

“Short term functional outcomes of single Stage Surgically treated Multiligamentous Knee injuries in cases of Knee Dislocation”

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KEY WORDS : Knee dislocation, ligament reconstruction, ligament repair, multiligament knee injury
Abbreviations : MLKI (Multi ligament knee Injury)

ABSTRACT

Introduction: Knee dislocation is a disastrous injury with significant displacement of tibia over femur leading to disruption of multiple ligaments of knee and other surrounding soft tissue structures. Open wounds and neurovascular insult can put the limb in jeopardy. The complexity of injury and varied treatment makes this MLKI challenging.

Purpose : This review article describes multiligament knee injuries (MLKI) in depth, with a focus on associated injuries, operative management, outcomes, and complications.

Materials and Methods : We conducted a retrospective observational study of all patients who underwent MLKI surgeries between 2014 to 2020 in a dedicated Arthroscopy and sports injury Center (Deliwala Hospital in Bhavnagar). Over the past 7 years, we have treated many cases and have taken 30 cases for this article. The Schenck knee dislocation classification was used to classify the ligament injury patterns.

Results : The male of age group 36-50 yrs most commonly involved. High Velocity flexion injury is most common mechanism. Medial sided bicruciate injuries most common pattern. 3 patients develops knee stiffness, 2 superficial wound infection and 1 had popliteal artery injury. Early surgeries (3-6 weeks) is always preferred over delayed one. Repair had higher failure rate and lower return to sports activities compared to reconstructions. Surgical treatment has higher mean Lysholm score 96.3.

Conclusions : This review suggests that the best treatment guidelines for MLKI is still awaited due to heterogeneous nature of the injuries themselves and the many treatment strategies available, but better functional outcomes have been achieved with reconstruction rather than repair. Surgery must be performed early within 6 weeks for better results. When feasible ACL reconstruction can be delayed thereby reducing rate of arthrofibrosis. High-quality research efforts needed to investigate best modality of treatment of MLKI.

INTRODUCTION

Knee dislocation is potentially disastrous injury with significant displacement of the tibia and femur disrupting multiple knee ligaments and surrounding soft tissue envelope. If neuro-vascular involvement be there, limb is severely jeopardised. In knee dislocation, multiligament knee injuries are quite rare with an estimated prevalence of 0.02% to 0.2% of all orthopaedic injuries.^[1]

These injuries are associated with high velocity road

traffic accident with knee either in flexion or in extension. Multiligament knee injury defined as disruption to at least two of the four major knee ligament structures: the anterior cruciate ligament (ACL), the posterior cruciate ligament (PCL), the posteromedial corner, and the posterolateral corner (PLC).^[2,3] A knee dislocation is typically characterized by rupture of both cruciate ligaments, in combination with either an associated grade III medial or lateral sided injury.^[4-6] True incidence is masked due to spontaneous reduction of knee dislocation

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prior to presentation.^[3]

On the basis of tibial displacement relative to femur, knee dislocations can be classified into Kennedy position classification system. This system classifies knee dislocation into anterior, posterior, lateral, medial, and rotatory [Table 1]. Rotatory dislocations later subclassified into anteromedial, anterolateral, posteromedial and posterolateral^[14]

Schenck classify knee dislocation in 1994, on the basis of anatomical patterns of ligaments torn^[5,6] and later modified by Wascher. Each knee dislocation abbreviated with KD (knee dislocation) and is followed by the number of ligaments (or complexes) disrupted (I to IV) and "M" if the posteromedial corner is injured or "L" if the posterolateral corner is injured. It was further classified to include a type V for periarticular fractures, a "C" modifier for arterial injuries, and an "N" modifier for nerve injuries (Table 2)^[5,7]

Table 1: Kennedy "position" classification system for knee dislocations

DIRECTION	MECHANISM	INJURY PATTERN
Anterior (most common)	Hyperextension	Posterior Capsules, ACL/PCL tears
Posterior (2nd most common)	Dashboard	PCL torn
Lateral	Valgus	Collaterals, Cruciates
Medial	Varus/rotation	Collaterals, Cruciates
Rotatory	Rotatory	Complex tears

Table 2: Schenck anatomic classification system for knee dislocations

<p>Schenck Classification (based on the number of ruptured ligaments)</p> <ul style="list-style-type: none"> • KD I Multiligamentous injury with the involvement of the ACL or PCL • KD II Injury to ACL and PCL only (2 ligaments) • KD III Injury to ACL, PCL, and PMC or PLC (3 ligaments). • KDIIIM (ACL, PCL, MCL) and KDIIIL (ACL, PCL, PLC, LCL). • KD IV Injury to ACL, PCL, PMC, and PLC (4 ligaments) KDIV has the highest rate of vascular injury (5-15%%) based on Schenck classification • KD V Multiligamentous injury with periarticular fracture

FIG 1: Showing clinical pictures of Knee subluxation with posterior knee dislocations.

- (A) Posterior sag suspecting PCL injury
- (B) valgus stress showing laxity of medial side suspecting MCL injury,
- (C) Bruise over anterior aspect of thigh and knee suspecting high velocity acute injury



ASSOCIATED INJURY

Knee dislocation associated with damage to popliteal artery, common peroneal nerve and other soft tissue injuries around knee.

The prevalence of vascular injury associated with knee dislocation ranging from 3.3% to 64%.^[8-12] The diagnosis of popliteal artery injury is a subject of controversy, as numerous authors have advocated routine arteriography or duplex Colour Doppler. Urgent Intervention is needed either repair or use graft. Unfortunately, knee dislocations associated with popliteal artery injury generally have a poor prognosis with high rates of eventual amputation.^[8-9]

The common peroneal nerve injured because of anatomic constraints on its ability to accommodate to traumatic changes in knee position, both proximally at the fibular neck and distally at the intermuscular septum.^[13] The incidence is 14%–25%, with as high as 41% cases reported after posterolateral complex (PLC) injuries.^[15] Approximately 30% of cases have a complete neurological palsy and the rest have a partial peroneal nerve palsy.^[16] Only 38.4% patients with a complete palsy, and 87.3% patients with incomplete palsy have been found to have functional recovery (MRC grade ≥ 3).^[17] It leads to substantial morbidity due to the resulting foot drop and likely need for an orthosis, neurolysis, nerve transfer and tendon transfer required if it persists after 1 year.

MRI is extremely sensitive for detecting cruciate ligament, collateral ligament injury, and injury to the posterolateral and posteromedial corner. Its key to identifying extraligamentous or other soft-tissue knee injuries.

Stress radiography^[18,19] is inexpensive tool capable of showing the magnitude of knee instability in an objective and quantifiable way, and can assist in preoperative decision making. stress radiography utilized to quantify and to follow postoperative stability in addition to preoperative assessment. At our institution routinely intraoperative stress radiographs are obtained to direct the reconstruction and repair of soft tissues.

This review article describes multiligament knee injuries in depth, with a focus on associated injuries, operative management, outcomes, and complications.

MATERIALS AND METHODS

STUDY CENTRE: Arthroscopy and Sports Injury Center (Deliwala Hospital in Bhavnagar)

STUDY POPULATION: All IPD and OPD patients coming to clinic who underwent MLKI surgeries.

INCLUSION CRITERIA:

1. Patient who underwent surgery for at least 2 knee ligament structures.
2. Same operating surgeon.
3. Single stage surgery.
4. At least 6 months of follow-up.

EXCLUSION CRITERIA:

1. Open injuries
2. Associated multiple bone fracture
3. Head injuries
4. Bilateral involvement
5. Patient who Lost follow-up.

SAMPLING TECHNIQUE- Simple Random Sampling

STUDY DESIGN- Retrospective Observational Study

STUDY DURATION- June 2014 to June 2020

SAMPLE SIZE CALCULATION AND JUSTIFICATION

Samples are taken as per inclusion criteria and 30 cases are included for our study.

DATA COLLECTION

All information along with identity of participants will be kept confidential. After explaining the purpose of the study, a written informed consent was obtained from all the participants before data collection. Injury was classified according to schenck classification.^[6] The data were recorded in a predesigned and pretested proforma. parameter to be studied:

1. Age
2. Gender
3. Mode of injury
4. Mechanism of injury
5. Complications following surgery
6. Functional outcomes by **LYSHOLM SCORE-** Calculated using following parameters : a) Limp, b) support, c) pain, d) instability, e) locking, f) swelling, g) stair-climbing, h) squatting.

STATISTICAL ANALYSIS:

Data was collected in a predesigned proforma and later tabulated in a Microsoft excel sheet. Data was analyzed using SPSS software version 20, IBM Corporation. Results on categorical data is shown as n (% of cases).

RESULTS AND DISCUSSION

Total 30 patients of MLKI in knee dislocation included as per inclusion criteria who were treated in dedicated arthroscopy and sports injury center in Bhavnagar from 2014 to 2020. Patients were followed atleast 6 month postoperatively in our center. 17 patients followed more than 4 year and 8 patients more than 2 year and rest 5 for 9 months.

As shown in table 3, incidence of MLKI is predominant in 36-50 years age group and higher in male (73%) than female (27%). Most common mode of injury is high velocity road traffic accident (90%) with flexion mechanism (table-5,6). 23 patients undergone surgeries within 4 weeks and rest 7 after 4 weeks. All patient undergone single stage Arthroscopy reconstruction surgery of torn structures. In few patients open reconstruction of collaterals done. Most frequent injury (table-9) associated was ACL + MCL (36.67%) followed by ACL+PCL (23.34%). All patients undergone Autograft reconstruction, among them in 26 patients we use Hamstrings tendon and in 4 patients Peroneus longus Tendon. In single stage surgery, 2 Ligaments were reconstructed in 24 cases and 3 Ligaments reconstructed in 6 cases (Fig-2,3).

Fig.2 : (A) Preoperative KD-III L type of Knee Dislocation.2 (B) Postoperative Single stage 3 Ligament [PCLR +ACLR+ PLC] Reconstruction in a 36yrs female (Modified Larson's & Muller Popliteal Bypass technique)

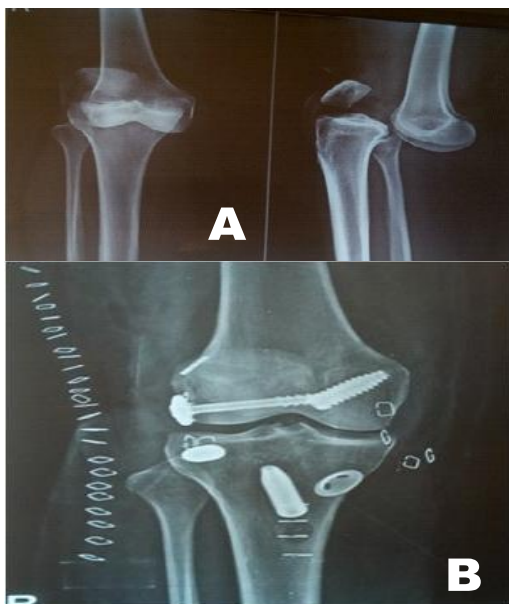


Fig.3 (A/B): Single Stage ACLR +MCL reconstruction in MLKI



Complications (Table-8) occurs in few patients. 2 patient got superficial early infection for which debridement was done at 15 days and that was cured at 3 months. 1 patient develop vascular insufficiency as arterial clots which was repaired immediately by vascular surgeon and limb was salvaged. Postoperatively due to noncompliant to physiotherapy 3 patients develop knee stiffness, one of which undergone manipulation under anesthesia and later gain knee movement to continue ADL. Other one due to infection and stapler insitu develops stiffness. Later on undergoes debridement and dressing, finally regain knee movement.

All patients undergoes preoperatively and postoperatively Lysholm knee score^[37] for assessment of functional outcome of each patients in a proper format. A score between 0 and 100 is generated, allowing a rating of excellent (95 to 100), good (84 to 94), fair (65 to 83), or poor (< 65). In our cases there is significant improvement in score of average 96.3 compared to 38.8 preoperatively.

DISCUSSION

It is very difficult to accurately predict the outcomes of MLKI patient due to heterogenous nature of anatomical knee injury pattern along with relative rarity of cases [2]. Different functional and clinical outcome measures, different treatment regimen reduces the validity of these study conclusions.

To offset the rarity and heterogeneity in this group, a multicentric research should be conducted where large volume of patient can be taken with entire spectrum of injury pattern and treated by experience surgeons.

In our study, most of patients are in age group of 20-50 years constituting 83.34% of our total cases which is

Table 3: Age Distribution

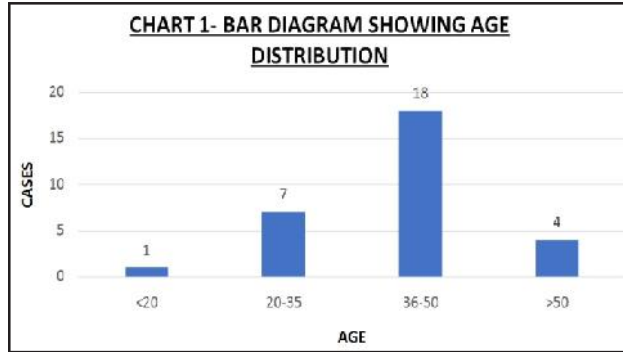


Table 4: Sex Distribution:

SEX	NO. OF CASES (n)	PERCENTAGE (%)
MALE	22	73%
FEMALE	8	27%

Table 5 : Mode of Injury

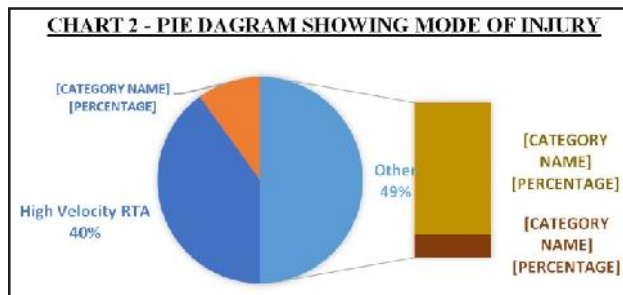


Table 6: Mechanism of Injury

MECHANISM OF INJURY	NO. OF CASES (n)	PERCENTAGE (%)
FLEXION INJURIES	24	80%
EXTENSION INJURIES	6	20%

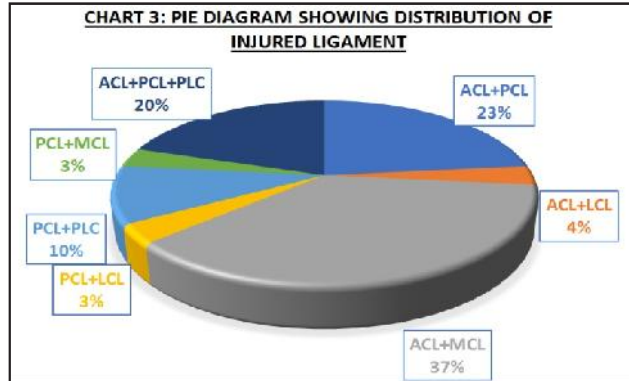
Table 7: Complications

COMPLICATION	NO. OF CASES (n)
WOUND INFECTION	2
VASCULAR INJURY	1
NERVE UNJURY	0
KNEE STIFFNESS	3

Table 8: Functional Outcomes (LYSHOLM SCORE)

	LYSHOLM SCORE
PRE- OP (Avg)	38.8
POST- OP (Avg)	96.3

Table 9: Ligament Injured and Repair/Reconstructed



LIGAMENT INJURED	NO. OF CASES	PERCENTAGE
ACL + PCL	7	23.34%
ACL + LCL	1	3.33%
ACL + MCL	11	36.67%
PCL + LCL	1	3.33%
PCL + PLC	3	10%
PCL + MCL	1	3.33%
ACL + PCL + PLC	6	20%
TOTAL	30	

consistent with other similar studies of MLKI with reference to age.

1. Gender distribution-

Male patients constituted 73% of the cohort compared to female patients with only 27%. Therefore men more commonly involved than females.^[1,20]

2. Mechanism of injury-

MLKI can be caused by both high velocity injuries like RTA as well as low velocity injuries like domestic falls and sports related injuries. In this study the most common cause of MLKI was RTA constituting 80%. This was followed by domestic falls and sports related injuries in 20% of patients. So there were more prediliction to high velocity injuries over low velocity. This mechanism of injuries correlates with other mentioned in other previous studies on MLKI.^[1,21]

3. Pattern of injury-

There is diverse opinions regarding the most common combination of injured ligaments. Maotshe G et al.^[1] study of 303 patients showing cruciates with medial sided injuries as the most common pattern, where as in Robertson et al.^[22] and Berker et al.^[23] it is the lateral sided injuries along with cruciate.

In our study, the distribution is as shown in Table 9 and ACL with medial sided injuries is the most common pattern with 36.67% of total cases followed by ACL plus PCL injuries constituting 23.34% of the total cases.

4. Early vs Late surgery:

Consensus regarding timing of surgery is always debatable. Patients undergoing surgery within 3 weeks of injury shown to have higher return to sports as compared to those who undergo surgery in the chronic stage (>3 weeks usually at a mean of 51 weeks). However, the functional outcome scores were reported to be similar in both the groups.^[2,24]

5. Repair versus reconstruction:

Recent studies have demonstrated unacceptable high failure rates with isolated repair of damaged collateral ligaments. Although delayed reconstruction demonstrates improvements over early repair. Collateral stability achieved best if treated in early phase and healed more effectively if central cruciate stability is achieved simultaneously.

Stannard et al.^[25] and Levy et al.^[2] showed better outcomes with the PLC reconstructions as compared with their repairs. The average failure rate was found to be 7.5% after reconstruction and 38.5% after repair with similar mean Lysholm and IKDC scores at final follow-up.^[26] Owens et al performed primary repair of complete MCL avulsion in 11 patients with knee dislocation, with excellent valgus stability reported in all patients.^[27] In conclusion, the reconstruction has a lower failure rate than repair for PMC injuries in multiligament injured knees, similar to the findings for the PLC.

Reconstruction of both the ACL and PCL has become popular, with good outcomes reported using autograft, allograft, and synthetic ligaments. PCL reconstruction has been described using both single and double bundles, as well as inlay versus transtibial techniques.^[29,30,31] Mariani et al looked at the outcome in groups of patients with ACL and PCL injuries with three surgical techniques: both cruciates repaired, both cruciates reconstructed, or ACL reconstruction combined with PCL repair.^[28] All three groups had very similar IKDC and Lysholm Scores.

Literatures comparing repair vs reconstruction of both cruciates, showing direct repair had statistically significant increased rates of posterior sag and lower rates of return to preinjury level, whereas both cruciate

reconstruction group had increased return to sport rates. In conclusion operative repair when feasible but mostly reconstruction is better treatment option than conservative treatment.

The optimal strategy is likely one where both early repair and reconstructive techniques are combined to allow immediate stability and early mobilization.

6. Single stage vs stage repair or reconstruction:

Another debatable topic is whether to treat it in single stage or in staged manner. Stage surgery includes collateral ligament repair or reconstruction in acute stage (<3 weeks) followed by supervised rehabilitation for 3–6 weeks. In Second stage ACL and PCL reconstruction is performed once Knee Rom is > 100 degree.

There are various studies by Jari and Shelbourne^[32] Tay and MacDonald^[33] and Liowet al^[34] advocating staged reconstruction, this study shows equally better outcomes with single stage multiligament reconstruction. Tao J et al.^[35] and Jiang et al.^[36] supporting the single stage treatment of MLKI. Single stage surgery lead to arthrofibrosis, infection and stiffness as complications. In our study 3 patients develops knee stiffness. Single stage MLKI management has added advantages like less number of admissions to hospital and also facilitates early initiation of rehabilitation including early resumption of daily activities and sports.

7. Outcome Analysis :

Previous studies incorporates variety of knee-specific scores and this nonuniformity makes comparison between studies very difficult. Multicentered research is needed to clearly define superiority of specific knee scores.

Overall, the mean pre surgery Lysholm scores were 38.8 and the postsurgery mean Lysholm scores were 96.3. This is in consensus with other studies supporting surgical management of MLKI by Maotshe et.al,^[1] Tao J et.al^[35] and JiangWet al.^[36] hence surgical management provides superior outcomes in MLKI. There is no statistically significant difference in outcomes of two ligament injury reconstruction and three ligament injury reconstruction.

CONCLUSION

This article guides young surgeons, whenever feasible MLKI should treat as early as possible with single stage repair or reconstruction and put on assisted rehabilitation

to achieve good outcomes. Multicentric research should be conducted with large volume of patient with entire spectrum of injury pattern to evaluate outcome study.

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