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Clinical outcome comparison between LaPrade and Larson's technique for posterolateral corner injury of knee

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ABSTRACT

Background: The knee joint is the largest synovial joint in the body. It is a modified hinge joint. It is a tri axial joint consisting of three articulations, patella-femoral, medial tibio-femoral and lateral tibio-femoral joint. The posterolateral corner (PLC) is often called the "dark side" of the knee due to its complexity and the minimal amount of research performed to better understand its anatomy and biomechanics. The present study was conducted to analyse the postoperative clinical outcome of Larson's technique in one group and LaPrade technique in another group and elucidating which technique best restores stability and function to an isolated PLC injury.
Methods: This was a prospective study involving 40 patients with postero-lateral corner injuries (PCL) divided into two groups of 20 patients each. Larson's reconstruction and LaPrade's reconstruction techniques were done and the clinical outcomes were analyzed.
Results: Mean postoperative Lysholm score for Larson group was 78.10±10.26 with scores ranging from 58-92 with median value of 80.0. Mean postoperative Lysholm score for LaPrade group was 85.7±8.802 with scores ranging from 60-96 with median value of 87.0. Mean postoperative IKDC score for Larson group was 74.0±8.93 with scores ranging from 60-90 with median value of 75.0. Mean postoperative IKDC score for LaPrade group was 84.9±5.67 with scores ranging from 73-92 with median value of 85.5. This study recorded similar outcomes in both the groups.
Conclusions: The posterolateral knee reconstruction techniques presented here significantly improved objective stability in patients with a chronic posterolateral knee injury.

Keywords: Knee injury, Knee joint, LaPrade technique, Larson's technique, Lysholm score

INTRODUCTION

In the last few decades, injuries to the knee joint are common because of popular knee pivoting sports including soccer, skiing, and basketball. The posterolateral corner (PLC) is an area of the knee that does not receive adequate research recognition despite its functionality and contribution to the overall stability of the knee. The postero-lateral corner (PLC) of the knee consists of important stabilizing structures that play a crucial role in varus and rotational stability through all ranges of motion.[1-3] The 3 major static stabilizers of the PLC are the fibular collateral ligament (FCL), popliteus tendon (PLT), and popliteo-fibular ligament (PFL).[1]

The incidence of postero-lateral corner (PLC) injuries has risen owing to the increase in motor vehicle accidents and athletic traumas. The mechanism of injury to the PLC usually involves direct varus stress, hyperextension, or twisting of the knee. These injuries rarely an isolated injury and are commonly associated with anterior cruciate ligament (ACL) or posterior cruciate ligament (PCL)

tears.[4-6] However, a PLC injury can be overlooked or misdiagnosed. Left untreated, it can cause chronic pain and residual instability. Thus, it is of utmost importance to detect and treat the injury properly.

Ligament injury accounts for nearly 40% of all knee injuries and Injury to the isolated postero-lateral structures is infrequent, while the association with ACL and or PCL tear is common (28% of isolated postero-lateral injuries and 72% of injuries combined with of one or both cruciate ligaments). Though an uncommon occurrence, there has also been evidence that the tibiofibular joint becomes jeopardized in the event of a PLC injury in part because the most distal aspect of the fibular collateral ligament (FCL) and popliteofibular ligament (PFL) attach to the fibular head. Because of the low healing potential of these injuries, surgery is usually indicated. PLC reconstruction is normally advocated for grade 2 or 3 PLC lesions, considering its superior outcomes compared with conservative treatment.[7-13]

Animal and clinical studies have reported that grade III PLC injuries heal poorly without surgical intervention, resulting in varus and rotational instability of the knee.[14,15] Persistent posterolateral instability leads to a varus thrust gait, which increases forces on the medial compartment of the knee. This may result in meniscal injuries and accelerated medial compartment osteoarthritis. Chronic posterolateral instability has also been shown to increase forces on the ACL and PCL, which can potentially lead to graft failure in the setting of multiligament injury. Historically, both repair and reconstruction have been used for treating PLC tears. PLC repairs have been reported to have a higher reoperation rate when compared with reconstructive techniques 18/16. As a result, reconstructionis recommended for grade III injuries. There has been a recent trend toward more anatomic reconstruction, specifically, of the three most critical biomechanical structures that control varus and external rotation: the LCL, popliteus tendon, and PFL.

Multiple PLC reconstruction techniques exist but none have proven to perform best for complete repair and biomechanical functionality. There has been great interest in two specific PLC techniques, Larson's and LaPrade. These two are most commonly used techniques have shown promising clinical outcomes but the two techniques have never been compared against each other from clinical outcome perspective. Advantages of the Larson technique include: a relatively straight-forward procedure for reconstruction of the fibular collateral ligament (FCL) and popliteofibular ligament (PFL) that requires less time as compared to other techniques. The LaPrade technique benefits from the inclusion of popliteus tendon (PLT) graft which produces added reinforcement to the PLC.

Aim of the study

The present study is conducted to analyze the postoperative clinical outcome of Larson's technique in one group and LaPrade technique in another group and elucidating which technique best restores stability and function to an isolated PLC injury.

METHODS

This was a prospective study with sample size of 40 patients (20 in each group) operated between April 2016 and January 2018 conducted in the Department of Orthopaedics, Kamineni Hospitals, L.B. Nagar, Hyderabad and Telangana State to compare the clinical outcome of LaPrade and Larson's techniques for posteriolateral corner injury of knee.

Inclusion criteria

Males and females age ranging from 18 to 44 years. Posteriolateral corner injury. No previous surgery performed on the affected knee. No previous cruciate ligament damage sustained in either the affected or the contralateral knee.

Exclusion criteria

Patients with medial collateral ligament injury. Patients with posterior cruciate ligament injury. Patients with anterior cruciate ligament injury. Evidence of osteoarthritis on plain radiographs. Patients with generalized ligamentous laxity.

Methods and analysis of results

Patients diagnosed with PLC injury were operated in our hospital with either of the two PLC reconstruction techniques. They were divided into two groups by randomization and underwent reconstruction by two different techniques which were as following: Group: 1) Larson's technique. Group: 2) LaPrade's technique.

The study was approved by the local ethical committee and the patients gave their informed consent to participate. Preoperative evaluation was done by taking patient's detailed history including age, sex, medical history, and clinically evaluated by dial test, varus stress test. Patient was further evaluated radiologically by antero posterior view and lateral view of involved side knee joint x-rays. Preoperative investigations included haemoglobin, blood grouping, others relevant tests depending on co-morbidity and to rule out infection, total leucocyte count, differential count, erythrocyte sedimentation rate (ESR), C reactive protein (CRP) were done. Patient was evaluated by using Lysholm scale and IKDC scoring scale.

Lysholm score evaluation

Final score was calculated by adding all the scores. Scores were categorized as follows: a score of 100 means no symptoms or disability. Excellent: (95-100). Good: (84-94). Fair: (65-83). Poor: (<64).

IKDC knee score evaluation

Scores for each item were summed to give a total score. The total score is calculated as:

$$\frac{\text{sum of items}}{\text{maximum possible score}} \times 100$$

Postoperative evaluation was done by using 1) Lysholm score, 2) IKDC scores and 3) Postoperative complications such as pain, swelling control, range of motion, regaining normal muscle strength etc.

Statistical analysis

Statistical analysis was done using EPI INFO software (desktop version). Assuming that samples obtained are of normal distribution, parametric tests were employed for comparison and relationship determination. Comparison of variables between groups was carried out by the student t test.

RESULTS

The result of study includes 40 patients who had undergone PLC reconstruction surgery between March 2016 and January 2018. For final end result evaluation, all patients were reviewed and analyzed at the end of 6 months postoperatively.

Results include preoperative, intra-operative findings and postoperative subjective assessment scores and examination findings, IKDC scoring scale, and range of motion, measured to the nearest 5 degrees by using a goniometer. Means and frequencies were calculated for the demographic data and the results of the subjective questionnaire analysis.

Table 1: Age distribution of the patients.

Age group of patients (in years)	Larson's (%)	LaPrade's (%)
18-22	4 (20)	4 (20)
23-27	6 (30)	7 (35)
28-32	6 (30)	5 (25)
33-37	3 (15)	2 (10)
38 and above	1 (5)	2 (10)
Total	20 (100)	20 (100)

Table 2: Affected side.

Side	Larson's (%)	LaPrade's (%)
Right	11 (55)	14 (70)
Left	9 (45)	6 (30)
Total	20 (100)	20 (100)

Out of 20 patients in Larson's reconstruction group, 17 were males and 3 were females. In the LaPrades reconstruction group, out of 20 patients 18 were males and 2 were females.

In the Larson's reconstruction group, of the total 20 patients, 11 patients had right side injury and 9 patients had left side injury to the knee.

In the LaPrades reconstruction group, of the total 20 patients, 14 patients had right side injury and 6 patients had left side injury.

In the Larson group, patients presenting with only pain were 13 (65%), patients presenting with only complaint of giving away were 5 (25%) and patients presenting with complaint of pain associated with giving away were 2 (10%).

In the LaPrade group, patients presenting with only complaint of pain were 9 (45%), patients with only complaint of giving away were 7 (35%) and patients with complaint of pain associated with giving away were 4 (20%).

Table 3: Presenting complaints.

Presenting complaints	Larson's (%)	LaPrade's (%)
Pain	13 (65)	9 (45)
Giving away	5(25)	7 (35)
Pain and giving away	2 (10)	4 (20)
Total	20 (100)	20 (100)

Time period from injury to surgical intervention was between 2 weeks to 1 year.

In Larson group, 7 patients (35%) presented within 3 months of injury, 9 patients (45%) in 4-6 months, 4 patients (20%) in 7-9 months of injury. In the LaPrade group, 4 patients (20%) presented within 3 months of injury, 8 patients (40%) in 4-6 months, 5 patients (25%) in 7-9 months of injury and 3 patients (15%) in 10-12 months.

Dial test

In the Larson group, the preoperative evaluation for 20 patients (100%) was positive for Dial test, and in the postoperative evaluation 20 patients (100%) were negative for Dial test.

In the LaPrade group, the preoperative evaluation 20 patients (100%) were positive for Dial test and in the postoperative evaluation all 20 patients (100%) were negative for dial test.

Varus test

In the Larson group, the preoperative evaluation for 20 patients (100%) was positive for varus test, and in the postoperative evaluation 20 patients (100%) were negative for varus test.

In the LaPrade group, the preoperative evaluation for 20 patients (100%) were positive for varus test, and in the postoperative evaluation 20 patients (100%) were negative for varus test.

Range of motion (ROM)

In the Larson group, the preoperative range of motion was measured with goniometer. Normal range of motion (0-140°) was seen in 4 patients (20%), 11 patients (55%) had good range of motion (0-120°), 3 patients (15%) had range of motion (0-110°), 1 patient (5%). had range of motion (0-100°), 1 patient (5%) had (0-900) range of motion. Post operatively 19 patients (50%) had full range of motion (0-140°). 1 patient (5%) had range of motion (0-120°).

Table 4: Range of motion (ROM) in Larson reconstruction group.

ROM	Preop (%)	Postop (%)
0-90	1 (5)	0
0-100	1 (5)	0
0-110	3 (15)	0
0-120	11 (55)	1 (5)
0-130	0	0
0-140	4 (20)	19 (95)
Total	20 (100)	20 (100)

In the LaPrade group, the preoperative range of motion was measured with goniometer. Normal range of motion (0-140°) was seen in 8 patients (40%), 6 patients (30%) had good range of motion (0-120°). 2 patients (10%) had range of motion (0-110°), 2 patients (10%) had range of motion (0-100°), 2 patients (10%) had (0-90°) range of motion. Post operatively 15 patients (75%) had full range of motion (0-140°).1 patient (5%) had (0-130°) range of motion and 4 patients (20%) had range of motion (0-120°).

Table 5: Range of motion (ROM) in LaPrade reconstruction group.

ROM	Preop (%)	Postop (%)
0-90	2 (10)	0
0-100	2 (10)	0
0-110	2 (10)	0
0-120	6 (30)	4 (20)
0-130	0	1 (5)
0-140	8 (40)	15 (75)
Total	20 (100)	20 (100)

There were 2 postoperative infections at two months in Larson technique of reconstruction and 3(50%) among Larson group and 2(100%) among LaPrade group had knee pain. Only 1 (16.66%) had pain at terminal extension. There were no sensory deficits reported in either of the reconstruction technique.

Lysholm scores

Pre-op scores

Mean preoperative Lysholm score for Larson group was 42.80±13.09 with scores ranging from 20-78 with median value of 43.50.

Mean preoperative lysholm score for LaPrade group was 46.05±12.529 with scores ranging from 20-70 with median value of 47.0.

Post op scores

Mean postoperative Lysholm score for Larson group was 78.10±10.26 with scores ranging from 58-92 with median value of 80.0.

Mean postoperative Lysholm score for LaPrade group was 85.7±8.802 with scores ranging from 60-96 with median value of 87.0.

Table 6: Lysholm score.

Score	LS (%)	LP (%)
Excellent	0	4 (20)
Good	6 (30)	9 (45)
Fair	10 (50)	6 (30)
Poor	4 (20)	1 (5)
Total	20 (100)	20 (100)

IKDC objective score

Pre-op scores

Mean preoperative IKDC score for Larson group was 33.35±6.87 with scores ranging from 20-45 with median value of 33.50

Mean preoperative IKDC score for LaPrade group was 36.9±6.39 with scores ranging from 31-46 with median value of 38.5.

Post op scores

Mean postoperative IKDC score for Larson group was 74.0±8.93 with scores ranging from 60-90 with median value of 75.0

Mean postoperative IKDC score for LaPrade group was 84.9±5.67 with scores ranging from 73-92 with median value of 85.5

Statistical analysis of relationship and differences between variables:

Lysholm preoperative score for both groups test value was 0.427 which is not significant and for post-operative p-value for both groups was 0.0163. Here the p value was

<0.05. This indicates that the techniques are significant when functional outcomes were measured with Lysholm scores.

IKDC preoperative score for both groups test value was 0.09 which is not significant and for post-operative p value for both groups was 0.0001. Here the p value was <0.05. This indicates that the techniques are significant when functional outcomes were measured with IKDC scores.

Table 7: Statistical analysis of Lysholm preoperative score.

Lysholm preoperative	Mean	Median	Variance	Standard deviation
Laprade	46.05	47.0	156.99	12.529
Larson	42.80	43.50	171.53	13.09
N	**Df**	**t value**	**P value**	**Significance**
40	38	0.8	0.427	Not significant

Table 8: Statistical analysis of Lysholm post-operative score.

Lysholm post-operative	Mean	Median	Variance	Standard deviation
Laprade	85.7	87.0	77.48	8.8025
Larson	78.10	80.0	105.35	10.264
N	**Df**	**t value**	**P value**	**Significance**
40	38	2.51	0.0163	Significant

Table 9: Statistical analysis of IKDC pre-operative score.

IKDC pre-operative	Mean	Median	Variance	Standard deviation
Laprade	36.9	38.5	40.83	6.39
Larson	33.35	33.5	47.29	6.87
N	**Df**	**t value**	**P value**	**Significance**
40	38	1.69	0.09	Not significant

Table 10: Statistical analysis of IKDC post-operative score.

IKDC post operative	Mean	Median	Variance	Standard deviation
Laprade	84.9	85.5	32.20	5.67
Larson	74.00	75	79.78	8.93
N	**Df**	**t value**	**P value**	**Significance**
40	38	4.61	0.0001	Significant

P value for postoperative evaluation of Lysholm scores and IKDC scores between the two groups showed statistical significance (p=0.0163, p=0.0001). This indicates that there was significant statistical difference between the two groups in respect of postoperative functional outcomes.

DISCUSSION

There are several reported surgical techniques for treating posterolateral knee injury. An anatomical reconstruction results in the best results in reducing abnormal joint motion and in improving patient function.

Larson's procedure was one of the first fibular-based techniques, and reconstructs the LCL and PFL with distal insertion sites located at the fibula. It is widely accepted due to the virtues of being less technically demanding and offering promising clinical results. Our technique was based on Larson's methods, and has been modified to reproduce a physiological tension pattern for LCL and PFL using a single ST autograft.

In the Larson group, the preoperative range of motion was measured with goniometer. Normal range of motion (0-140°) was seen in 4 patients (20%), 11 patients (55%) had good range of motion (0-120°), 3 patients (15%) had range of motion (0-110°), 1 patient (5%). had range of motion (0-100°), 1 patient (5%). had (0-90°) range of motion. Post operatively 19 patients (50%) had full range of motion (0-140°). 1 patient (5%) had range of motion (0-120°).

In the LaPrade group the preoperative range of motion was measured with goniometer. Normal range of motion (0-140°) was seen in 8 patients (40%), 6 patients (30%) had good range of motion (0-120°). 2 patients (10%) had range of motion (0-110°), 2 patients (10%) had range of motion (0-100°), 2 patients (10%) had (0-90°) range of motion. Post operatively 15 patients (75%) had full range of motion (0-140°).1 patient (5%) had (0-130°) range of motion, and 4 patients (20%) had range of motion (0-120°).

In Larson group, 7 patients (35%) presented within 3 months of injury, 9 patients (45%) in 4-6 months, 4 patients (20%) in 7-9 months of injury. In the LaPrade group, 4 patients (20%) presented within 3 months of injury, 8 patients (40%) in 4-6 months, 5 patients (25%) in 7-9 months of injury and 3 patients (15%) in 10-12 months.

Infection was seen in 2 patients in Larson's group (33.33%), none in LaPrade group. Infection subsided with conservative management and intravenous antibiotics.

Knee pain was seen in 3 patients (50%) in Larson group and in 2 patients (100%) in LaPrade group. Knee pain was seen in postoperative follow-up of 3 and 6 weeks. This subsided with conservative treatment and physiotherapy by the end of 6 months.

Pain at terminal extension was seen in 1 patient (16.66%) in Larson and none in LaPrade group. Pain at terminal extension was seen in 3 and 6 weeks postoperative follow up which subsided by the end of 6 months by physiotherapy and conservative treatment.

There were no sensory deficits reported in both groups during post-operative follow up period. The clinical

outcome results vary among the related studies, presenting mean postoperative Lysholm scores ranging from 65.5 to 91.8 and mean postoperative International Knee Documentation Committee scores ranging from 62.6 to 86.0.

Mean preoperative Lysholm score for Larson group was 42.80±13.09 and postoperative score was 78.10±10.26. Mean preoperative Lysholm score for LaPrade group was 46.05±12.529 mean postoperative score for group was 85.7±8.802.

Yoon and colleagues compared a non-anatomic fibular sling PLC reconstruction technique with an anatomic based reconstruction and demonstrated improved Lysholm scores and improved varus and external rotation laxity in the anatomic reconstruction group.[17]

Mean preoperative IKDC score for Larson group was 33.35±6.87 with mean postoperative score 74.0±8.93. Mean preoperative IKDC score for LaPrade group was 36.9±6.39 with mean postoperative score 84.9±5.67. A prospective evaluation by Geeslin et al demonstrated significant improvements in all IKDC objective scores, side-to-side differences in varus stress radiographs, and improvement in mean Cincinnati and IKDC subjective outcomes scores.[18]

Lysholm preop for both groups test value was 0.427 which was not significant and for post-operative p value for both groups was 0.0163. Here the p value was <0.05. This indicates that the techniques are significant when functional outcomes were measured with Lysholm scores.

IKDC preop for both groups test value was 0.09 which was not significant and for post-operative p value for both groups was 0.0001. Here the p value was <0.05. This indicates that the techniques are significant when functional outcomes were measured with IKDC scores.

P value for postoperative evaluation of Lysholm scores and IKDC scores between the two groups showed statistical significance (p=0.0163, p=0.0001). This indicates that there was significant statistical difference between the two groups in respect of postoperative functional outcomes.

In 2002 Buelow et al performed a prospective nonrandomized trial comparing femoral fixation with a bioabsorbable Larson (Arthrex, Karlsfeld, Germany) with an LaPrade1 (Smith and Nephew Inc, Andover, MA) There were 30 patients in each arm. Outcome measures used at 2 years' follow up were radiographs, International Knee Documentation Committee (IKDC) score, Cincinnati Knee Score, and KT-1000TM (MEDmetric Corp, San Diego, CA) measurements and found out that both methods were similar in outcomes. It was comparable to our study. There were 20 patients in each group. Outcomes were measured after 6 months follow up. Our study also showed that both methods were similar in outcomes.

CONCLUSION

We conclude that the anatomical posterolateral knee reconstruction technique reported in this study for the fibular collateral ligament, popliteus tendon, and popliteofibular ligament restores varus and external rotary stability in knees with grade III posterolateral knee injuries. The posterolateral knee reconstruction technique presented here significantly improved objective stability in patients with a chronic posterolateral knee injury.

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