Outcomes of multiligament knee reconstruction in high-energy trauma, prospective cohort study involving 78 patients

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Faculty disclosure information

Nothing to disclosure

Introduction

- Outcomes after multiligament knee reconstruction (MLKR) following high-energy trauma are limited in the literature

Dean RS, et al. Am J Sports Med. 2021
LaPrade RF, et al. Am J Sports Med. 2019

- Questions:
    - surgical timing: acute vs. chronic
    - outcomes stratified by Schenck classification
    - association with extensor mechanism injury

Marder RS, et al. Orthop J S Med. 2021
Alentorn-Geli E, et al. Knee Surg. 2019
Medvecky MJ, et al. J Bone Joint 2023

Purpose

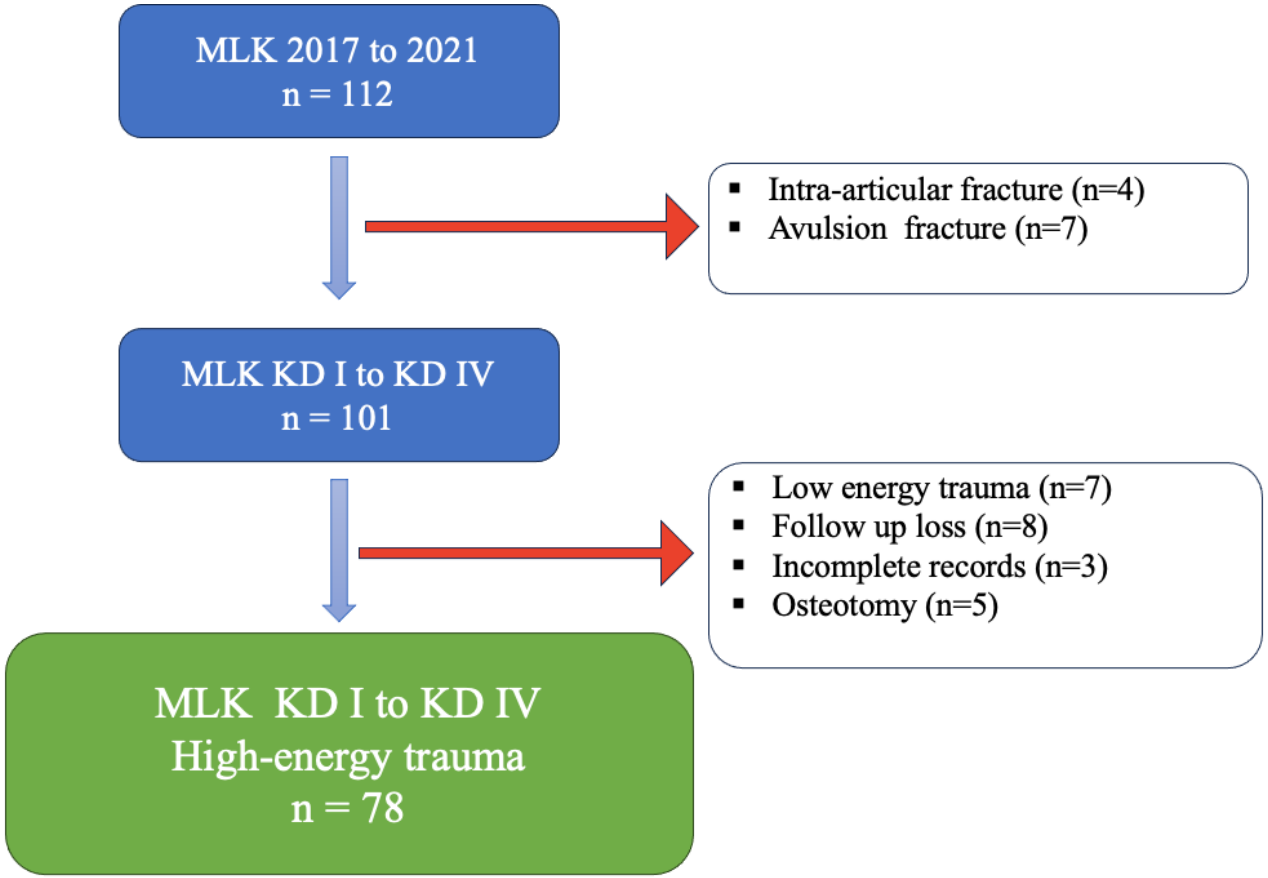
- Evaluate the outcomes MLKR with autologous graft in injuries resulting from high-energy trauma
- Compare the outcomes MLKR and patellar tendon (PT) repair in a single procedure in relation to a group without injury to the PT submitted to MLKR
- Compare the outcomes of surgical treatment in acute and chronic injuries
- Outcomes taking into account the Schenck classification

- Inclusion criteria

- Skeletally mature
- Minimum follow-up of 24 months
- Injury to at least 2 of the 4 ligaments
- Diagnosis confirmed by PE and/or MRI
- Injuries resulting from high-energy trauma

- Exclusion criteria

- Avulsion fracture
- Intra-articular fracture
- Previous knee surgery
- Knee arthritis
- Chronic injury and axis alteration



Surgical Management: Autograft were used in all cases

- MLKR in pacients without PT Injury:
  - PCL arthroscopically transtibial single bundle
  - ACL arthroscopically transportal
  - PLC Arciero , LaPrade et al., or Larson et al.
  - MCL Canuto et al.

- MLKR in pacients with PT Injury:
  - PCL transtibial single bundle
  - ACL was not reconstructed
  - PLC Arciero
  - MCL Canuto et al.
  - PT: distal avulsion direct repair
    intra-substance ST reinforcement

Rehabilitation

- All patients had the same acute rehabilitation goals
- Long removable rigid brace for 8 weeks
- Rehabilitation was started on the 2 day
- First 4 weeks, the ROM 0 and 90, after that full ROM was allowed
- 6 weeks, progressive weight-bearing started, using crutches
- 8 weeks, the long static immobilizer was removed
- Return to sports activities after 12 months: the one-leg hop test, absence of pain, and effusion

Table 1 – Descriptive Demographics of the Cohort, High-energy Multiligament Injuries and Minimum 2-Year Follow-up (N = 78)

Injured ligament	N (%)	Mean Age at Surgery, y (Range)	Male: Female, N	Mean BMI (Range)	Median Time to Surgery, d (Range)	Acute: Chronic, N	External fixator (no/yes)	Mechanism of Injury (Motorcycle/Car: Pedestrian)	Mean Follow-up, m (Range)
ACL/MCL	2 (2,6)	27,5 (19-36)	2:0	21,8 (18,9-24,7)	165,5 (10-321)	1:1	2:0	2:0:0	39,0 (29-49)
ACL/PLC	6 (7,7)	26,8 (20-28)	5:1	24,4 (20,4-27,8)	19,0 (14-212)	5:1	6:0	5:0:1	40,5 (26-51)
PCL/MCL	2 (2,6)	26,5 (22-31)	1:1	26,1 (23,8-28,3)	317,0 (16-618)	1:1	2:0	2:0:0	37,5 (26-49)
PCL/PLC	14 (18,0)	28,4 (17-44)	11:3	23,2 (18,8-27,2)	17,5 (13-393)	12:2	13:1	10:1:3	37,0 (24-50)
ACL/PCL	1 (1,3)	25,0 (25-25)	1:0	26,6 (26,6-26,6)	272,0 (272-272)	0:1	1:0	1:0:0	25,0 (25-25)
ACL/PCL/MCL	15 (19,0)	32,4 (21-49)	13:2	24,9 (19,2-30,1)	15,0 (6-291)	14:1	12:3	11:1:3	34,6 (25-46)
ACL/PCL/PLC	19 (24,0)	28,8 (20-48)	16:3	24,9 (20,6-30,6)	17,0 (6-302)	15:4	15:4	15:1:3	32,8 (24-47)
ACL/PCL/MCL/PLC	19 (24,0)	30,3 (19-46)	19:0	23,2 (18,2-30,4)	11,0 (4-21)	19:0	9:10	19:0:0	33,6 (24-46)
Entire cohort	**78 (100)**	**29,5 (17-49)**	**68:10**	**24,1 (18,2-30,6)**	**16,0 (4-618)**	**67:11**	**60:18**	**65:3:10**	**34,9 (24-51)**

ACL, anterior cruciate ligament; BMI, body mass index; MCL, medial collateral ligament; PCL, posterior cruciate ligament; PLC, posterolateral corner; m, month; y, year; N, Number of individuals

Table 2 – Description of Associated Injuries in the Total Sample of Patients (N = 78)

Injured ligament	Vascular Injury	Peroneal Nerve Injury	Extensor Mechanism Injury (patellar ligament)	Fracture (excluding knee)	Meniscal Injury	Cartilage Injury	Open Injury
ACL/MCL	2:0	2:0	2:0	2:0	2:0	2:0	2:0
ACL/PLC	6:0	6:0	6:0	6:0	4:2	6:0	6:0
PCL/MCL	2:0	2:0	2:0	2:0	1:1	2:0	2:0
PCL/PLC	13:1	13:1	14:0	12:2	12:2	11:3	13:1
ACL/PCL	1:0	1:0	1:0	1:0	0:1	1:0	1:0
ACL/PCL/MCL	15:0	15:0	12:3	14:1	10:5	13:2	15:0
ACL/PCL/PLC	17:2	17:2	16:3	18:1	13:6	17:2	19:0
ACL/PCL/MCL/PLC	19:0	17:2	9:10	18:1	4:15	17:2	17:2
Entire cohort	**75:3**	**73:5**	**62:16**	**73:5**	**46:32**	**69:9**	**75:3**

ACL, anterior cruciate ligament; BMI, body mass index; MCL, medial collateral ligament; PCL, posterior cruciate ligament; PLC, posterolateral corner

Note: Values are presented as Number of individuals (No/Yes) for all variables

Pre- and Postoperative Outcome Scores for the Entire High-energy Multiligament Reconstruction Cohort (N = 78) at a minimum 24 months follow-up

Scores	Preoperative		Postoperartive		p
	Mean (SD)	Range	Mean (SD)	Range	
Lysholm	6,19 (15,7)	0-62	83,31 (9,0)	53-100	<0,001*
IKDC	4,56 (12,1)	0-49	69,92 (11,4)	33-100	<0,001*
Tegner	4,03 (1,1)	2-6	3,51 (0,8)	2-6	<0,001*
Satisfaction	-	-	8,55 (1,3)	3-10	-

*p<0,05

Range of motion and time to return to work (months) (N=78)

Variáveis	N	Mean	DP	Med	Min	Max
Extension	78	0,12	0,87	0	-2	3
Flexion	78	119,9	7,54	120	100	130
Time to return to work (months)	78	4,64	2,30	4	2	12

Objective IKDC : 86% A or B

Postoperative Outcome Scores Comparing isolated acute KD III and IV (N=32) and associated with patellar ligament injury (N=16) Reconstruction Groups

Scores	Acute injury KD III e KD IV				p
	No patellar ligament injury (N=32)		With patellar ligament injury (N=16)		
	Mean (SD)	Range	Mean (SD)	Range	
Lysholm Pós	80,19 (7,8)	53-91	77,44 (6,8)	65-88	0,128
IKDC Pós	67,27 (11,6)	33-94	64,62 (6,7)	53-77	0,321
Tegner Pós	3,38 (0,8)	2-6	3,44 (0,6)	2-4	0,531
Satisfaction	8,34 (1,0)	6-10	8,31 (1,1)	7-10	0,828

Postoperative outcome scores comparing injuries KD I e II vs KD III vs KD IV

Scores	Postoperative Injured ligaments						p
	KD I e II (N=25)		KD III (N=34)		KD IV (N=19)		
	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	
Lysholm	91,12 (7,1)	63-100	81,68 (7,2)	53-91	75,95 (6,2)	65-88	<0,001*
IKDC	77,0 (11,4)	52-100	67,73 (11,0)	33-84	64,52 (7,1)	53-77	<0,001*
Tegner	3,68 (1,0)	2-5	3,47 (0,8)	2-6	3,37 (0,6)	2-4	0,595
Satisfaction	9,0 (1,5)	3-10	8,44 (1,0)	6-10	8,16 (0,9)	8-7	0,005*

*p<0,05

Postoperative Outcome Scores Comparing Acute and Chronic Reconstruction Groups

Scores	Postoperative				p
	Acute (N=42)		Chronic (N=11)		
	Mean (SD)	Range	Mean (SD)	Range	
Lysholm	85,79 (9,0)	53-100	88,18 (7,1)	74-100	0,60
IKDC	71,55 (12,8)	33-100	75,07 (10,4)	60-100	0,40
Tegner	3,45 (1,0)	2-6	3,91 (0,7)	3-5	0,08
Satisfaction	8,60 (1,4)	3-10	9,09 (1,0)	7-10	0,26

Pre- and Postoperative Stress Radiographs for Patients With MCL, PCL, and FCL/PLC Injuries According to Valgus, Posterior and Varus Stress

Stress Radiograph	Preoperative		Postoperative		p
	Mean (SD)	Range	Mean (SD)	Range	
PCL (N=61)	14,70 (2,9)	10-21	1,80 (0,8)	1-4	<0,001*
MCL (N=37)	5,89 (2,2)	3-10	1,20 (0,7)	1-3	<0,001*
FCL/PLC (N=51)	9,78 (3,0)	4-15	1,19 (0,6)	1-3	<0,001*

All measurements are reported in millimeters. *p<0,05

Tabela 10 – Patients With Reported Complications After Multiligament Knee Surgery (N = 14)

Variáveis	N (%)
Arthrofibroses	7 (9,0)
Infection	3 (3,9)
DVT	0 (0)
Graft Failure	1 (1,3)

Percentages are based on total sample size (N = 78). DVT, deep venous thrombosis

Conclusion

- Single-stage reconstruction with autograft and early rehabilitation leads to significantly improved outcomes, low complication rate in high-energy trauma
- Single-stage PT repair and MLKR with early rehabilitation: leads to comparable outcomes to the group without PT injury
- Return to work in 4.64 months with a return rate of 93.6%
- There was no difference in the outcomes when comparing reconstruction in the acute and chronic phases
- KD I and II injuries compared to KD III and IV injuries - minimum detectable difference achieved for Lysholm score
- No clinically important minimum difference was observed for IKDC and minimum detectable difference for Tegner considering Schenck classification

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