SYSTEMATIC REVIEW FOR MANAGEMENT OF POSTEROLATERAL CORNER INJURIES OF THE KNEE

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ABSTRACT

Background: There is a paucity of outcome data to guide the surgical treatment of posterolateral corner knee injuries.
Purpose: To systematically review the literature to compare clinical outcomes of the treatment PLC injuries.
Study Design: Systematic review; Level of evidence, 4.
Methods: A systematic review of the literature including PubMed was performed. The following search terms were used: “posterolateral corner”, “chronic PLC injuries” “acute PLC injuries” and “repair of PLC injuries”, “reconstruction of PLC”. Inclusion criteria were: Human examinations and treatment, measures of functional and clinical outcome included, exclusion criteria were: Non English papers, Non-human trials, Articles with no clinical data.
Results: Eighteen studies with a total of 559 patients were included. When time to surgery was performed within 6 weeks it is considered acute injury while on the other hand more than that was considered chronic injury. Surgical treatment varied between repair and reconstruction there was an overall success rate of repair 75% and failure rate of 25% and overall success rate of reconstruction was 91% and 9% failure rate.
Surgical techniques: 83 patients underwent repair for the PLC while 476 patients underwent reconstruction for the PLC, surgical techniques varied among studies, between repair and reconstruction techniques which was different between studies, including fibular sling using one femoral tunnel or two femoral tunnels, posterolateral capsular shift trying to increase rotational stability, anatomic PLC reconstruction, biceps tenodesis and isometric reconstruction of the FCL and the popliteus with a single graft.
Conclusion: The repair of acute PLC injuries and staged treatment of combined cruciate injuries were associated with a substantially higher postoperative PLC failure rate than reconstruction. Further research is required to identify the reconstruction technique that provides optimal subjective and objective outcomes.
Key words: posterolateral corner, chronic PLC injuries, acute PLC injuries and repair of PLC injuries, reconstruction of PLC.

2.INTRODUCTION

Posterolateral corner lesions have been estimated to occur in 9.1% of acute knee injuries with haemarthrosis and 16% of all knee ligament injuries, often presenting with concomitant anterior cruciate ligament or posterior cruciate ligament or both, isolated PLC has shown to account for less than 30% of the injuries, failure to detect these injuries has been shown to be an important cause of recurrent instability and failed cruciate ligament reconstructions [1].

The main structures that make up the PLC of the knee are the lateral collateral ligament, popliteus tendon, popliteo-fibular ligament, and lateral knee capsule [2] (Fig. 1).

Fig. (1) Illustration demonstrating anatomy and relationships of the FCL, popliteus tendon, PFL, and lateral gastrocnemius tendon (lateral view of a right knee) [3].

In the past, although also once considered to be the "dark side of the knee", treatment of lateral side instability has been challenging due to limited data on the anatomy and biomechanics of the PLC structures and under-reporting of clinical outcomes following non-operative and operative treatment. However, more recently, the anatomy and biomechanics have become well-defined and good outcomes have been reported after PLC operative treatment following anatomic reconstruction principles [4].

Although there are several operative techniques for management of PLC injuries but none of these techniques has been standardized [5].

3.MATERIALS AND METHODS

Online search was done using the midline database on PUBMED from 2006 to 2016, all the English language published studies will be identified with the search keywords of "posterolateral corner", "chronic PLC injuries" "acute PLC injuries" and "repair of PLC injuries", "reconstruction of PLC". Literature search database on PUBMED showed 399 studies.

1ry screening: 295 studies were excluded due to language other than English language and other topics not related to search goals.

2ry screening: Title or abstract review 78 studies excluded due to cadaveric studies and duplicates.

3ry screening: Full text review was done and 8 articles were excluded due to lack of functional outcome and case reports. 18 studies were included.

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) flow diagram for study selection was used.

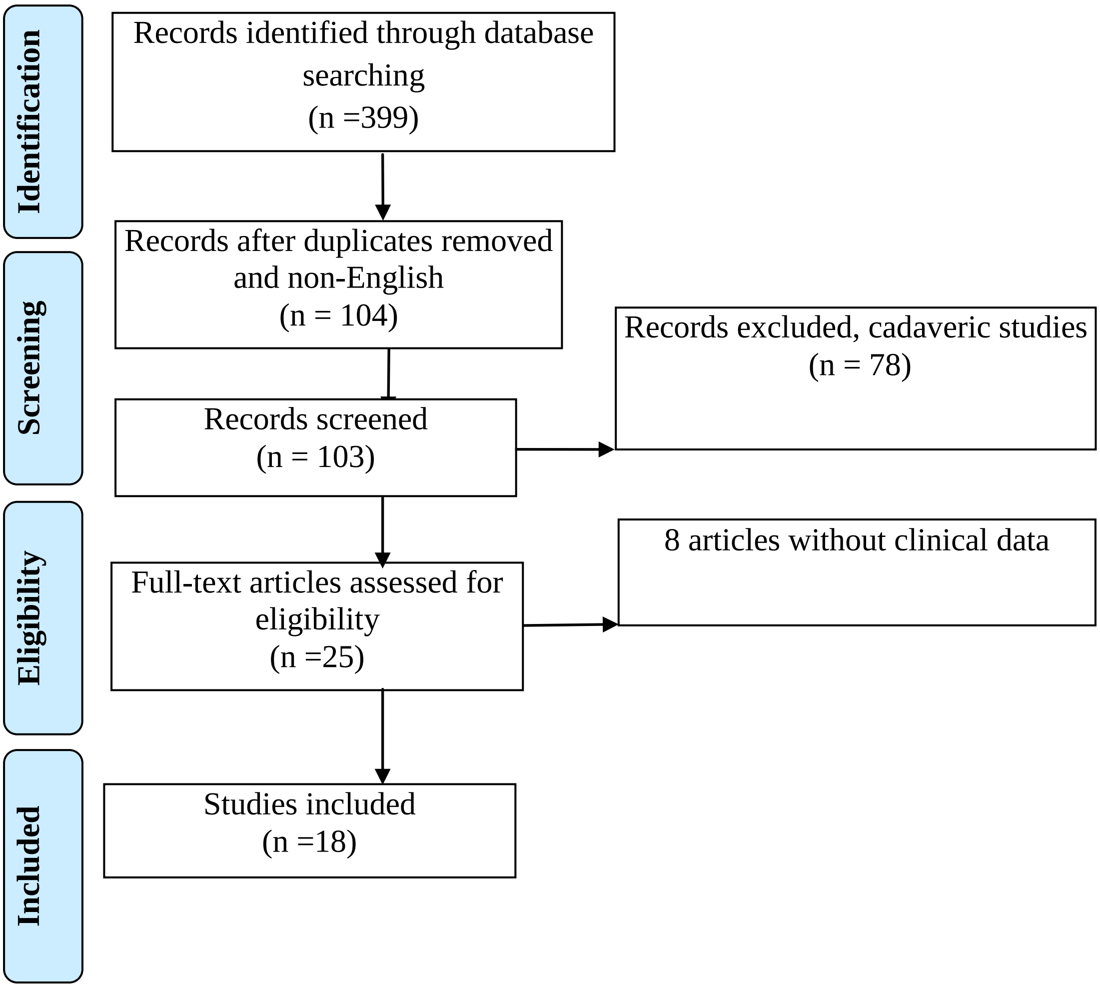
Inclusion criteria:

Studies which are included in our systematic review met the following guidelines:

1) They provided levels I to IV evidence in one of the 3 areas of interest or more outlined previously.
2) Human examinations and treatment.
3) They included measures of functional and clinical outcome.

Exclusion criteria:

1) Non English papers.
2) Non-human trials.
3) Articles with no clinical data.



Data collection:

Patients demographics, surgical technique, duration of follow up, subjective outcomes (Lysholm scores, IKDC) and objective outcome (varus stress examination, varus stress radiographs) mean were recorded.

Lysholm and IKDC scores were chosen because it is the most widely reported subjective outcome for PLC injuries.

Post-operative varus examination and radiographic findings were collected and classified as success or failure.

Success was defined as grade 0 or I.

Failure was defined as grade II or III post-operative or the need to reoperate because of varus instability.

4. RESULTS

Our search revealed 18 studies accounting for total of 559 patients included in the final analysis (Table 1).

Acute cases: Ibrahim et al, Geeslin and LaPrade, McCarthy et al (18 cases) Schechinger et al (7 cases), Levy et al.

Chronic cases: McCarthy et al (43 cases), Schechinger et al (9 cases), Fanelli et al, Kim et al (2013, 2012, 2011 and 2010), Zorzi et al Noyes et al (2011 and 2007) al Yoon et al Jakobson et al LaPrade et al.

Different surgical techniques were used in the studies shown in table (2).

Table (1) showing list of, papers no. of patients, time to surgery, mean follow up time and age of patients.

Author	Study no.	No. of patients	Year	Time to surgery	Mean follow up (months)	Age (years)
Shelbourne et al [10]	1	21	2007	4-41 days	48	21 (16-31)
Noyes et al [19]	2	14	2007	2-198 months	72	27 (15-43)
Bin and Nam [11]	3	8	2007	2-14 days	48	30 (20-51)
Schechinger et al [9]	4	Chronic 9 Acute 7	2009	Chronic 2-190 months Acute 17-30 days	30	30 (20-53)
Levy et al [5]	5	Chronic 18 Acute 10	2010	Chronic 5-20 months 20-45 days	35	Not recorded
Kim et al [16]	6	42	2010	5-48 months	48	31 (20-48)
Jakobson et al [21]	7	27	2010	5-78 months	48	28 (13-57)
LaPrade et al [22]	8	64	2010	2-144 months	32	32 (18-58)
Geeslin and LaPrade [7]	9	26	2011	3-42 days	28	27 (16-63)
Kim et al [15]	10	46	2011	4-27 months	24	35 (19-60)
Noyes et al [18]	11	13	2011	3-108 months	72	25 (15-43)
Yoon et al [20]	12	32	2011	2-95 months	36	35 (20-54)
Kim et al [14]	13	23	2012	2-30 months	24	36 (21-53)
Ibrahim et al[6]	14	20	2013	15-21 days	42	26.4 (18-48)
Kim et al [13]	15	65	2013	5-48 months	32	37 (16-64)
Zorzi et al17]	16	19	2013	5-122 months	36	29 (17-41)
Fanelli et al [12]	17	34	2014	2-48 months	30	27 (15-53)
McCarthy et al[8]	18	Chronic 43 Acute 18	2015	Chronic 4-90 months Acute 15-40 days	Chronic 38 Acute 42	33 (21-58)

Table (2) Showing surgical techniques for each study

Author	PLC repair or reconstruction technique
Ibrahim et al (2013)	Fibular sling with a single femoral fixation point
Geeslin and LaPrade (2011)	Anatomic reconstruction of midsubstanace FCL and popliteus tendon injuries, and direct repair of lateral capsule avulsion with suture anchors and repaired popliteus tendon bony avulsions.
McCarthy et al (2015)	For the chronic group reconstruction with fibular sling with 2 femoral tunnels was done. For the acute group direct repair of FCL and popliteus tendon injuries with suture anchors.
Levy et al (2010)	For the chronic group reconstruction with fibular sling with a single femoral fixation point. For the acute group direct repair of FCL and popliteus tendon injuries with suture anchors and posterolateral capsule reefing.
Scechinger et al (2009)	Reconstruction with fibular sling with 2 femoral tunnels and performed posterolateral capsule imbrication.
Shelbourne et al (2007)	Performed “en masse surgical repair” of the healing lateral structures to the tibia using a staple (with possible separate repair of biceps femoris tendon to the fibula).
Bin and Nam (2007)	Direct repair of fibular collateral ligament and popliteus tendon injuries with suture anchors and posterolateral capsule reefing.
Fanelli et al (2014)	Fibular sling with a single figure of eight graft and capsular imbrication.
Kim et al (2013)	Isometric reconstruction of the FCL and the popliteus with a single graft, recreating the anterior tibiofibular ligament.
Kim et al (2012)	Isometric reconstruction of the FCL and the popliteus with a single graft, recreating the anterior tibiofibular ligament.
Kim et al (2011)	21 patient Isometric reconstruction of the FCL and the popliteus with a single graft, recreating the anterior tibiofibular ligament (Group A), 25 patient biceps rerouting tenodesis (Group B).
Kim et al (2010)	Isometric reconstruction of the FCL and the popliteus with a single graft, recreating the anterior tibiofibular ligament.
Zorzi et al (2013)	Fibular sling, single femoral fixation point.
Noyes et al (2011)	Femoral-fibular-looped FCL reconstruction with capsular imbrication.
Noyes et al (2007)	Bone-Patellar tendon-Bone FCL reconstruction.
Yoon et al (2011)	Single fibular sling with 2 femoral tunnels “anatomic reconstruction” involves a fibular sling with anatomic popliteal tendon reconstruction.
Jakobson et al (2010)	Fibular sling with 2 femoral tunnels and secondary graft, recreating the popliteus tendon and PFL.
LaPrade et al (2010)	Anatomic reconstruction of FCL, popliteus and PFL.

Outcomes:

Post-operative Lysholm score, IKDC was documented in table (4)

Table (3) Post-operative Lysholm score and IKDC

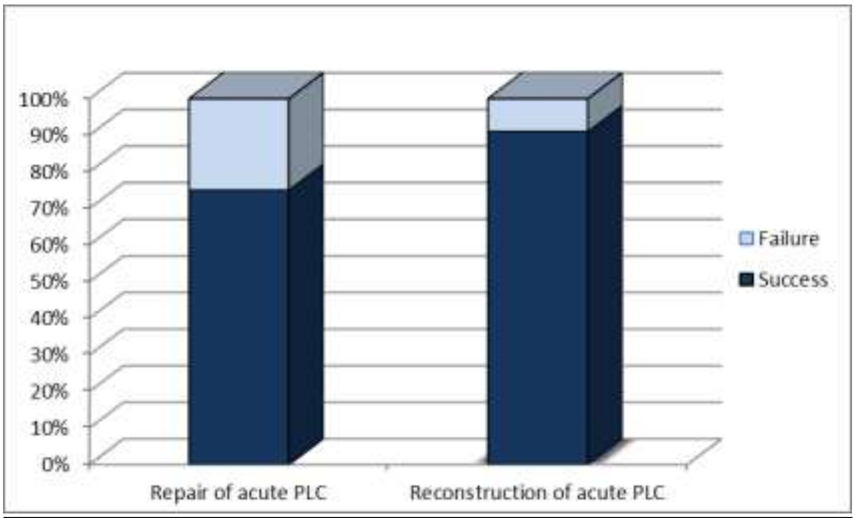
Author	Mean Lysholm	Mean IKDC
Ibrahim et al (2013)	90	Not recorded
Geeslin and LaPrade (2011)	89.5	81.5
McCarthy et al (2015)	Recon. 83 Repair 83	68 71
Levy et al (2010)	Recon. 88 Repair 85	77 79
Schechinger et al (2009)	Acute 88.7 Chronic 89.9	78.1 81.3
Shelbourne et al (2007)	91.5	91.3
Bin and Nam (2007)	87.5	Not recorded
Fanelli et al (2014)	91.8	Not recorded
Kim et al (2013)	86.3	Not recorded
Kim et al (2012)	90.1	Not recorded
Kim et al (2011)	Group A 89.1 Group B 82.7	Not recorded
Kim et al (2010)	86.6	Not recorded
Zorzi et al (2013)	89.1	86
Noyes et al (2011)	87.4	Not recorded
Noyes et al (2007)	85.8	Not recorded
Yoon et al (2011)	86.4	75.3
Jakobson et al (2010)	90.2	Not recorded
LaPrade et al (2010)	84.2	62.6

Varus stress test:

Table (4) showing postoperative varus stress results

	0	+1	+2	Criteria of measurement
Ibrahim et al (2013)	14	3	3	Examination
Geeslin and LaPrade (2011)	16	5	5	Examination
McCarthy et al (2015)	Recon. 15 Repair 13	26 3	2 2	Examination
Levy et al (2010)	Recon. 11 Repair 3	6 3	1 4	Examination
Schechinger et al (2009)	Acute 5 Chronic 5	2 4		Examination
Shelbourne et al (2007)	9	5	7	Radiograph
Bin and Nam (2007)	5	2	1	Radiograph
Fanelli et al (2014)	20	12	2	Examination
Kim et al (2013)	31	22	12	Radiograph
Kim et al (2012)	13	8	2	Radiograph
Kim et al (2011)	Group A 16 Group B 5	4 11	A 1 B 9	Radiograph
Kim et al (2010)	27	13	2	Radiograph
Zorzi et al (2013)	12	5	2	Examination
Noyes et al (2011)	8	2	3	Radiograph
Noyes et al (2007)	8	5	1	Examination
Yoon et al (2011)	21	10	1	Examination
Jakobson et al (2010)	9	17	1	Examination
LaPrade et al (2010)	48	12	4	Examination

Objective outcomes were classified as success or failure based on postoperative varus stress examination findings, varus stress radiographs, where Success was defined as grade 0 or I. Failure was defined as grade II or III post-operative or the need to reoperate because of varus instability.
That makes the failure rate of repair of acute PLC is 25% and failure rate of reconstruction of PLC is 9%



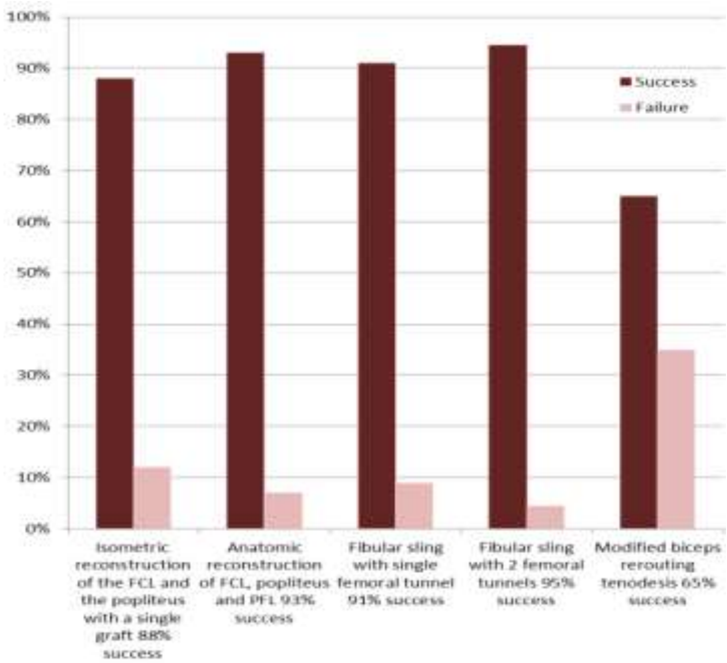
Repair of acute PLC injury is associated with 25% failure rate.
Reconstruction of acute PLC is associated with 9 % failure.

Success and failure of different reconstruction techniques:

1- Isometric reconstruction of the FCL and the popliteus with a single graft. Success 88% Failure 12%.

Anatomic reconstruction of FCL, popliteus and PFL. Success 93% failure 7%
Fibular sling with single femoral tunnel. Success 91% failure 9%
Fibular sling with 2 femoral tunnels. Success 95% failure 5%.
Modified biceps rerouting tenodesis. Success 65% failure 35%

Comparison between success rates of different reconstruction techniques:



5. DISCUSSION

The most evident outcome was that the acute repair of the PLC is associated with 25% failure rate, and reconstruction of PLC is associated with 9 % failure. Reconstruction techniques varied among studies which can be categorized, all reconstruction techniques had very close failure rates, the highest failure rate was isometric reconstruction of the FCL and the popliteus with a single graft with failure rate 12% and the lowest one was the fibular sling with 2 femoral tunnels with failure rate 5%. There were several limitations including PLC injuries mostly occur combined with other injuries where 59% had combined PCL injuries, while only 23% had combined ACL injuries, 6% had combined ACL and PCL injuries, and 12% had isolated PLC injuries, making it difficult to suggest a specific treatment for PLC injuries, no randomized control trials, surgeon's experience affects decision and outcome of the surgical technique, level of evidence in the literature for outcomes after the surgical treatment of PLC injuries limits any definitive conclusions regarding an optimal surgical technique, as with any systematic review, it is possible that relevant articles or patient subgroups were not identified with our search terms and literature review.

6.CONCLUSION

Repair of acute PLC injuries was associated with a 25% failure rate, whereas reconstruction of PLC structures had 9% failure rate. Reported subjective and objective outcome scores varied across the 15 studies. Surgical techniques included variations of fibular slings, capsular shifts, and 2-tunnel techniques (fibular tunnel and tibial tunnel), anatomic reconstruction. Further research with longer follow up, and randomized control trials is needed to determine the optimal surgical technique for treating PLC injuries because of the wide variability of reported objective and subjective postoperative outcomes.

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