DOI: 10.7860/JCDR/2022/60375.17240

Original Article

Orthopaedics Section

# Tibial Guidewire Insertion Timing- Does it Affect the Functional Outcome in Arthroscopic Anterior Cruciate Ligament Reconstruction? A Prospective Longitudinal Study

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## ABSTRACT

**Introduction:** Tibial fixation site of graft in arthroscopic Anterior Cruciate Ligament (ACL) reconstruction has an effect on anterior displacement and internal rotation of the tibia. The position of the interference screw determines the final orientation of the graft. The screw position in turn depends on the position of the tibial guidewire. The tibial guidewire can be placed, before introducing the graft or after the graft placement. There are no studies in the literature comparing the outcome of tibial guidewire placement timing in arthroscopic ACL reconstruction.

**Aim:** To compare the functional outcome of arthroscopic ACL reconstruction, with placing the tibial guidewire before and after graft passage.

**Materials and Methods:** This prospective longitudinal study was conducted at Government Medical College, Thiruvananthapuram, India, from February 2020 to January 2021, among patients undergoing arthroscopic ACL reconstruction. A total of 84 patients with an isolated ACL tear, who underwent arthroscopic ACL reconstruction were followed-up for a minimum period of nine months. Two groups were studied, each with 42 patients. In group 1, the tibial guidewire was placed posterolaterally in the tibial tunnel and then, the graft was pulled through femoral and tibial tunnels. In group 2, the guidewire was placed after the graft was passed through femoral and tibial tunnels. Functional outcomes were evaluated with International Knee Documentation Committee (IKDC) and Lysholm knee scores after nine months. Statistical analyses were carried out using Statistical Package for Social Sciences (SPSS) statistics version 22.0.

**Results:** The median age of the study subjects were 27 (22;35) years. Fifty nine (70.2%) patients were males. Forty eight (57.1%) patients had left-sided injuries. The majority of injuries (n=58, 69%) were due to sports injuries. In 14 patients (16.7%), the mode of injury was due to road traffic accidents and in 12 patients (14.3%) it was due to a fall. In the majority of the cases (n=50, 59.5%), the duration between injury and ACL reconstruction was three months. The mean IKDC subjective score of group 1 was 86±5.51 and that of group 2 was 81.9±6.64; (p-value=0.003). The mean Lysholm score of group 1 was 84.9±8.73 and that of group 2 was 79.6±9.56; (p-value=0.009).

**Conclusion:** Arthroscopic ACL reconstruction placing the tibial guidewire posterolaterally prior to graft passage has got a better functional outcome compared to placing the guidewire, after passing the graft. Prior placement of guidewire, before graft ensures the posterolateral position of the interference screw at the tibial tunnel and increases the graft obliquity.


**Keywords:** Graft obliquity, Interference screw, Lysholm knee score, Posterolateral guidewire, Tibial tunnel

## INTRODUCTION

The Anterior Cruciate Ligament (ACL) is one of the primary stabilisers of the knee against anterior translation, rotation and valgus stress. The risk of ACL injury is high among sports persons and active young women [1]. The ACL deficiency leads to knee instability, recurrent injuries and intra-articular damage leading to osteoarthritis. Treatment of choice is arthroscopic ACL Reconstruction (ACLR) using autografts (hamstrings, quadriceps, peroneus longus, bone-patella tendon-bone graft), allografts or synthetic grafts. No significant differences were found among these grafts, in terms of clinical objective and subjective results [2]. Hamstring autografts gained popularity, due to low harvest morbidity and excellent biomechanical graft properties [3]. They result in better knee stability and better synovial coverage compared to allografts [4]. Regeneration of the harvested tendon were found in 85% of the cases, with imaging and histologic methodologies [5]. Graft fixation at femoral and tibial tunnels are by using suspensory fixation devices, interference screws or staples. Adjustable and fixed length cortical suspensory fixation device has similar graft healing effect in the femoral bone tunnel [6]. Interference screw tibial fixation has superior biomechanical properties for cyclic testing compared to the suspensory fixation [7]. Anatomic ACLR had better outcomes compared with non anatomic ACLR [8]. Single-bundle reconstruction and anatomic tunnel position with suspension femoral fixation and screw fixation for the tibia is preferred [9].

The ACL graft position and orientation in the joint depends on the position of the tibial and femoral tunnels. ACL fibres form a flat ribbon 2 mm from its femoral insertion [10]. Tibial ACL insertion is C-shaped and its centre is the bony attachment of anterior root of lateral meniscus. Anteromedial bone tunnel with a flat graft and a "C-shaped" tibial footprint is desired in anatomical ACL reconstruction [11]. Center of the ACL tibial footprint is 15 mm anterior to Posterior Cruciate Ligament (PCL) and near to medial spine [12]. Tibial fixation site have an effect on anterior displacement and medial rotation of tibia [13]. During Lachman test, anterior tibial translation is greater with vertical grafts. Tibial tunnel determines ACL graft obliquity and knee stability [14]. Position of the interference screw determines the orientation of the graft. When the screw is positioned in the posterolateral corner, the graft moves anteromedially, producing a more oblique graft mimicking natural ACL.

The guidewire for tibial interference screw is usually placed after graft passage. Alternatively, guidewire can be positioned in the posterolateral corner of tibial tunnel prior to graft passage [15]. However, there are no studies in the literature comparing these two

procedures. The purpose of the present study was to compare the functional outcome of arthroscopic ACL reconstruction with placing the tibial guidewire in the posterolateral aspect of tibial tunnel prior to graft passage, with the conventional technique of passing the guidewire after the graft is pulled through the femoral and tibial tunnels, for fixing interference screw.

## MATERIALS AND METHODS

A prospective longitudinal study was conducted at Government Medical College, Thiruvananthapuram, India, after IEC clearance (HEC.No.01/23/2020/MCT), from February 2020 to January 2021, among patients undergoing arthroscopic ACL reconstruction. The last patient was recruited in April 2020. All consecutive skeletally mature patients with ACL injury, who met the inclusion criteria and presented within the stipulated period of study were included. Written informed consent were obtained from all the participants.

**Inclusion and Exclusion criteria:** Patients above 18 years with isolated complete ACL tear confirmed by Magnetic Resonance Imaging (MRI) were included in the study. Patients with associated bony injury around knee, meniscal injuries, posterior cruciate ligament injury and with bilateral knee injuries were excluded from the study.

All the surgeries were done by the same surgical team. Arthroscopic single bundle anatomical ACL reconstruction were done with hamstring tendon autografts in all cases. Total 84 patients were enrolled for the study. All patients were allotted to two groups using alternate odd and even numbers:

- **Group 1** (n=42): Patients underwent arthroscopic ACL reconstruction with placing a guidewire in the posterolateral aspect of tibial tunnel prior to graft passage.
- **Group 2** (n=42): In all patients, the guidewire was placed in tibial tunnel only after graft passage.

The clinical data collected and examined, as per the guidelines given in the International Knee Documentation Committee (IKDC) subjective knee evaluation form [16] and Lysholm knee scoring scale [17].

**International knee documentation committee score:** The IKDC subjective form consists of 18 questions related to symptoms, sports activity and knee function. Individual items are summed and transformed to a scale 0 to 100 [16].

- Normal score is 91-100,
- Near normal 81-90,
- Abnormal 71- 80 and
- Severely abnormal 70 or less

**Lysholm knee scoring scale:** The Lysholm knee scoring scale is a patient reported instrument that consists of subscales for pain, instability, locking, swelling, limp, stair climbing, squatting and the need for support [17].

- Score 91-100 -excellent;
- Score 84-90 -good;
- Score 65-83 -fair and
- Score 64 or less -unsatisfactory

### Surgical Technique

All surgeries were done under spinal anaesthesia. Standard anterolateral and anteromedial portals were used. After diagnostic arthroscopy, femoral tunnel was made using transportal technique at the centre of femoral footprint. A loop of Ethibond (Ethicon, India) was passed through it. Tibial tunnel was created using a tibial ACL jig at an angle of 55°. Ethibond was pulled through the tibial tunnel. After this, in group 1, patients the guidewire for the interference screw was passed in the tibial tunnel and held it in the posterolateral part of tibial tunnel using artery forceps [Table/Fig-1]. Graft was then pulled through tibial and femoral tunnels with guidewire in-situ [Table/Fig-2,3].

Fixation of graft at femoral attachment was with adjustable loop suspensory fixation. After flipping of the button at the femoral end, the guide wire was pulled distally, so that only a minimum portion of it remains inside the joint. This prevents the possibility of breakage of guidewire during cycling. The knee was cycled 20 times to remove the graft creep. After cycling, the position of the guidewire was again confirmed. With the knee in 20° flexion and applying a posterior drawer, interference screw was passed over tibial guidewire, maintaining constant tension on the graft.

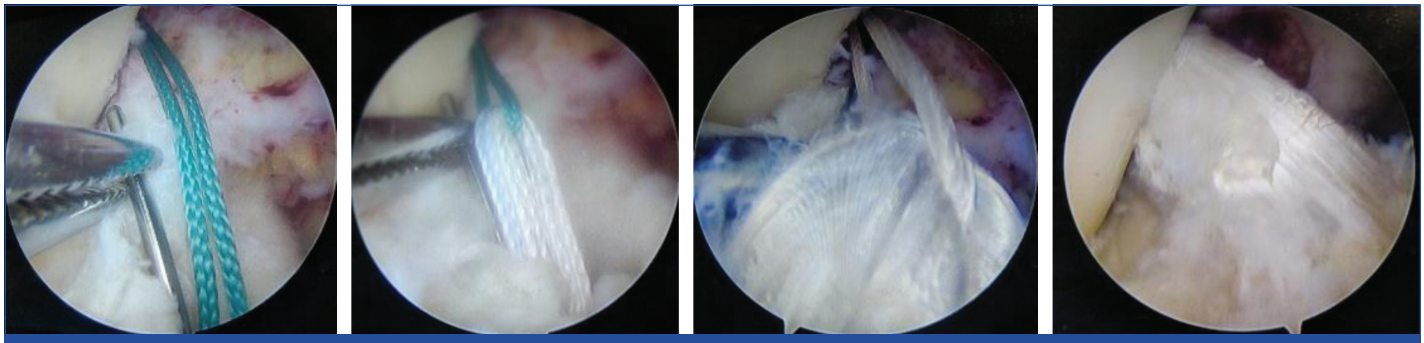
In group 2 patients, the graft was pulled through tibial and femoral tunnels [Table/Fig-4] and fixed at femoral end with adjustable loop suspensory fixation. The knee was cycled 20 times. The tibial guidewire was passed between the graft and posterior part of tibial tunnel [Table/Fig-5]. With the knee in 20° flexion and applying a posterior drawer, interference screw passed over tibial guide wire, maintaining constant tension on the graft. Parenteral antibiotics was given for three days. Partial weight bearing with brace, quadriceps strengthening exercises and knee flexion started in the first week. Physiotherapy continued to attain full knee flexion and weight bearing, without brace by six weeks after surgery. Regular follow-up of all patients were done at Outpatient Department. An independent observer assessed the functional outcome by IKDC score and Lysholm score at nine months. The results were compared among the two groups.

## STATISTICAL ANALYSIS

Statistical analyses was carried out using Statistical Package for Social Sciences (SPSS) statistics version 22.0 (IBM Corp; Chicago, United States of America). Continuous variables were presented as mean±standard deviation or median±interquartile range. The Chi-square test was used to analyse categorical variables. Independent t-test was used for normally distributed continuous variables. The Mann-Whitney U test was used for comparing non normally distributed data. A p-value <0.05 was considered statistically significant.

## RESULTS

In the present study, the median age of the study subjects were 27 (22;35) years [Table/Fig-6]. Fifty nine (70.2%) patients were males. Forty eight (57.1%) patients had left-sided injury and rest had right-sided. Majority of injuries, n=58 (69%) were due to sports



**[Table/Fig-1]:** Ethibond with tibial guidewire posterolaterally. **[Table/Fig-2]:** Graft pulled with guidewire in-situ. **[Table/Fig-3]:** Graft pulled through tibial tunnel with guidewire in-situ. **[Table/Fig-4]:** Graft passed without guidewire. (Images from left to right)

**[Table/Fig-5]:** Guidewire placement after graft.

injuries [Table/Fig-7]. In majority of the cases n=50 (59.5%), the duration between injury and ACL reconstruction was three months [Table/Fig-8]. The baseline features were comparable [Table/Fig-9]. The IKDC subjective score at nine months ranged from 68.9 to 98.8. Functional outcome of total patients according to IKDC score was found to be normal for 14 (16.7%) and near normal for 50 (59.5%) patients [Table/Fig-10].

| Age (years) | n (%) | Male n (%) | Female n (%) |
|---|---|---|---|
| 18-20 | 16 (19.1%) | 11 (13.1%) | 5 (6.0%) |
| 21-30 | 38 (45.2%) | 27 (32.1%) | 11 (13.1%) |
| 31-40 | 30 (35.7%) | 21(25.0%) | 9 (10.7%) |
| Total | 84 (100%) | 59 (70.2%) | 25 (29.8%) |

**[Table/Fig-6]:** Age and gender distribution.

| Mode of injury | Frequency (n) | Percentage (%) |
|---|---|---|
| Road traffic accident | 14 | 16.7 |
| Sports injury | 58 | 69 |
| Fall | 12 | 14.3 |
| Total | 84 | 100 |

**[Table/Fig-7]:** Mode of injury.

| Duration (in months) | Frequency (n) | Percentage (%) |
|---|---|---|
| 1 | 6 | 7.1 |
| 2 | 15 | 17.9 |
| 3 | 50 | 59.5 |
| 4 | 9 | 10.7 |
| 5 | 3 | 3.6 |
| 6 | 1 | 1.2 |
| Total | 84 | 100 |

**[Table/Fig-8]:** Duration between injury and procedure.

| Variables | Total (N=84) | Group 1 (n=42) | Group 2 (n=42) | p-value |
|---|---|---|---|---|
| **Age** (years) (median; IQR) | 27.0 (22.0;35.0) | 26.5 (21.0;34.5) | 27.5 (25.0;34.8) | 0.335# |
| **Gender (n)** | | | | |
| Female | 25 (29.8%) | 10 (23.8%) | 15 (35.7%) | 0.340* |
| Male | 59 (70.2%) | 32 (76.2%) | 27 (64.3%) | |
| **Mode of injury (n)** | | | | |
| Road traffic accident | 14 (16.7%) | 5 (11.9%) | 9 (21.4%) | 0.167* |
| Sports injury | 58 (69.0%) | 33 (78.6%) | 25 (59.5%) | |
| Fall | 12 (14.3%) | 4 (9.52%) | 8 (19.0%) | |
| **Duration between injury and procedure** (months) (median;IQR) | 3.00 (2.75;3.00) | 3.00 (3.00;3.00) | 3.00 (2.00;3.00) | 0.460# |

**[Table/Fig-9]:** Baseline variables.
p-value calculated by #Mann-Whitney U test, *Chi-square test

| IKDC score | Group 1 | | Group 2 | | Total | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Normal (91-100) | 9 | 21.4 | 5 | 11.9 | 14 | 16.7 |
| Near normal (81-90) | 30 | 71.4 | 20 | 47.6 | 50 | 59.5 |
| Abnormal (71-80) | 2 | 4.8 | 16 | 38.1 | 18 | 21.4 |
| Severely abnormal (≤70) | 1 | 2.4 | 1 | 2.4 | 2 | 2.4 |
| Total | 42 | 100 | 42 | 100 | 84 | 100 |

**[Table/Fig-10]:** International Knee Documentation Committee (IKDC) score among study groups.

The mean IKDC subjective score of group 1 was 86±5.51 and that of group 2 was 81.9±6.64 (p-value=0.003). Lysholm score at nine months ranged from 60-98. Of the total patients, 41 (48.8%) had good functional outcome and 30 (35.7%) had fair outcome. The mean Lysholm score of group 1 was 84.9±8.73 and that of group 2 was 79.6±9.56; the difference was statistically significant (p-value=0.009) [Table/Fig-11,12]. There were no cases of haemarthrosis or infection requiring aspiration or joint lavage. There were no cases of arthrofibrosis or graft rupture.

| Lysholm score | Group 1 | | Group 2 | | Total | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Excellent (95-100) | 4 | 9.5 | 3 | 7.1 | 7 | 8.3 |
| Good (84-94) | 27 | 64.3 | 14 | 33.3 | 41 | 48.8 |
| Fair (65-83) | 9 | 21.4 | 21 | 50 | 30 | 35.7 |
| Poor (≤64) | 2 | 4.8 | 4 | 9.5 | 6 | 7.2 |
| Total | 42 | 100 | 42 | 100 | 84 | 100 |

**[Table/Fig-11]:** Lysholm score among study groups.

| Parameters | Total | Group 1 | Group 2 | p-value (t-test) |
|---|---|---|---|---|
| IKDC score | 83.9±6.40 | 86.0±5.51 | 81.9±6.64 | 0.003 |
| Lysholm score | 82.2±9.48 | 84.9±8.73 | 79.6±9.56 | 0.009 |

**[Table/Fig-12]:** Mean IKDC and Lysholm scores of study groups.

## DISCUSSION

Majority of ACL injuries in this study were due to sports injuries (n=58, 69%) and it can be substantiated by the fact that majority of the patients were males n=59, (70.2%) and the average age of patients was 27 years. Taketomi S et al., in a retrospective study involving 226 patients, recommended that ACL reconstruction should be done within six months of injury to prevent chondral or meniscal damages [18]. Rushdi I et al., in their study reported that arthrofibrosis was a potential complication of acute ACL reconstruction, especially if, done within three weeks of injury [19]. The duration between injury and procedure in majority of cases (59.5%) in this study was three months.

The present study showed that IKDC subjective score and Lysholm score at nine months were high when the guidewire was passed posterolaterally prior to graft placement in the tibial tunnel. The position of guidewire determines the position of interference screw. Bedi A, et al., in a cadaveric study to evaluate the effect of tibial tunnel position on knee kinematics, postulated that better control of the Lachman and the pivot shift is seen when ACL graft is placed in the anterior aspect of tibial footprint [20]. Udagawa K et al., in their study on factors influencing graft impingement, reported that since the tibial tunnels were created with knee in 90° flexion and it moves laterally as knee extends, due to the screw-home movement, the tibial tunnel should be medial within the ACL tibial footprint to decrease the risk of wall impingement [21].

Chernchujit B et al., in their study of 61 patients comparing anterior and posterior screw placements in the tibial tunnel concluded that, the sagittal plane graft obliquity was increased in patients with posterolateral position of the interference screw in the tibial tunnel. This also pushes the graft anteriorly and near to the anterior tibial margin. This orientation mimics the normal ACL [22].

Tibial guidewire placement after graft passage through femoral and tibial tunnels may be difficult, due to snuggly fitting graft in tibial tunnel [15]. Sometimes, it may get misplaced, anterior or medial to graft. It may pass through the fibres of graft causing subsequent intrasubstance damage of the graft during screw insertion [15]. Graft displacement in the tibial tunnel while fixing interference screw affects the orientation of the graft. When the screw is in the posterolateral corner, the graft moves anteromedially producing a more oblique graft, mimicking native ACL [14,22]. When the screw is placed anteromedially, the graft moves posterolaterally in the tibial tunnel, making it more vertical leading to greater anterior tibial translation. If the screw is placed medially, it pushes the graft laterally, causing impingement with lateral femoral condyle [15]. Posterolateral position of the interference screw in the tibial tunnel has got a better functional outcome [15,22].

### Limitation(s)

Small sample size and relatively short follow-up period. A follow-up period of nine months was a short period to comment on late complications like early osteoarthritis.

## CONCLUSION(S)

Arthroscopic ACL reconstruction placing the tibial guidewire posterolaterally prior to graft passage has got a better functional outcome, compared to placing the guidewire after passing the graft through femoral and tibial tunnels. Prior placement of guidewire before graft ensures posterolateral position of interference screw at tibial tunnel and increases the graft obliquity.

### Acknowledgement

Authors would like to thank Dr. I Yadev for his contributions in statistical analysis.

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**PLAGIARISM CHECKING METHODS:** [Jain H et al.]
- Plagiarism X-checker: Nov 04, 2022
- Manual Googling: Nov 16, 2022
- iThenticate Software: Nov 22, 2022 (7%)

**ETYMOLOGY:** Author Origin

**AUTHOR DECLARATION:**
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Sep 23, 2022**
Date of Peer Review: **Oct 15, 2022**
Date of Acceptance: **Nov 26, 2022**
Date of Publishing: **Dec 01, 2022**