

Functional and radiological assessment of reconstructed anterior cruciate ligament with respect to graft stretch

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Abstract

Purpose of the study was to assess the functional level of reconstructed anterior cruciate ligament clinically and radiological assessment of graft stretch by using stress radiography. To compare laxity values of operated and normal knee as measured using the stress radiography. To determine the effectiveness of ACL reconstruction surgery with respect to graft stretch. To assess the functional and radiological outcome of ACL reconstruction surgery.

Patients who had undergone ACL reconstruction surgery within a minimum of 9 months duration post-surgery were clinically, then radiologically and functionally by Lysholm and Tegner questionnaire. The study period spanned from October 2017 to June 2019 with a sample size of 100 patients.

Clinically about 22 patients had antero-postero translation 5-10mm and 30 patients had instability symptoms. All the patients with suspected graft stretch with stress x-ray having 5-10mm antero posterior translation had complaints of instability. Hence would like to conclude that graft stretch plays a vital role in the long term longevity of reconstruction.

Keywords: Post op ACL graft stretch, stress x-rays

Introduction

The reconstructed graft undergoes various phases of healing, resembling native ligament by the end of 9 months^[1-5]. Despite advances in surgical techniques and the ability to implant an anatomic, isometric graft, ACL reconstruction is not a universally successful procedure. Rates of recurrent laxity 1 year postoperatively have been reported to be as high as 17%^[6]. In the present Indian scenario, post operatively, patients are compliant with early follow up but the follow up after initial rehabilitation is very difficult in an Indian set up.

Aims and Objectives

To assess the functional level of reconstructed anterior cruciate ligament clinically and

radiological assessment of graft stretch by using stress radiography.

To compare laxity values of operated and normal knee as measured using the stress radiography.

To determine the effectiveness of ACL reconstruction surgery with respect to graft stretch.

To assess the functional and radiological outcome of ACL reconstruction surgery.

Materials and Methods

Patients who have undergone ACL reconstruction surgery from Akash institute of medical sciences and research institute, Shri Atal Bihari Vajpayee Medical College and Research Institute and Sapthagiri Medical College and Hospital within a minimum of 9 months duration post-surgery were called by means of telephone or email, after ruling out exclusion criteria. They were explained about the study over the phone and informed consent was taken over the phone. Once the patient visited the OPD, a written consent was taken and the patient was assessed clinically, then radiologically with lateral stress view x-ray for both knees and functionally by Lysholm and Tegner questionnaire. The study period spanned from October 2017 to June 2019 with a sample size of 100 patients.

Inclusion criteria

1. A minimum 9-month-old post-op arthroscopic ACL reconstructed patients.
2. Patient between the age group of 18 to 45 years.

Exclusion criteria

1. Bilateral ACL injury.
2. Multi-ligament knee injury.
3. Repeat injury to the same knee or contralateral knee.
4. Associated lower limb fractures.

Lateral stress x-rays: The patient is made to lie in a supine position with the knee flexed to 60-90° with the cassette placed parallel to the knee and the rays passing perpendicular to the cassette. The patient is encouraged to relax the hamstring muscles fully so as to minimize hamstring dynamic resistance to anterior tibial translation. When the patient is sufficiently relaxed, the examiner grasps the proximal tibia with both hands while placing both thumbs along the anterior joint line, rest of fingers of both hands over the calf and exerts an anteriorly directed force. Two radiographs are obtained one without traction and other with anteriorly directed manual traction. The x-rays are analyzed later. The ACL length is measured by the distance from the roof of the intercondylar notch/blumensaat line where the endobutton/screw is placed to the midpoint of the tibial plateau (calculated by dividing the entire length of tibial plateau divided into half)^[7].

Result and discussion

It is clear from the literature that primary reconstruction of the torn ACL with BPTB graft or hamstring graft is the treatment of choice and is the most widely practiced treatment across the globe.

According to Rupp *et al.*, the evolution of knee stability over time is a concern, especially as animal experiments have described degenerative changes and a lack of ligamentization process after posterior cruciate ligament replacement using a BPTB graft^[8,9]. Due to these changes in micro morphology, a secondary stretch-out of the graft may occur. There are few clinical studies presenting data in favour of such a theory.

Rupp *et al.* have assessed the post-operative ACL reconstruction from BPTB graft at 6

months; 3-6 years (4.3 years mean) Clinical results were evaluated by means of the Lysholm score and the IKDC score. Laxity was assessed using a KT-1000 arthrometer applying an 89 N anterior load in 20° of flexion. Increased laxity was defined as a >5 mm increase in AP translation between the first and the second follow-up. At mid-term follow-up pivot shift was negative in 86% of cases. IKDC score: normal=28%, nearly normal=44%, abnormal=24%, severely abnormal=4%. KT-1000: <3 mm=68%, 3-5 mm=24%, >5 mm=8%. The mean KT-1000 side-to-side difference was 1.08 (0.17) mm at 6 months and 2.01 (0.29) mm at 3-6 years. The difference was statistically significant ($P<0.005$). According to the defined criteria, seven patients had increased laxity at the second follow-up, suggesting a malfunction of the graft due to stretch-out or injury. In this subgroup the mean KT-1000 measurements were 0.86 (0.26) mm at the first follow-up and 5.93 (0.54) mm at the second follow-up. In ten of these patients, a malposition of the tunnels was identified as a possible cause.

In our study we followed up 88 patients retrospectively at a mean interval of 2.7 years (operated from 2013-March to 2017-December) with a minimum period of 9 months post-surgery as the criteria for assessment of graft stretch.

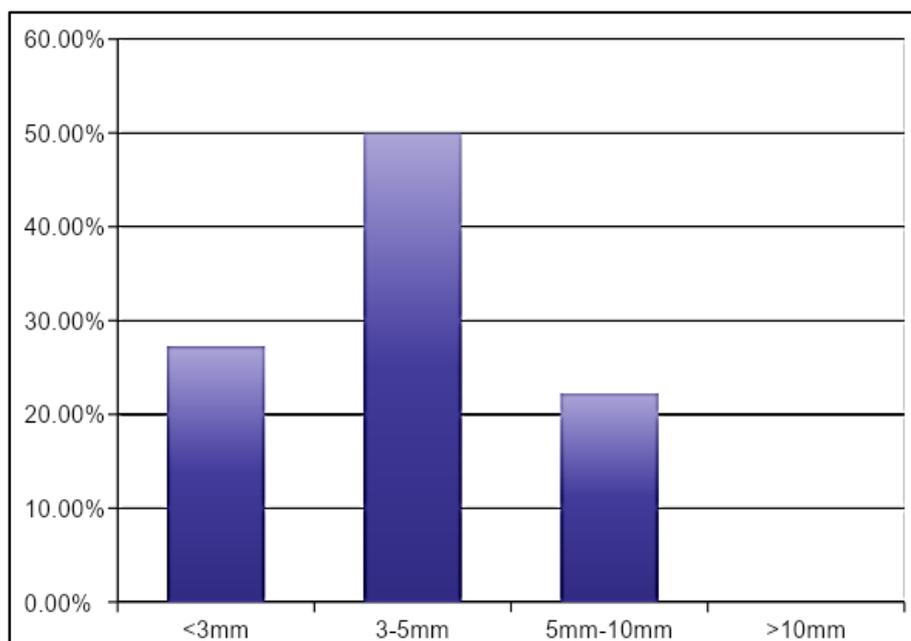
We compared the operated knee with the unoperated knee with stress x-rays, clinical examination. Graft stretch was considered when the patient had symptoms of instability, Lachman grade II with soft end point and stress x-rays with anteroposterior transition of 5-10mm, >10mm and side to side difference of >3mm.

Rupp *et al.* followed up patients at 6 months, 3-6 years. Laxity was considered when increase in antero posterior transition of >5mm at second follow up as measured by robotic assisted device and KT-1000 arthrometer. But however Daniel *et al.*^[10] showed that average absolute knee laxity increases from 5.8 mm in normal knees to 13.0 mm in ACL-deficient knees using the KT-1000. Subsequent studies have yielded similar results.

In our study we found that patients with instability complaints of the operated knee were 30 out of 88 accounting for 34.1% and lachman grade II were 22 (soft end point only 4 out of 22) accounting 25% clinically, patients with radiologically measured antero posterior transition of < 3mm were 24(27.27%), 3-5mm were 44(50%), 5mm-10mm are 20(22.72%), >10mm were 0% these values correlated with the results of the study done by Rupp *et al.* from our study we also found that the laxity tested clinically is in correlation with the radiologically measured values, but however the patient complaints are not in correlation with clinical findings, mainly due to the terminology understanding difficulties of the patient.

Radiological assessment of anteroposterior laxity in operated knee by stress x-ray

Anteroposterior laxity	Number	Percent
<3 mm	24	27.27%
3-5 mm	44	50%
5-10mm	20	22.72%
>10mm	0	0



88 cases were included in our study. 32 patients were between 20-24yrs, the average age at the time of surgery was 28.55yrs. Predominantly male patients when compared to females, males were 80 patients (90.9%) female were 8 numbers (9.1%). This correlates with the Rupp *et al.* study, in which 51 patients (17 female (33.3%), 34(66.7%) male) the average age at the time of surgery was 27.6 years. Implying the fact that the young male subjects are predominant and requiring repair.

In our study we also found that the right knee is more subjected to injury than the left, as 50 were diagnosed as right ACL tear (56.8%), 38 cases were diagnosed as left ACL tear (43.2%). Researchers from Washington University School of Medicine in St. Louis and the Santa Monica Orthopedic and Sports Medicine Research Foundation looked at ACL injuries in dominant versus supporting legs among 93 athletes, 41 male and 52 female^[11]. The participants were a mix of professional, college, high school and youth soccer players who had undergone surgery for a complete ACL tear. Injuries on the dominant leg occurred in 74% of males, but only 32.3% of females. Female athletes are more prone to sustaining ACL injuries on their supporting leg.

The mean Lysholm score was 92.06 among our patients. This correlates with the scores of study by Rupp *et al.*

The mean Tegner activity levels were level 7 in 36.36%, level 6 in 31.2% (together accounting for 67.8%), post-surgery 43.18% of the patients remained at level 6 and 31.2% at level 4. The reason for not getting back to the pre injury level was mainly fear of reinjury.

Tegner Activity Score	Pre-Injury	Post-Injury
LEVEL 1	4	4
LEVEL 2	0	0
LEVEL 3	0	6
LEVEL 4	2	28
LEVEL 5	4	12
LEVEL 6	28	38
LEVEL 7	32	0
LEVEL 8	8	0
LEVEL 9	2	0
LEVEL 10	8	0
Chi-Square Test, P Value <0.001, Significant		

In our observation while conducting the study, we noticed that most of the patients with laxity

symptoms had hamstring weakness compared to the sound knee, hence the need for focused hamstring strengthening exercises is required.

Conclusion

We evaluated a total of 88 patients who had undergone ACL reconstruction with ipsilateral hamstring graft, followed up after a minimum period of 9 months with stress x-rays. We observed that clinically about 22 patients had antero-postero translation 5-10mm and 30 patients had instability symptoms. All the patients with suspected graft stretch with stress x-ray having 5-10mm antero posterior translation had complaints of instability. Hence would like to conclude that graft stretch plays a vital role in the long term longevity of reconstruction. The exact etiology for the instability wasn't evaluated. However in literature multiple etiologies are correlated for reconstructed graft stretch like anterior positioning of femoral tunnel, loss of muscle bulk, decrease in muscle strength, loosening of tibial interface screw, and thin size of the graft.

Key points in conclusion

1. Clinically about 25% of subjects had graft stretch and are significant.
2. More awareness has to be created among the operated subjects regarding the need for regular rehabilitation physiotherapy.
3. Need for more encouragement for participation into pre injury activities post-surgery.

Most of the subjects were not professional athletes, rather they were recreational players and hence TEGNER activity alone cannot be considered for rating the functionality of patients and judging the success rate of reconstructed ACL.

Conflict of interest: On behalf of all authors, the corresponding author states that there is no conflict of interest.

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