Patients Who Undergo Tibial Tubercle Anteromedialization and Medial Patellofemoral Ligament (MPFL) Reconstruction Demonstrate Similar Psychological Readiness and Rates of Return to Sport to Those Who Undergo Isolated MPFL Reconstruction

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INTRODUCTION: The comparative literature describing rates of return to activities among medial patellofemoral ligament reconstruction (MPFLR) with or without a concomitant tibial tubercle osteotomy (TTO) is limited and lacks consensus. There are limited studies that have investigated whether undergoing additional TTO has an effect on psychological readiness to return to sports. The purpose of this study was to investigate the rate of return to sports and sport psychological readiness between patients who underwent isolated medial patellofemoral ligament reconstruction (iMPFLR) compared to a matched cohort of patients who underwent MPFLR with anteromedializing tibial tubercle osteotomy (MPFLR/TTO).

METHODS:
Patients who underwent primary MPFLR with minimum 2-year follow up were retrospectively reviewed from 2012-2020 at an urban academic center. Pre-injury sport and work information, Kujala, Tegner, Visual Analogue Score (VAS) for pain, satisfaction, and MPFL-Return to Sport after Injury (MPFL-RSI) score were collected. Two blinded readers independently measured the tibial tuberosity-trochlear groove distance (TT-TG), Caton-Deschamps index, and assessed trochlear dysplasia using the Dejour classification. Patients in iMPFLR and MPFLR/TTO groups were matched 1:1 based on age, sex, BMI, and length of follow up. Intraclass correlation coefficient (ICC) estimates and were calculated to determine inter-rater reliability based on a single-rater, absolute-agreement, two-way mixed effects model for measurement of TT-TG distance and CDI. Cohen's weighted Kappa coefficient was calculated for Dejour class ratings. Multivariate regression analysis was performed to assess associations of clinical and radiographic findings on return to sport.

RESULTS:
This study included 74 patients (37 iMPFLR, 37 MPFLR/TTO) at mean follow up of 4.4 years. These groups returned to sport at similar rates (iMPFLR: 73.0%, MPFLR/TTO: 67.6%, p=0.611), though iMPFLR patients returned more quickly (8.4 vs. 12.8 months, p=0.019). Most patients in iMPFLR and MPFLR/TTO groups resumed work (95.2% vs. 88.4%, p=0.617). Decreasing age (OR 1.25, p=0.020) and males (OR 87.73, p=0.007) were associated with increased odds of return to pre-injury sport level. Patients with Dejour types B/C took more time to return compared to patients with mild/no trochlear pathology (59.9 vs. 34.3 weeks, p=0.003). Increasing MPFL-RSI was predictive of return to sport (OR 1.08, p<.001) and return to pre-injury level (OR 1.07, p<.001).

DISCUSSION AND CONCLUSION:
Patients who underwent MPFLR with anteromedializing TTO demonstrate similar rates of return to sport and psychological readiness compared to an isolated MPFLR matched comparison group, though iMPFLRs returned more quickly. Patients with more severe trochlear pathology required more time to return to sports.

TABLE 1
Patient Demographics & Clinical Outcomes

Demographics	iMPFLR	MPFLR/TTO	p
N (patients)	37	37	
Sex (female)	27 (70.2%)	27 (70.2%)	1
Age (years)	25.8 ± 10.4	26.1 ± 8.6	0.402
BMI	26.0 ± 6.1	26.2 ± 5.3	0.534
Symptom duration (months)	44.6 ± 70.3	69.3 ± 69.2	0.011
Follow-up (months)	50.6 ± 23.2	54.3 ± 26.9	0.717
Clinical Outcomes			
VAS Pain	1.5 ± 2.3	1.1 ± 2.0	0.447
VAS Pain During Sport	2.4 ± 2.9	2.6 ± 2.8	0.717
Mean Satisfaction (%)	83.3 ± 26.3	85.0 ± 23.9	0.743
Kujala	84.9 ± 15.3	85.0 ± 15.3	0.505
Tegner - Pre-Injury	6.7 ± 2.1	5.7 ± 2.8	0.159
Tegner - Post-Injury	3.2 ± 1.9	2.8 ± 2.3	0.419
Tegner - Current	5.0 ± 2.0	5.0 ± 2.3	0.843
MPFL-RSI	53.9 ± 30.1	62.4 ± 26.5	0.184
MPFL-RSI Passing Rate, % (n)	48.6 (18)	54.1 (20)	0.555

*Concomitant tibial tubercle osteotomy during medial patellofemoral ligament reconstruction (MPFL)
†Visual Analogue Score
‡Difference on Tegner score was calculated as the difference between the score at latest follow-up and pre-injury score
Abbreviations: TTO tibial tubercle osteotomy, VAS Visual Analogue Scale, MPFL-RSI Medial Patellofemoral Ligament Return to Sport Index

TABLE 2
Preoperative Imaging Measurements, Concomitant Procedures, & Operative Details

		iMPFLR (n=37)	MPFLR/TTO (n=37)	p-value
Preoperative MRI and Radiograph Characteristics	TT-TG (mm)	14.4 ± 2.9	18.5 ± 5.2	<0.001
	Preoperative lateral x-ray	n=27	n=28	
	Caton-Deschamps Index	1.11 ± 0.13	1.12 ± 0.22	0.695
	Patella alta, n (%)	4 (17.4)	8 (34.8)	0.102
	Dejour class, n (%)			0.189
	None	19 (70.4)	12 (42.9)	-
	B	2 (7.4)	3 (10.7)	-
	B	6 (22.2)	10 (35.7)	-
	C	-	3 (10.7)	-
	D			
Concomitant Procedures	Lateral release / medial imbrication	20 (54.1)	15 (40.5)	0.206
	Partial meniscectomy	1 (2.7)	0 (0)	1
	Chondroplasty	15 (40.5)	18 (48.6)	0.905
	Microfracture	2 (5.4)	1 (2.7)	1
	Synovectomy	3 (8.1)	1 (2.7)	0.615
	Loose body removal	9 (24.3)	3 (8.1)	0.112
Operative Details & Complications	Graft type, % gracilis (n)	89.2% (33)	94.6% (35)	0.674
	Angle of flexion during graft tension, n (%)			0.598
	30-degrees	15 (42.8)	10 (27.8)	-
	45-degrees	2 (5.7)	2 (5.6)	-
	60-degrees	18 (51.4)	24 (66.7)	-
	Preoperative knee flexion ROM, deg	120.4 ± 25.1	126.1 ± 19.4	0.117
	Flexion ROM at latest follow-up, deg	129.4 ± 9.4	129.4 ± 9.4	0.786
	Subsequent MUA, n (%)	6 (16.2)	2 (5.4)	0.261
	Any secondary procedure, n (%)	7 (18.9)	7 (18.9)	1

Abbreviations: iMPFLR isolated medial patellofemoral ligament reconstruction, TTO tibial tubercle osteotomy, MRI magnetic resonance imaging, TT-TG tibial tubercle to trochlear groove distance, ROM range of motion, MUA manipulation under anesthesia

TABLE 3
Reasons for Lack of Return to Sport at the Same or Higher Pre-Injury Level

Cohort	Reason for Lack of Return	No Return, n (%)	Lower Level, n (%)	Overall, n (%)
iMPFLR	Physical Symptoms	5 (41.7)	-	5 (23.8)
	Pain	2 (16.7)	1 (11.1)	3 (14.3)
	Fear of Re-Injury	3 (25.0)	4 (44.4)	7 (33.3)
	Lack of Confidence	2 (16.7)	-	2 (9.5)
	Lifestyle Factors	-	4 (44.4)	4 (19.0)
MPFLR/TTO	Physical Symptoms	3 (30.0)	-	3 (14.3)
	Pain	3 (30.0)	2 (18.2)	5 (23.8)
	Fear of Re-Injury	2 (20.0)	7 (63.6)	9 (42.9)
	Lack of Confidence	1 (10.0)	-	1 (4.8)
	Lifestyle Factors	1 (10.0)	2 (18.2)	3 (14.3)

Abbreviations: iMPFLR isolated medial patellofemoral ligament reconstruction, TTO tibial tubercle osteotomy

TABLE 4
Multivariate Regression for Predictors of Return to Sport & Time to Return Based on Preoperative Characteristics

Variable	Odds Ratio or Beta Coefficient	95% Confidence Interval	p
Logistic regression for Return to Sport at Any Level			
Age	1.08	0.94 – 1.24	0.278
Sex	>999	<0.01 – >999	0.999
BMI	1.02	0.88 – 1.19	0.782
TTO	0.61	0.09 – 4.40	0.627
TT-TG	1.31	0.91 – 1.89	0.146
Dejour classification	1.02	0.14 – 7.56	0.984
Patella alta	5.89	0.44 – 78.87	0.181
Logistic regression for Return to Pre-Injury Sport Level			
Age	1.25	1.04 – 1.50	**0.020**
Sex	87.73	3.45 – >999	**0.007**
BMI	1.08	0.92 – 1.28	0.335
TTO	2.15	0.19 – 24.33	0.536
TT-TG	1.06	0.73 – 1.52	0.772
Dejour classification	2.11	0.11 – 39.19	0.617
Patella alta	15.88	0.80 – 316.06	0.070

Abbreviations: BMI body mass index, TTO tibial tubercle osteotomy, TT-TG tibial tubercle to trochlear groove distance