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Comparative analysis of anteromedial portal versus transtibial femoral tunnel drilling in arthroscopic anterior cruciate ligament reconstruction

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Abstract

Arthroscopic anterior cruciate ligament reconstruction is standard procedure for ACL deficient knee with episodic or recurrent knee instability. Two described techniques one is transtibial and another one transportal (anteromedial portal) for femoral tunnel formation in Anterior cruciate ligament reconstruction are described. Present study is to identify differences in functional outcome and surgical analysis between both techniques in single bundle anterior cruciate ligament reconstruction with quadrupled semitendinosus and gracilis graft.

Keywords: ACL – anterior cruciate ligament, arthroscopy transportal transtibial tegner-lysholm score, IKDC core

Introduction

Anterior cruciate ligament (ACL) injuries are one of the most common knee injuries. Knee injuries account for approximately 60% of sports injuries. ACL tears account for more than 50% of knee injuries. It has recently plagued numerous sportsmen and sportswomen, contributing to as many as 80% of all sports injuries. Anterior cruciate ligament injury potentially causes further recurrent knee injury, resulting in many not being able to return back to preinjury levels. For individuals not involved in sports, an ACL tear may contribute to premature osteoarthritis. For patients who undergo surgical management of their ACL tear, the risk of early-onset osteoarthritis remains ^[1]. The injury itself is painful and disabling, causing lost time from both sports and work. As ACL tears also result in instability and deficits in neuromuscular control, they potentially result in decrease in balance capabilities. Trend of ACL injuries is on rise, morbidity and disease burden is increasing. Anterior knee instability associated with rupture of the anterior cruciate ligament is a disabling clinical problem, especially in the athletic individual ^[2]. There are many registries in U.S.A, Norway, Denmark and Germany to identify statistics of ACL injuries.

Epidemiology of ACL injury varies from region to region, sports and contact sports are major cause in western countries where as road traffic accidents are still major cause in country like India.

The anterior cruciate ligament has a poor capacity for intrinsic repair. Thus, patients who have knee symptoms related to an anterior cruciate ligament deficiency may consider ligament reconstruction as a means of stabilizing the tibiofemoral joint and restoring high-level function of the knee joint. Numerous authors have described successful reconstruction of the anterior cruciate ligament with use of a myriad of donor autograft (patellar, hamstring, or quadriceps) and allograft (Achilles, patellar, hamstring, or tibialis anterior) tendons ^[3-7] and number of techniques tried successfully. To date more than 400 different techniques have been described for the ACL reconstruction from open to arthroscopic technique.

Earlier open arthrotomy and reconstruction of the Anterior Cruciate Ligament was done. However excessive soft tissue dissection led to complications like increased post-operative pain, infection, knee stiffness and prolonged duration of rehabilitation. In 1954, the development of successful arthroscope brought new possibilities to the field of knee surgery. Advances made in arthroscopy, understanding of anatomy, biomechanics of joint, technical.

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Issue of graft selection, placement, tensioning, fixation, post-operative rehabilitation and early return to full range of motion has led to evolution of arthroscopic techniques. From then Anterior Cruciate Ligament reconstruction often been done arthroscopically [8].

Arthroscopic anterior cruciate ligament reconstruction is to provide a stable knee with adequate range of motion for daily activities. Arthroscopic anterior cruciate ligament reconstruction surgery has evolved as a safe and satisfactory procedure in the treatment of internal derangement of knee joint with complete ACL tear. In a progressively challenging society, the necessity for optimal knee stability following Arthroscopic anterior cruciate ligament reconstruction is becoming increasingly important. Understanding the kinematics regarding knee joint and its stabilizers and Arthroscopic anterior cruciate ligament reconstruction and even minor changes influence knee function is therefore of utmost importance.

Anterior cruciate ligament plays major role in stability, it helps in anterior-posterior and rotational stability of knee joint, more anatomical placement of Arthroscopic anterior cruciate ligament reconstruction gives better results

AIMS and objectives of our study

Primary objective

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

- Knee stability
- Range of movement of affected knee
- Ability to return to previous routine activities

Secondary objective

1. To compare anatomical position of ACL ligament positioning between both techniques.
2. To identify complications, analyse surgical techniques between anteromedial portal femoral drilling technique and transtibial femoral drilling technique.

Methods and Materials

I started my study after ethics committee approval and informed willing consent from every participant in the study

- This is a prospective study and includes operations that were undertaken between June 2017 to June 2018.
- All the surgeries performed in the same institution that is Nizam’s Institute of medical sciences, Punjagutta,

Hyderabad, by the same team of surgeons.

- This is study of 40 patients with ACL tear and treated with arthroscopic ACL reconstructive surgery from a period within 2017 to 2018 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.

Inclusion criteria

- Repeated/episodic knee instability with ACL tear.
- All skeletally mature patients- age (18-50) years.

Exclusion criteria

- Patients with compound and pathological fractures of tibia and femur.
- Patient who are unfit for surgery.
- Geographical constraints who don’t maintain regular follow-up.
- Patients unwilling for surgery / study all skeletally immature patients.

Data Collection

Cases which come to outpatient department with complaint of instability in knee, detailed clinical examination of the patient mainly concentrating on the stability tests of knee are done. those patients who have clinically ACL laxity, were evaluated further with radiograph, MRI knee joint Patients with clinic-radiologically diagnosed with Anterior cruciate ligament injury, counselled regarding status of knee, explaining pros and cons of surgical and conservative management, benefits of ACL reconstruction.

Admitted and posted for arthroscopic ACL reconstruction after proper will full consent for surgery and study patients requiring ACL reconstruction were grouped randomly (randomization is simple randomization -flipping coin technique is used) into two groups 20 cases in each group. Patient of one group are operated in for ACL reconstruction using anteromedial portal for femoral drilling and patients of another group are operated using transtibial portal.

All patients are pre-operatively, intraoperatively and post operatively followed and evaluated with functional scores

Observations and results

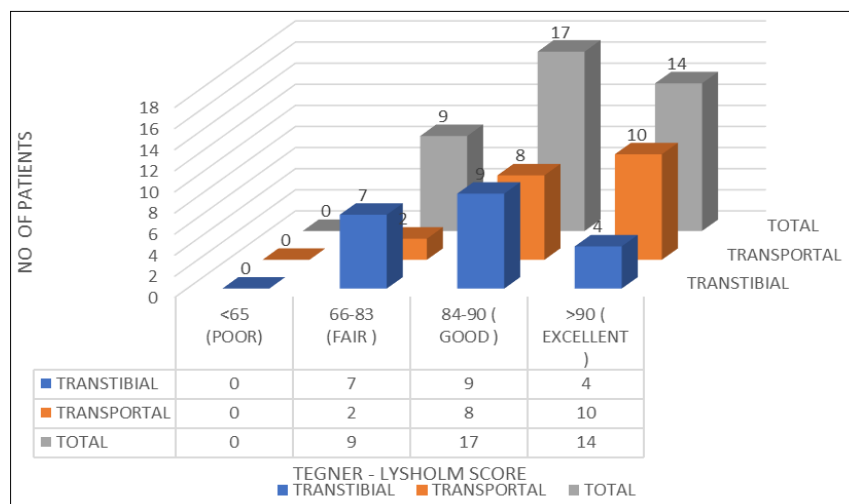


Fig 1: Post-OP Lysholm Score

P value and statistical significance

the two-tailed P value equals 0.0117. Post-operative lysholm

score difference between transportal group and transtibial group is considered to be statistically significant.

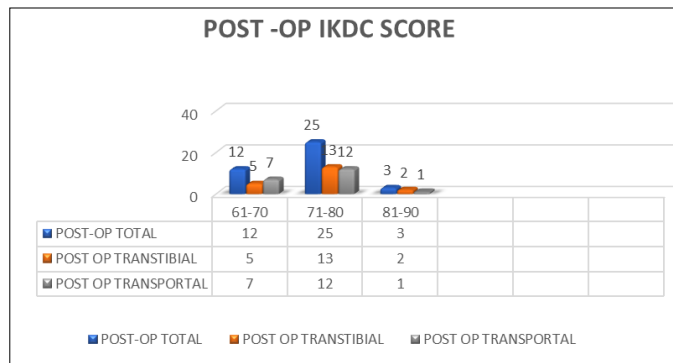


Fig 2

P value and statistical significance

The two-tailed P value equals 0.0238. Post -op IKDC

score between transtibial and transportal group is considered to be statistically significant

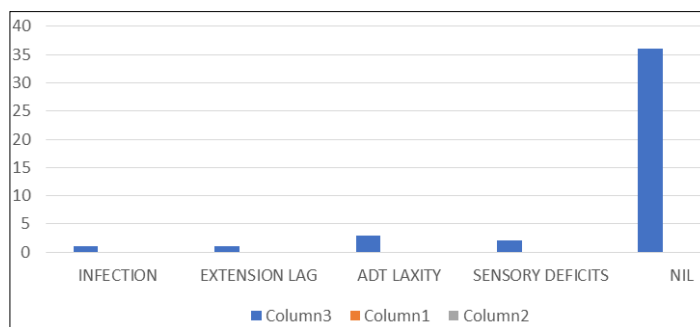


Fig 3: Complications

1 patient (4%) had wound complication, 1 patients had decreased extension Range Of Motion, 2 patients had sensory deficits, 3 patients had ACL laxity with more than grade II

ADT positive found out to be 2 patients from transtibial group and 1 from transportal group, Rest of the patient didn't have major complication during their post-operative period.

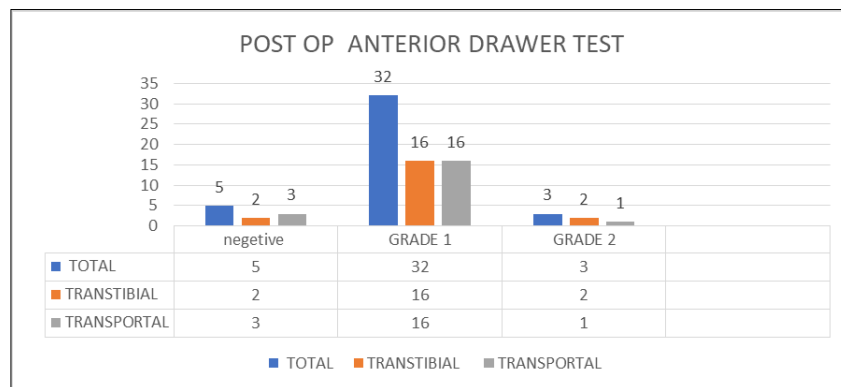


Fig 4: Post-operative anterior drawer test

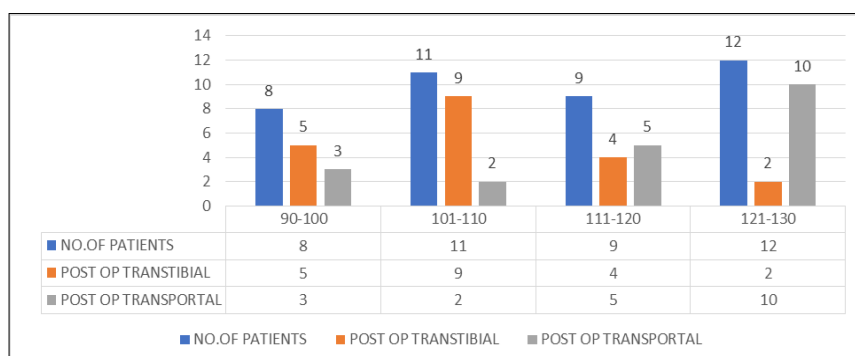


Fig 5: Post op knee range of motion (flexion)

The average knee flexion range in post op transtibial group is 0-110.5 and average flexion range in post op transportal group is 121 degrees, and mean post op knee range is 115.75 degrees

P value and statistical significance

- The two-tailed P value equals 0.0055. The difference in flexion range between transtibial and transportal group is considered to be very statistically significant
- 80% of the patients were able to return to their pre injury activity and all the cases are able to do their routine daily activities alone. 90 % transportal group could return to preinjury level of tegner -lysholm score, 70 % of transtibial could return to preinjury level

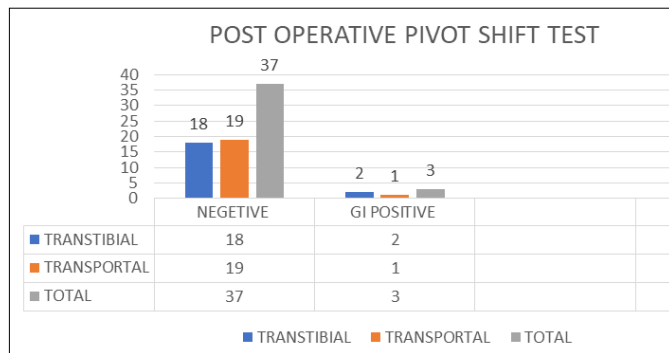


Fig 6: Post-operative pivot shift test

No significant post-operative Pivot shift test difference observed between transtibial and transportal group

Discussion

The study comprised of 40 patients with clinico-radiologically diagnosed anterior cruciate ligament tear operated for anterior cruciate ligament reconstruction with Single Bundle Quadrupled Semitendinosus and Gracilis tendon autograft during the study period of April 2017-march 2018, in Nizams Institute of medical sciences, Hyderabad. Patients randomized into two groups based on femoral tunnel formation methods into transtibial and transportal groups. Rest of tibial tunnel formation, graft preparation, graft fixation are similar in two groups. End button used for femoral fixation and bio absorbable interference screw for tibial fixation.

- In the study of 40 patients, divided into two groups randomly (simple randomization technique used) into transtibial group consisting of 20 patients and transportal as 20 patients.
- Tourniquet time: procedure time is represented here with amount of tourniquet used.

The mean tourniquet duration in transtibial group is 84.6 minutes. The mean tourniquet time in transportal group is 89.95 minutes the average tourniquet time for all cases is 87.275 minutes. The P value equals 0.0048. Tourniquet time between transtibial and transportal group is considered to be very statistically significant. Procedure time and tourniquet time usage is more in transportal.

Surgical procedure

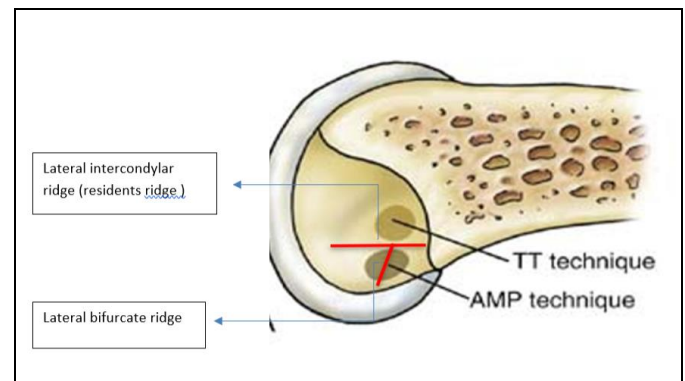
Two randomized groups formed are transtibial and transportal groups based on femoral tunnel drilling technique 20 cases each in transportal and transtibial

Intraoperative surgical analysis between transtibial and transportal groups

In Transportal group, extra portal needed for orthogonal view of medial wall of lateral condyle of femur for positioning of guide wire and checking for posterior wall blow-out.

In transportal group for proper positioning of guide wire over anatomical foot print needed 120 degrees of knee flexion or more.

It was observed that the entry point on medial wall of lateral condyle femur in transportal technique is below lateral intercondylar ridge And central between two bundles or more posterior comprising anatomical area of anteromedial bundle of ACL and tunnel formed is oblique when compared with transtibial technique and entry in transtibial is just above or on lateral intercondylar ridge and femoral tunnel formed is more of vertical. the transportal group has near anatomical reconstruction of ACL when compared to transtibial group Theoretically Transportal group has risk of posterior wall blowout fractures of femoral condyle, but in our study no case is reported with posterior wall blow-out fractures of lateral femoral condyles



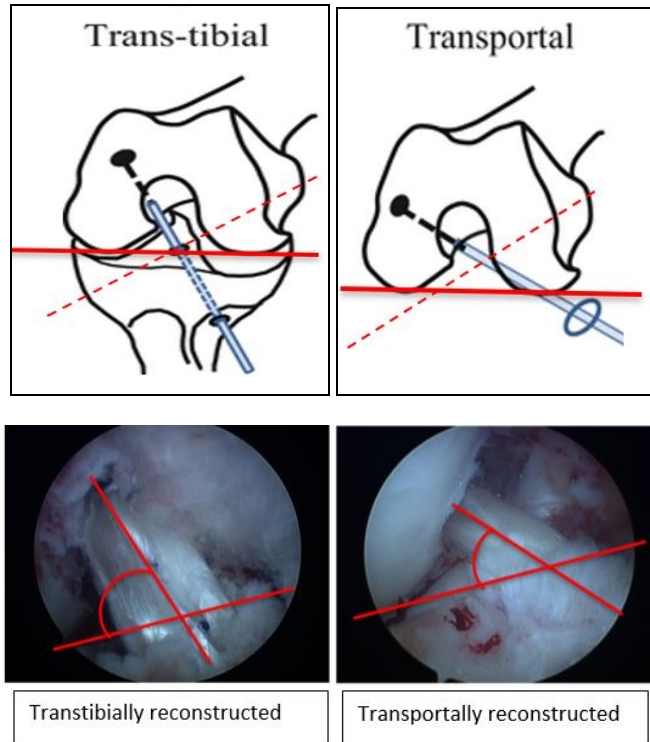
Angle of entry is also different in transtibial group and transportal, the difference of angle seen in sagittal plane and coronal plane, more acute angles formed in transportal, because play for femoral entry is restricted in transtibial by bony tunnel, so anatomically positioned ACL entry could not be established length of femoral tunnel : The average femoral tunnel length in transtibial cases group is 47.7mm average femoral tunnel length in transportal cases group is 42.05 mm, and mean tunnel length is 44.825 mm. Transportal femoral tunnel group has smaller femoral tunnels compared to transtibial group

The average graft length in transtibial is 127.25 mm, and average graft length in transportal is 99.25mm, and mean graft length in all patients is 113.25 mm

Because of more obliquity of tunnel placement in transportal group, significant decrease of femoral tunnel length is seen in transportal group compared to transtibial, as tunnel length decreased total graft length needed decreases, it implies that in transportal technique graft length needed is less compared with transtibial group, hence we can alter arrangement of hamstrings graft and can increase thickness of diameter or only semitendinosus graft can only be used for graft preparation, as this technique decreases the weakness of flexion of knee and decrease incidence of more soft tissue injury. The amount of graft inside femoral tunnel is less in transportal group compared with transtibial group

- In our study, the average graft diameter is 7.825 size, with a minimum of 7mm and maximum of 9mm. the average graft thickness in transtibial cases is 7.5 size and transportal cases is 8.2 size

Mark Clatworthy⁵ in a study on Graft Diameter matters in Hamstring ACL reconstruction concluded that smaller diameter hamstring grafts do have a higher failure rate. Grafts $\leq 7.5\text{mm}$ had twice the failure rate of grafts compared to $\geq 8\text{mm}$. Using a multivariate analysis for every 1mm decrease in graft diameter there is a 45.7% higher chance of failure. It implies that transportal group can achieve optimal thickness of graft compared to transtibial group. But in our study graft diameter is more in transportal comparative to Transtibial group, and not associated with any alteration in graft harvesting and graft preparation techniques



Post-operative evaluation

Functional outcome

The postoperative outcomes between transtibial and transportal groups are compared with subjective scores like Tegner-Lysholm score, IKDC score, clinical tests, post-op knee range of motion, and return to pre injury level of knee function, with minimum of 6 months post op follow-up.

- Pre operatively lysholm scoring of all patients is poor (avg score-40.7).
- Mean post op lysholm score in transtibial group is 84.80 (good) and transportal is 89.7 (excellent)
- Transportal group has better improvement in lysholm score compared with transtibial group with significant $P(0.0117)$ value
- The average pre-operative IKDC score in transtibial group is 38.38 And mean IKDC score in pre op transportal group is 41.215 Post-operative average IKDC score in transtibial group is 71.830, post- op IKDC score in transportal group is 75.86, mean post op IKDC score is 73.695. Mean transportal IKDC score is more compared with Mean transtibial group with significant P value (0.0238)

Ubale^[10] compared Functional Outcome of Transtibial and Transportal Femoral Tunnelling Techniques of Arthroscopic ACL Reconstruction and concluded that transportal technique

offered better functional results post-operatively in terms of Lysholm and IKDC scores.

Apoorva *et al.*^[11] concluded anteromedial portal technique gives superior results in terms of knee IKDC, Lysholm, Tegner's, Pain on VAS and SF-36 scores.

Chen *et al.*^[9] in a metaanalytic study concluded that the Single-bundle hamstring ACL reconstruction using AM technique showed superior surgeon-recorded stability according to the IKDC knee score, Lachman test, and pivot-shift test. However, there was no difference in patient-reported functional outcome (Lysholm score)

- **Post-op clinical tests:** Anterior drawer test with proper rehabilitation protocol.
All attained improvement in knee laxity tested by Anterior drawer test, 37(92.5%) cases attained knee laxity comparable to opposite limb (nil – GI laxity), 3(7.5%) patients had grade ii laxity and, almost similar results of post op laxity tested by ADT is seen in both transtibial and transportal group. 2 cases of GII laxity seen in transtibial group and 1 case in transportal group
- But the patients with laxity were asymptomatic, hence no further intervention was done and the patients were put on physiotherapy and close follow-up
- **Knee range of motion:** The average knee flexion range in post op transtibial group is 0-110.5 and average flexion range in post op transportal group is 0-121 degrees, statistically significant knee flexion range differences is observed between transtibial and transportal groups.
- Apoorva *et al.*^[11] in his study described no significant difference in average range of motion between transportal and transtibial group.
- 80% of the patients were able to return to their pre injury activity and all the cases are able to do their routine daily activities alone. 90 % transportal group could return to preinjury level of tegner -lysholm score, 70 % of transtibial could return to preinjury level.

Conclusion

- We conclude that single bundle Anterior Cruciate Ligament reconstruction with quadrupled semitendinosus graft has good functional results and success rate
- Arthroscopic ACL Reconstruction using transtibial and anteromedial (transportal) portal techniques are both effective modalities of treatment in patients with ACL deficient knees but the anteromedial (transportal) portal technique gives statistically significant outcome in terms of knee IKDC, Lysholm-Tegner's, knee range of motion, return of knee function to pre-injury level.
- Our study conclude that- The transportal group has a better functional outcome than the transtibial group

Limitations

- Our sample group is small group.
- It is a short term study and there is need for long term studies with more number of patients in sample and randomized controlled studies to further establish this. Follow up duration is inadequate to assess long term instability and development of secondary osteoarthritis.
- All clinical tests for stability were performed by clinicians. Objective assessment using an arthromere (KT-1000) was not done.

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