at Femoral End with Suspensory Loop (Suspensory) Fixation V/S Interference Screw (Aperture) Fixation

[1]Shaik Mohamed Abid and [2]B. Mahesh

[1,2]Department of Orthopaedics, Fathima Institute of Medical Sciences, Kadapa, A.P., India

ABSTRACT

This prospective study is to compare the fixation strength between suspensory loop(suspensory) and interference screw(aperture) in arthrosporic ACL Reconstruction using autogenous Hamstring grafts. The present study consists of 70 patients with a history of knee injuries who have admitted in Department of Orthopaedics during the period of two years, with a duration of follow-up 3rd month, 6th month and 12th month postoperatively. In the present study, out of 70 patients, 59 (84.3%) patients were males and 11 (15.7%) were females.16 (45.7%) patients who had RTA and 19 (54.3%) patients had sports injury underwent aperture screw fixation. 18(51.4%) patients had RTA and 17 (48.6%) patients had sports injury underwent suspensory loop fixation. Among the patients who underwent aperture screw fixation, 12 (34.3%) patients had left side of injury and 23 (65.7%) patients had the right side of the injury. Whereas in the suspensory loop fixation, 14(40.0%) patients had left side of injury and 21 (60.0%) patients had the right side of the injury. In the present study, 22(31.4%) patients had a grade-II ACL tear, and 48 (68.6%) patients had a Grade-III ACL tear. In the present study, 1(1.4%) patient had a grade-II lateral meniscal injury, 1(1.4%) patient had a Grade-III lateral mensal injury, 6 (8.6%) patients had a Grade-III medial meniscal injury and 62 (88.6%) patients had no associated injury. Among the patients who underwent aperture screw fixation, 2 (5.7%) patients had a Grade-III medial meniscal injury and 33 (94.3%) patients had no associated injury. Whereas in the suspensory loop, 1(2.9%) patient had a grade-II lateral meniscal injury, 1(2.9%) patient had a Grade-III lateral meniscal injury, 4 (11.4%) patients had a Grade-III medial meniscal injury, and 29 (82.9%) patients had no associated injury. There is a statistically significant difference between the type of threads for KSS_Pain Score at pre-op (P=0.003). There is a statistically significant difference between the cutting thread and smooth thread for KSS_PAIN SCORE at 6 months (P=0.012). There is a statistically significant between the suspensory loop and aperture screw for KSS_Pain SCORE at 12 months (P=0.021). There is a statistically significant between the suspensory loop and aperture screw for KSS_Function Score at 3 months (P=0.0110). There is a statistically no significant difference between the suspensory loop and aperture screw for KSS_Function Score at 6 months (P=0.004). The mean±SD of KSS_Function Score for aperture screw (92.65±5.19) higher than the mean±SD of KSS_Function SCORE for suspensory loop (98.67±6.08) at 12 months. There is a statistically significant between the suspensory loop and aperture screw for KSS_Function Score at 12 months (P=0.347).

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Key Words
Anterior cruciate ligament, suspensory loop, aperture screw

Corresponding Author
B. Mahesh,
Department of Orthopaedics, Fathima Institute of Medical Sciences, Kadapa, A.P., India

Author Designation
[1]Associate Professor
[2]Assistant Professor

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INTRODUCTION

An anterior cruciate ligament (ACL) is the commonest ligament that undergoes tear compared to the posterior cruciate ligament. Majority of patients are athletes due to sports injury. In the initial 6-8 weeks, the graft is subjected to 2,50,000 cycles of load postoperatively. 150-450 N forces acts on reconstruction construct during daily activities and rehabilitation[1,2]. Fixation devices [500N] can fail earlier than graft [2500N-4000N] when subjected to loads. Tunnel widening is more commonly seen at the femoral end compared to tibial end fixation. So, it is very important to select the perfect fixation device for the femoral end[3]. The central ideology to perform is to compare the strength, stability and outcome of autograft [Hamstring] in anterior cruciate ligament reconstruction at the femoral end with Suspensory loop. (Suspensory) fixation v/s Interference screw (Aperture) fixation, postoperatively. In knee anterior cruciate ligament (ACL) reconstructive surgery, there are many ways to fix or stabilize graft tissue., controversies abound regarding fixation technique including the location of fixation and the optimal method for Anterior cruciate ligament graft fixation has not determined. The management of the anterior cruciate ligament tear has developed extensively during the past decades. Intra-articular reconstruction with a biologic graft is currently the procedure of choice to treat a ruptured ACL. Numerous factors influence the clinical success of the ACL reconstruction, including the graft material itself, the graft's fixation, the placement of the graft and the rehabilitation after the reconstruction[4,5]. The classic basic science study evaluating the effect of Anterior cruciate ligament graft fixation site on knee stability by Ishibashi et al. extolled joint-line fixation[6]. The purpose of my study was to compare Anterior cruciate ligament soft tissue allograft reconstruction using suspensory versus aperture fixation. Our hypothesis was that Anterior cruciate ligament soft-tissue graft reconstruction using suspensory fixation would result in equal knee anteroposterior (AP) stability to Anterior cruciate ligament soft-tissue graft aperture fixation at 1-year follow-up.

Aims:

- To compare the fixation of autograft in anterior cruciate ligament reconstruction at the femoral end with Suspensory loop (Suspensory) fixation v/s Interference screw (Aperture) fixation.
- The time period required to return to active work post-surgery.
- Range of movements achieved.
- Stability.
- Associated complications.

MATERIALS AND METHODS

All the patients were examined clinically and radiologically and underwent Anterior cruciate ligament reconstruction surgery in the orthopaedics department.

Inclusion Criteria:

- Age-20-45 yrs. Grade II and III ACL tears.
- ACL injury confirmed radiologically by knee MRI Associated meniscal injury.

Exclusion Criteria:

- Age <19yrs Osteoporotic bone. Osteoarthritis of Knee.
- Infections and joint pathologies. Multi ligaments instability.
- Generalized joint laxities.

Sample Size:

- A minimum of 70 cases was studied (35 Suspensory loop, 35 Interference screw) and 3 clinical assessment were considered, which was done at 3months, 6 months and 1 year postoperatively.
- During each follow up clinical evaluation done.

Methodology:

- Arthroscopic Anterior cruciate ligament reconstruction done.
- The patient was treated postoperatively with iv antibiotics, analgesics, antacids and multivitamins. Proper wound care, along with physiotherapy and rehabilitation, are done.
- Suture removal done on 11th post-op day.
- Patients were evaluated clinically at regular intervals at 3 months and 6 months and 1year respectively to assess the outcome of the study.

Physical Examination: General findings include-clicking, localized tenderness along the medial or lateral joint line or over periphery of meniscus. Locking of knee in fixed flexion, pseudo-locking, which may be related to muscle spasm, Limping.

Diagnostic Tests:

- Mc Murray Test.
- Apleys grinding test.

Magnetic Resonance Imaging: MRI show many of essential characteristics of meniscal tears. Critical to management, such as the location, shape, length and depth. In this way, MRI helps to provide an accurate assessment of stability, the likelihood of tear propagation and a determines whether it can be repaired. It is advantageous to know ahead of time if

a meniscal tear is repairable., the additional equipment, surgical assistants and time needed for repair can be anticipated. Patient also benefit from an earlier knowledge for need for surgery. The sensitivity reported in literature for detecting MM tear varies from 86-96% with specificity of 84-94%. For LM tear, the sensitivity decreases to 68-86% and specificity 92-98%.

Radiographic Studies: Radiographic studies also useful in diagnosis of ACL injuries. Plain radiographs often are normal., however, a tibial eminence fracture indicates an avulsion of the anterior cruciate ligament from its insertion. MRI is the most helpful diagnostic technique. The reported accuracy for detecting tears of ACL ligament has ranged from 70-100%. Because the anterior cruciate ligament crosses the knee joint at slightly oblique angle, the complete ligament rarely is captured in entire by a single MRI scan in the true sagittal plane.

Anterior Cruciate Ligament Reconstruction-Hamstring Auto Graft Operative Technique:

- The patient under spinal or epidural anaesthesia.
- We assess the range of motion, Lachman, Pivot Shift and Anterior drawer test of both operative and non-operative limb.
- On the fracture table Patient in the supine position and tourniquet applied to the operated limb.
- Patient placed closer to the side of the post to produce adequate valgus stress.
- A leg holder established which should provide the knee to flex to at least 120 degrees.

Graft Harvest and Preparation:

- An incision of 3cm made at approximately three finger breaths distal to the joint line and two-finger breaths medial to the tibial tubercle. Then dissect thought subcutaneous tissue until the sartorial fascia identified the pes tendons should be palpable deep to the sartorial fascia.
- A freer elevator or the closed Metzenbaum scissors' tip can be slid back of the sartorius fascia from superior to inferior till the superior border found to protect the Medial collateral ligament which is deep to the sartorial fascia.
- Once the sartorial fascia elevated it can incise longitudinall.

Expose the Gracillis and Semi Tendinosis Tendons:

- The tendons located on the deeper aspect of the sartorial fascia
- Clamp the incised sartorial fascia's superior border and use the scissors to release the superior medial edge in an L shaped fashion to expose the tendons.
- Use a right-angle clamp to bluntly release the tendons from the deep portion of the sartorial fascia.

Harvesting of Tendon:

- Whipstitch each tendon at their ends. The adhesions released until the tendons had good recoil when tension applied.
- The tendon stripper used to harvest the tendons and keep the knee flexed when harvesting to protect the saphenous nerve. Remove the remaining muscle fibres from the tendons with a ruler or large curette.
- Double both tendons over a central or around the device for fixation.

Portals:

- **Anterolateral:** An 11blade used to create the portal at a 45o angle into the joint just lateral to the patella tendon and slightly inferior to the distal pole of the patella and pass the blunt trocar.

Anteromedial:

- Flex the knee in 300 with valgus moment applied.
- Use a spinal needle to assess the direction and appropriate superior/inferior direction visualizing the lateral viewing portal entrance.
- The medial portal should be just superior to the medial meniscus and has to provide access to the anatomic Anterior cruciate ligament footprint on the femur and the medial meniscal root if needed.

Debride the ACL Footprint:

- The ACL remnant removed from the notch, usually with a shaver or a radiofrequency ablation device while noting the femoral and tibial side's anatomic footprint for reconstruction.
- Should leave a small portion of the footprint intact to permit proper identification of the Anterior cruciate ligament origin and insertion.
- If performing an inside-out technique, the knee flexed to at least 120o and a guide pin placed through the medial portal to the medial aspect of the lateral femoral condyle.
- According to the chosen graft fixation technique, the guide pin driven out through the skin at the lateral aspect should be over reamed to a predetermined distance. A separate lateral incision made over the lateral leg and a flip cutting drill-reamer used for tunnel preparation.
- Then pass the suture through the femoral tunnel and clamped for later passing of the graft.

- The tibial tunnel drilled through the initial graft harvest incision and the tibial drill guide is placed through the anteromedial portal while viewing from the anterolateral portal through the scope.
- The guide placed at the ACL tibial footprint in line with the medial tibial spine approximately at the of the anterior horn of the lateral meniscus (posterior aspect).
- The guide's external portion was flush to the anteromedial tibia midway between the medial tibial joint line and the anterior tibial tuberosity.
- Once the tunnel drilled, the suture in the femoral tunnel can be unclamped and the looped end retrieved through the tibial tunnel with the aid of a probe for graft passage.
- The femoral sided graft sutures were placed through the looped end of the passing suture, bringing out the tibia tunnel.
- Apply the tension as the sutures brought through the joint and out the lateral skin.

Secure and Seat the Graft on the Femoral Side:

- The femoral side of the graft pulled into the femoral tunnel.
- Final fixation performed as desired (Suspensory loop or Interference screw).

Secure and Seat the Graft at the Tibial Side:

- The knee can be cycled while pulling the graft through the tibial tunnel. Proper tensioning applied to the graft as the tibial side of the graft also fixed into place.
- After performing arthroscopy of the knee, the pathological lesion was identified and further surgery was carried out accordingly (partial/ subtotal meniscectomy for meniscal tears, ACL, reconstruction for ACL tears).

RESULTS AND DISCUSSIONS

The mean distribution of RTA mode in Aperture fixation and suspensory fixation are 16 and 18 respectively. The mean distribution of sport injuries in Aperture fixation and suspensory fixation are 18 and 17 respectively. The total number of RTA and Sport injury cases are 34 (48.6%) and 36 (51.4%) respectively. mean distribution of left side injuries in Aperture fixation and suspensory fixation are 12 and 14 respectively. The mean distribution of right side injuries in Aperture fixation and suspensory fixation are 23 and 21 respectively. The total number of left side and right side cases are 26(37.1%) and 44 (62.9%) respectively. After applying the t test the difference value came as 1 and chi square test is 0.241 which shows a P-value of 0.6233 that shows that there is no significance among Laterality.

Comparison Between Grade 2 and Grade 3 ACL Tears: The mean distribution of Grade 2 ACL tears in Aperture fixation and suspensory fixation are 7 and 28 respectively. The mean distribution of Grade 3 ACL tears in Aperture fixation and suspensory fixation are 28 and 20 respectively. The total number of GRADE2 ACL tears and Grade 3 ACL tears cases are 22(31.4%) and 48 (68.6%) respectively. After applying the t test the difference value came as 1 and chi square test is 4.182 which shows a P-value of 0.0409 that shows that there is significance.

Associated Injuries: The above table shows the comparison of associated injuries between 4 groups. The mean distribution of grade 2 lateral meniscal injury in Aperture fixation and suspensory fixation are 0 and 1 respectively. The mean distribution of grade3 lateral meniscal injury in Aperture fixation and suspensory fixation are 0 and 1 respectively. The mean distribution of grade 3 medial meniscal injury in Aperture fixation and suspensory fixation are 2 and 4 respectively. The mean distribution of NO associated injuries in Aperture fixation and suspensory fixation are 33 and 29, respectively. After applying the t test, the difference value came as 3 and chi square test is 2.925 which shows a P-value of 0.4034 that shows that there is no significance.

Type of Fixation: The mean distribution of in fixation at femoral end in suspensory was 34.4857 and standard deviation was 5.9576. The mean distribution of fixation at femoral end in Aperture mode was 34.2286 and standard deviation was 6.3156. The above table shows the comparison of Follow UP in relation to Preoperative, 3 months, 6 months, 12 months with reference to IKDC. The mean distribution of preoperative group in aperture mode was 47.2286 with a standard deviation value of 7.4126 followed by followed by 3 months,6 months ,12 months period with a mean distribution values and standard deviation values 61.3143 (5.2175), 82.8857 (7.0493), 93.7429 (3.6165) respectively.

SF 12 Physical Score: The mean distribution of preoperative group in suspensory mode was 36.51 with a standard deviation value of 2.9840 followed by 3 months, 6 months, 12 months period with a mean distribution values and standard deviation values of 2.3714 (3.3085), 52.8857(3.2789), 57.3429 (2.6451). The mean distribution of preoperative group in aperture mode was 36.7714 with a standard deviation value of 2.2763 followed by followed by 3 months,6 months ,12 months period with a mean distribution values and standard deviation values 42.4286 (3.4750), 53.7429 (2.2274), 57.1714 (1.8863) respectively.

Table 1. KSS_Pain and KSS_Function

Variable	Fixation_at_Femoral_end="Suspensory"			Fixation_at_Femoral_end="Aperture"					
	n	Mean	SD	n	Mean	SD	Difference	95% CI	P-value
KSS_PAIN_PRE_OP	35	70.8857	12.5200	35	78.6857	9.0644	7.8000	2.5865-13.0135	0.003
KSS_PAIN_3M	35	74.2000	12.3688	35	74.8286	15.1162	0.6286	-5.9594-7.2165	0.849 Sig.)
KSS_PAIN_6M	35	85.7429	7.6518	35	89.7714	5.3086	4.0286	0.8874-7.1698	0.01
KSS_PAIN_12M	35	91.7714	4.8025	35	94.2000	3.7401	2.4286	0.3754-4.4817	0.021
KSS_FUNC_PRE_OP	35	74.5429	12.1977	35	78.5143	9.0922	3.9714	-1.1601-9.1029	0.127
KSS_FUNC_3M	35	20.0286	5.1876	35	24.4857	8.6547	4.4571	1.0537-7.8606	0.011
KSS_FUNC_6M	35	77.1143	8.2668	35	78.8857	10.1627	1.7714	-2.6473-6.1901	0.426
KSS_FUNC_12M	35	89.9143	5.4523	35	92.6571	5.1902	2.7429	0.2038-5.2819	0.03

The preoperative P-value for KSS PAIN found to be 0.0039, which is significant. The 6 months and 12 months follow up P-value for KSS PAIN found to be 0.0127 and 0.0211, which is significant. The 3 months and 12 months functional follow up P-Value for KSS score found to be 0.0110 and 0.0347 which is significant.

The most common graft choices for Anterior cruciate ligament reconstruction are the quadrupled hamstring tendon graft and bone-patellar tendon-bone graft. The bone-patellar tendon-bone graft is an 8-11 mm-wide graft taken from the central third of the patellar tendon, with its adjacent patella and tibial bone blocks. This graft's attractive features include its high ultimate tensile load (approximately 2300 N), stiffness (approximately 620 N/mm) and the possibility of rigid fixation with its attached bony ends. The common problems in harvesting the patellar tendon graft are post-operative anterior knee pain and patellar fracture. Residual quadriceps weakness have even demonstrated in some studies though it will improve gradually. Because of its low donor site morbidity in recent years, the use of the hamstring tendon graft has increased. Use of a single strand of the gracilis or semitendinosus tendon is inadequate because the gracilis tendon only 49% and the semitendinosus tendon has only 75% which is the strength of the ACL. Now, surgeons are using either a triple-or quadruple -stranded semitendinosus graft or a quadruple stranded gracilis-semitendinosus tendon graft with both ends folded in to half and combined. This quadruple-stranded graft will also provide a multiple-bundle replacement graft that may better approximate the function of the two-bundle anterior cruciate ligament. The meta-analysis supports our primary study finding by Ilahi *et al.,* which also shows no clinical differences between intra-tunnel fixation and extra tunnel fixation of soft-tissue ACL reconstruction grafts, with the difference being that we investigated posterior tibial tendon auto graft whereas they investigated hamstring auto graft. One finding of our study that is not supported by the literature is that we showed no difference in tunnel widening between groups. In contrast, most previous publications showed greater tunnel widening with suspensory fixation. Although we cannot offer an evidence-based explanation for this difference, contemporary anatomic footprint restoration techniques and all-inside reconstruction techniques may be contributory because they are substantially different from other published techniques. Given the complexity of ACL surgery, including fixation, it is also possible that other, unknown confounding variables may have resulted in differences between our results and previous publications regarding tunnel widening. We are aware of only 1 clinical study reporting stability after all-inside ACL reconstruction using an aperture technique. The mean value of male patients in suspensory and aperture fixation mode was 36 and 29 in the current study, 11 and 9 in Lubowitz[7] and 24 in the HARDIK SETH study[8]. The mean follow up of Suspensory and aperture fixation in the current study is One year. The mean follow up of the two groups in a study by lubowitz *et al* is 2.2±0.3 yr and 2.3±0.4 yr. The mean follow up of Suspensory and aperture fixation in a study by hardik seth is one year. In the current study the mean age group among and suspensory group was 34.4857 and aperture group was 34.2286. The mean age group among the study conducted by Lubowitz Et Al in the suspensory and aperture was 40.2±11.9 and 41.6±9.1. The mean age group among the study conducted by hardik seth in the suspensory and aperture was 30.06±8.9 and 30.84±6.8 years.

CONCLUSION

It is concluded that there is a statistically no significant difference of the fixation strength between the suspensory loop and interference screw in arthrosporic ACL reconstruction using autogenous hamstring grafts. And also, we concluded that the fixation strength of the interference screw(aperture) is shown equal functional outcome than suspensory loop(suspensory) in arthrosporic ACL Reconstruction using autogenous Hamstring grafts.

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