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Study of objective radiographic assessment of tibial anterior translation after anterior cruciate ligament reconstruction surgery

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Abstract

The clinical guidance regarding advice to patient about return to activity after anterior cruciate ligament reconstruction (ACLR) surgery, is a complex one and related literature is not clear on this subject. In general, single leg hop test is included in this process. We evaluated a simple objective stress radiographic technique to measure anterior tibial translation and compared the results with that of single leg hop tests in a male population of 24 patients that underwent ACLR at a tertiary care orthopaedic hospital. Tests were recorded after 9th month of post-operative period. Patients were again evaluated at 12th month of post-operative period to record patient reported outcome. Results show average anterior translation of 2.3mm with range 1-4 mm and average hop index of 0.91 ranging from 0.85-0.95. 15 out of 24 patients recorded satisfactory outcome in both the test results. IKDC subjective evaluation scores at 12th month of post-period were satisfactory with average score 72.

In conclusion, this objective radiographic measurement technique can be routinely used as a part of decision-making regarding advice of return to activity after ACLR along with single leg hop test and patient reported outcome tools.

Keywords: Return to activity, anterior tibial translation, single leg hop test

Introduction

Anterior cruciate ligament reconstruction surgery is done to address, excessive anterior tibial translation and rotatory instability in knee joint resulting from the ligament deficiency. The proper clinical advice regarding return to previous work or activity is a complex but the most important final decision after ACLR that dictates final outcome of the surgery. The guidance regarding this important issue is sparse in literature ^[1]. Amount of anterior tibial translation, as judged from Lachman test, is commonly taken as a clinical measure of ACL deficiency. But, this clinical measurement, gives a subjective estimate at the best. The actual amount of translation can predict of long-term outcome after ACLR and may help in making decisions regarding postoperative rehabilitation protocol and return to normal activity. Hence, the need for an objective and practical measurement tool of anterior tibial translation that also can serve purpose of documentary proof of ACL sufficiency. Single leg hop test ^[2] is one of the widely used tool in making decisions regarding return to previous level of activity along with other scores such as Tegner's score, IKDC and Lysholm score etc. We used a simple, cost-effective objective radiographic measurement method to document tibial translation in the post-operative ACLR patients and compared the findings with that of single leg hop test.

Aim and objectives

To document tibial anterior translation and evaluate the radiological measurement values in comparison to single leg hop test in post-operative ACLR patients as an objective measure of ACL sufficiency.

Materials and methods

24 male randomly selected patients between ages 20 to 36 years that underwent arthroscopic ACLR using ipsilateral utologous hamstring tendon at a tertiary care orthopedic hospital in the

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years 2010 and 2011, were evaluated at routine a follow-ups after completion of 9 months and 12 months of post-operative period. Institutional ethical clearance was obtained for this study and informed consent was taken from all the participants of the study. All patients underwent adequate post-operative physiotherapy and exercise regimen as for institutional protocol.

Inclusion criteria

1. ACL Reconstructed patients after 9 months of post-operative period.
2. Male and skeletally mature patients between 20-45 years of age.

Exclusion criteria

1. Patients with associated other knee ligament injuries
2. contralateral limb abnormalities
3. Marked ipsilateral or contralateral quadriceps muscle weakness
4. Meniscal tears
5. Pre-existing radiological evidence of osteoarthritis were excluded from the study.

All of the patients, were tested by our radiological method and single leg hop test after 9th postoperative period, and results were documented. Patients were recalled for routine follow-up at 12th month after returning to routine activities for subjective evaluation. Subjective scoring and calculation of final IKDC scores was done using IKDC subjective knee

evaluation form ^[3] as a final evaluation.

Radiological assessment of anterior tibial translation-procedure (Picture 1)

Radiological assessment done by applying standard weight of 9 kgs ^[4, 5, 6] strapped to anterior aspect of lower thigh and patient lower leg was supported with knee in 20-30 of flexion. True lateral views with x ray source located 1 meter from film cassette that is kept in contact with the thigh and a metal marker of known size strapped to the anterior lower thigh in the middle of femur shaft, were taken. First line is drawn parallel to tibial plateau on this radiograph. Two tangential lines were drawn perpendicular to the first line at posterior most borders of tibial and femoral articular margins. The anterior translation of tibia in relation to distal femur was measured between these tangential lines. This measured distance was adjusted for magnification in relation to that of the longitudinal length of the metal marker and documented. Final result of anterior translation for each knee, was documented after deducting measurement of the contralateral leg and difference of up to 2mm was taken as satisfactory. Standard single leg hop for distance test was done and best of the three attempts is taken as a final value. Horizontal distance measured from initial toe position to back of the landing heel on a straight line. Injured leg tested subsequent to uninjured leg. Ratio of hopping distance of ipsilateral to that of contralateral normal leg, also known as hop index, was taken as final variable for comparison. Hop index value more than or equal to 0.9 was taken as satisfactory.



Picture 1

Results

Average age of our patients was 27 years. Radiological measurement of anterior tibial translation using our procedure resulted overall mean translation difference of 2.3 mm with range 1-4mm. 16 out of 24 patients had 2mm or less translation compared to healthy contralateral leg, that is considered as satisfactory result. Single leg hop horizontal distance measurements yielded average of 146 cm and 161 cm for ipsilateral and contralateral uninjured legs respectively. Range of final derived values of hop index was

0.85-0.95 with mean of 0.91 (table1). Satisfactory hop indices were obtained in 16 out of 24 study participants. 15 out of 24 patients obtained satisfactory results in both single leg hop and tibial translation measurements.

IKDC subjective knee evaluation scores at 12th month of post-operative follow-up had a range of 55 to 84 with mean of 72 (table 2). Results of SLHD test, anterior tibial translation and IKDC subjective evaluation scores show similar pattern on comparison across individual study subjects.

Table 1: Results of Radiographic ATT measurements, SLHD tests and derived Hop indices after 9th month

	age	Stress anterior translation	SLHD/contralateral SLHD (in centimeters)	Hop index
1	36	3	136/160	0.85
2	26	3	143/164	0.87
3	25	2	146/159	0.92
4	33	3	141/164	0.86
5	25	2	151/169	0.89
6	21	3	146/166	0.88
7	25	3	145/167	0.87
8	21	2	144/155	0.93
9	31	2	146/159	0.92
10	33	3	143/164	0.87
11	35	2	144/155	0.93
12	26	2	149/159	0.94
13	25	1	151/159	0.95
14	26	2	152/162	0.94
15	23	2	149/159	0.94
16	36	1	150/158	0.95
17	27	3	145/161	0.90
18	22	2	147/160	0.92
19	26	2	149/159	0.94
20	25	4	141/162	0.87
21	20	1	145/154	0.94
22	23	2	147/163	0.90
23	24	2	149/160	0.93
24	32	2	144/157	0.92

Table 2: IKDC subjective evaluation score at 12th month of follow-up

	Age	IKDC score
1	36	55
2	26	57
3	25	65.5
4	33	56
5	25	63.2
6	21	59
7	25	60
8	21	81.6
9	31	81
10	33	68.9
11	35	76
12	26	82
13	25	84
14	26	83
15	23	81
16	36	82
17	27	66.6
18	22	79.3
19	26	80.86
20	25	55.5
21	20	80.7
22	23	73.6
23	24	76
24	32	79

Discussion

The clinical decision-making regarding readiness of ACLR patient to go back to the preinjury level of activities, is always a complex process with no simple right answer. Patients are generally advised to return to previous activity at or after 9 months of post-operative period, as rate of re-injury decreases by 51% [7] after this period. Even at this stage, patients can be advised only after thorough evaluation that includes at least knee stability assessment. The clinical advice is usually made

based on clinical assessment of knee stability using Lachman test after a period of rehabilitation therapy and may take up to 8-12 months depending on type of activity one is returning to. Clinical tests introduce an element intra- and inter-test variability when used for evaluation of translation (8) and no single test has been shown to be a complete predictive measure of postoperative ACLR outcome although single leg hop test [9, 10] and several other measures are generally accepted as safe for that purpose.

Objective stress radiological measurement of anterior translation of tibia can be a very useful adjunct as well as can be used as a record of evidence of stability. Serves as an Inexpensive alternative to proprietary instrumented Lachman test such as KT-1000 arthrometer. Study of instrumented evaluation of knee joint stability showed ^[3] when about 9kgs of weight was applied to anterior aspect of the thigh to induce anterior tibial translation, abnormal anterior translation was noticed in 94% of people that correlates with complete ACL tear. The x-ray procedure that we used emulates this process by using same weight. It is simple and barely costs more than a routine lateral knee radiograph. Single leg hop test can be affected by patient's perceived self confidence in his or her own knee function whereas stress radiographic measurement removes that aspect of psychological element. None the less, SLHD is still a very useful test as it tests dynamic stress on ACL as compared to our stress radiograph technique which measures the effect of static stress. Stress radiographic measurement of anterior translation combined with other scores such as patient reported outcome measures can form a comprehensive 'return- to- activity-advice strategy'. Patient reported outcome measure also was chosen for comparison at a later follow-up, as available evidence shows correlation to disability after surgery. Limitations of our study were: study population was restricted to male gender and number of participants was less because many were lost to follow-up.

Conclusion

Stress radiographic measurement of anterior tibial translation in Post- ACLR patients can be a very useful tool in the decision-making process of clinical advice of return-to-work after 9 months of post-operative period. It forms a comprehensive approach when used along with single leg hop test and patient reported outcome scores in this clinical scenario.

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