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Lateral Meniscus Root Tear in ACL-Injured Patients Results in High-Grade Rotatory Knee Laxity: A Quantitative Pivot Shift Analysis

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Disclosures

Volker Musahl

- Consulting: None
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Kristian Samuelsson

- Member on the board of directors - Getinge AB (publ)

Others:

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Introduction

In vitro biomechanical studies:

- negative impact of lateral meniscus posterior root (LMPR) tears on rotatory laxity in knees with anterior cruciate ligament (ACL) tears[1,2,3]
- The effect of LMPR tears on pivot shift (PS) in ACL-injured patients is unclear.

Objective:

- To evaluate the impact of LMPR tears on rotatory knee laxity
- A clinically validated quantitative PS (QPS) analysis system is used
- Quantitative assessment of the relationship between LMPR tears and QPS in patients with ACL tears

Materials & Methods

Patients

- Prospective ACL tear registry - 2012 to 2020, University of Pittsburgh

Inclusion criteria

- Primary ACL tears, no concurrent ligamentous or bony injuries requiring operative treatment, and no previous surgeries to either knee.

Variables

•Patient demographics, manual and instrumented clinical exams were extracted through chart review.

•Intraoperative data - LMPR tear, tear depth, position, and relation to the popliteal hiatus

Materials & Methods

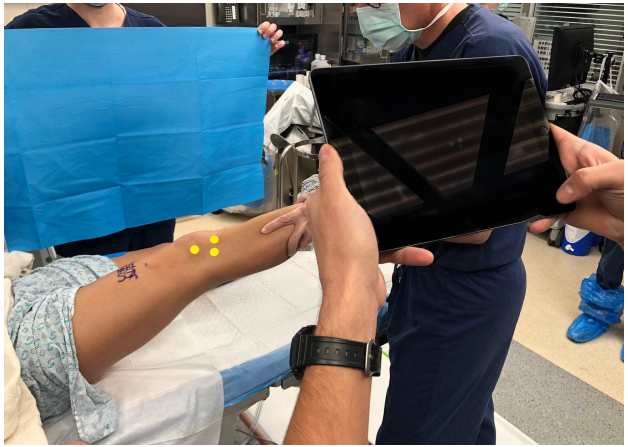
Groups

- Presence (LMPR+) or absence (LMPR-) of an LMPR tear concomitant with ACL injury.

Examination under anaesthesia

- Standardized PS test
- Anterior tibial translation (ATT; mm) with Rolimeter
- QPS assessment (mm) with a tablet-based image analysis system (PIVOT App)[4]

Figure 1 Quantitative pivot shift analysis with tablet-based technology



Materials & Methods

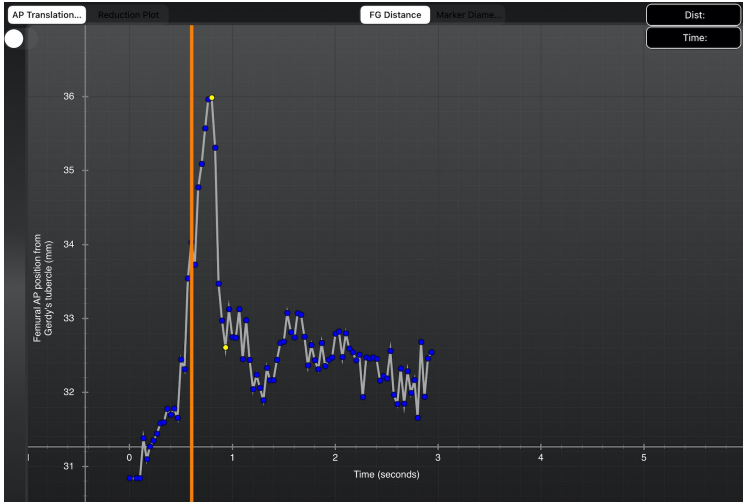
Descriptive statistics

- Frequency, proportion (%), median, and interquartile rage (IQR).

Between-group comparisons

- Categorical variables: *Fisher exact* and *Chi-square tests.*
- Non-normally distributed continuous variables: *Mann-Whitney U test*.
- Level of significance: p<0.05.

Figure 2 Quantitative pivot shift measurement results based on anteroposterior translation of the tibia in relation to Gerdy's tubercle



Results

A total of 111 eligible patients

- 25 (23%) LMPR+
- 86 (77%) LMPR-

Tear localization

- zone 1 (n = 9, 36%)
- zone 2 (n = 9, 36%)

Tear depth

- partial in 15 (60%) patients
- full in 10 (40%) patients
- 7 (28%) were central to the popliteal hiatus.

Variable	ACL-R (LMPR-)	ACL-R + LMPR tear (LMPR+)	P-value
Preoperative Lachman grade – involved knee, n (%)			
0	1 (0.1)	0	
1	10 (12)	3 (12)	
2	58 (67)	18 (72)	
3	5 (6)	0	
Unknown	12 (14)	4 (16)	
Preoperative pivot shift grade - involved knee, n (%)			
0	0	0	
1	29 (34)	4 (16)	
2	37 (43)	16 (64)	
3	2 (2.3)	0	
Unknown	18 (21)	5 (20)	
Quantitative pivot shift under anesthesia – involved knee, median (IQR) [mm]	3.2 (2.1)	3.6 (2.5)	0.11
Quantitative pivot shift under anesthesia – uninvolved knee, median (IQR) [mm]	1.2 (1.1)	1.1 ± (1.0)	0.45
Quantitative pivot shift under anesthesia – side-to-side difference, median (IQR) [mm]	1.9 (2.1)	2.4 (2.5)	**0.033**
Status of torn ACL, n (%)			
Complete femoral sided tear	77 (90)	22 (88)	
Partial posterolateral bundle rupture	6 (7.0)	2 (8)	
Unknown	3 (3.4)	1 (4)	
Medial meniscus tear, n (%)	34 (40)	17 (68)	**0.021**
LMPR tear depth, n (%)			
Partial	-	15 (60)	
Full	-	10 (40)	

Results

No significant difference between LMPR+ and LMPR- groups

- Age, sex, body mass index, time from injury to surgery

No significant difference (p=0.85) in ATT with Rolimeter

- LMPR+: 5.0 mm, IQR = 3.0
- LMPR-: 5.0 mm,IQR = 3.0

Majority of patients had grade 2 manual PS preop.

- LMPR+: n = 37, 43%
- LMPR-: n = 16, 64%

Variable	ACL-R (LMPR-)	ACL-R + LMPR tear (LMPR+)	P-value
Number, n (%)	86 (77)	25 (23)	
Age, median (IQR) [years]	21.5 (13.8)	19.0 (14.8)	0.36
Male, n (%)	45 (52)	17 (68)	0.18
BMI, median (IQR) [kg/m^2]	24.6 (6.2)	25.1 (4.4)	0.69
Right knee, n (%)	46 (53.5)	14 (56.0)	
Time from injury to surgery, median (IQR) [weeks]	8.0 (19.3)	6.0 (7.0)	0.26
Preoperative Lachman grade – involved knee, n (%)			
0	1 (0.1)	0	
1	10 (12)	3 (12)	
2	58 (67)	18 (72)	
3	5 (6)	0	
Unknown	12 (14)	4 (16)	

Results

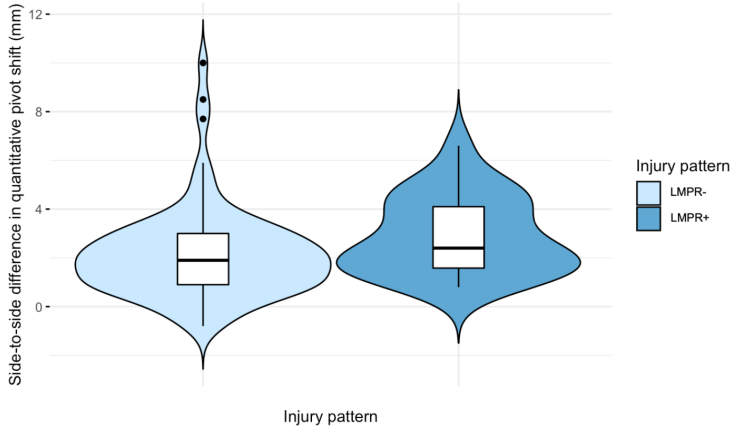
Side-to-side difference in QPS (p=0.033)

- LMPR+: 2.4 mm, IQR = 2.5
- LMPR-: 1.9 mm, IQR = 2.1

Significantly different prevalence of medial meniscus tears (p=0.021)

- LMPR+: n = 17, 68%
- LMPR-: n = 34, 40%

Figure 2 Side-to-side difference in quantitative pivot shift in patients with ACL injury ± LMPR tear



Conclusion

1. Patients with ACL and LMPR tears have significantly greater preoperative rotatory knee laxity compared to patients with ACL tears but no LMPR tears.
2. High-grade PS may increase suspicion for concomitant soft tissue injuries, including LMPR tears.
3. Consider repair of LMPR tears to prevent persistent rotatory knee laxity and further intraarticular injury in patients with ACL tears.
4. The impact of medial meniscus tears on QPS and rotatory knee laxity may require further investigation.

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