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ORTHOPAEDICS
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Minimum 10-Year Clinical Outcomes and Survivorship of Meniscal Allograft Transplantation with Bone Fixation

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**I (and/or my co-authors) have something
to disclose.**

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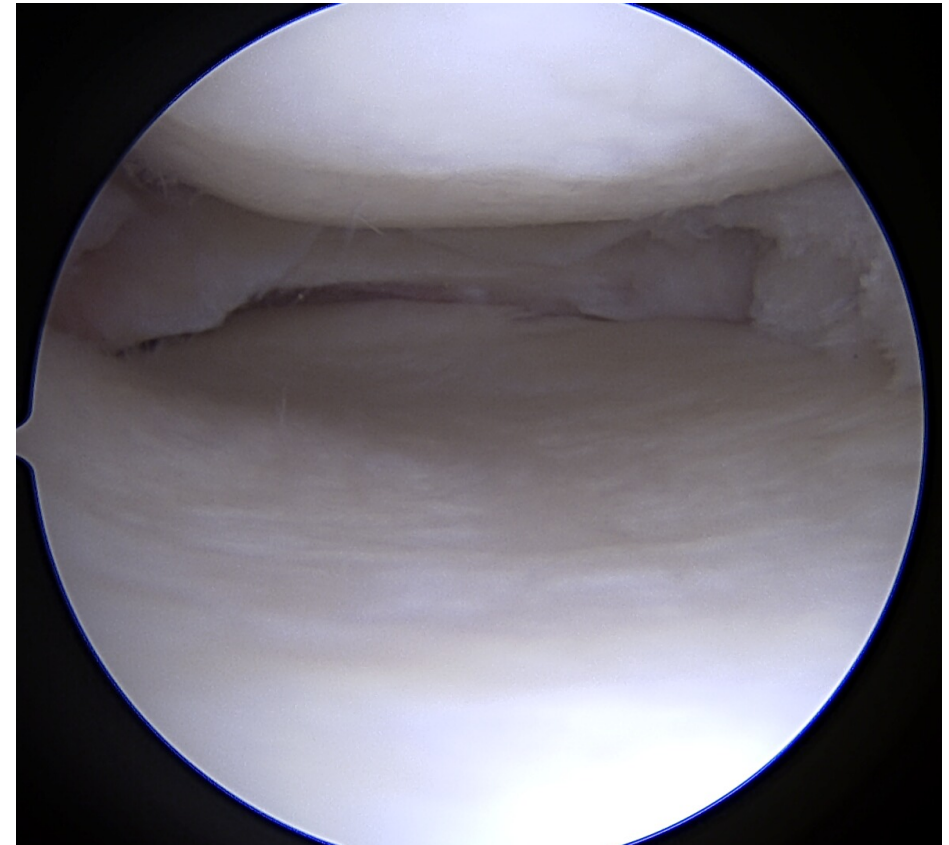


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The Problem

- 61 per 100,000 persons in the general population
- Load-bearing, shock absorption, stabilization
- Biomechanically optimal to save the meniscus
- Potential negative consequence of meniscectomy:
 - Post-meniscectomy syndrome
 - Knee osteoarthritis



Solutions

Arthroscopy, 2020

Return to Sport and Patient Satisfaction After Meniscal Allograft Transplantation

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Table 3. Graft Preparation Technique Reported in the Included Studies

Studies	Graft Preparation Technique
Binnet et al. (2012) ¹⁹	Lyophilized
Getgood et al. (2015) ²⁰	Fresh
Hommen et al. (2007) ³	Cryopreserved
Noyes et al. (2016) ⁵	Cryopreserved
Ogura et al. (2016) ²¹	Fresh-frozen (15/18 MATs), cryopreserved (3/18 MATs)
Kim et al. (2017) ¹²	Cryopreserved (5/49 MATs), fresh-frozen (44/49 MATs)
Van der Straeten et al. (2016) ²²	Fresh or fresh-frozen
Van der Wal et al. (2009) ²³	Cryopreserved
Verdonk et al. (2006) ²⁴	Fresh
Vundelinckx et al. (2014) ⁶	Cryopreserved
Wirth et al. (2002) ²⁵	Lyophilized (17/23 MATs), fresh-frozen (6/23)



Objective

To report on clinical outcomes and survivorship following primary meniscal allograft transplantation in a large cohort of patients at 10-year minimum follow-up.

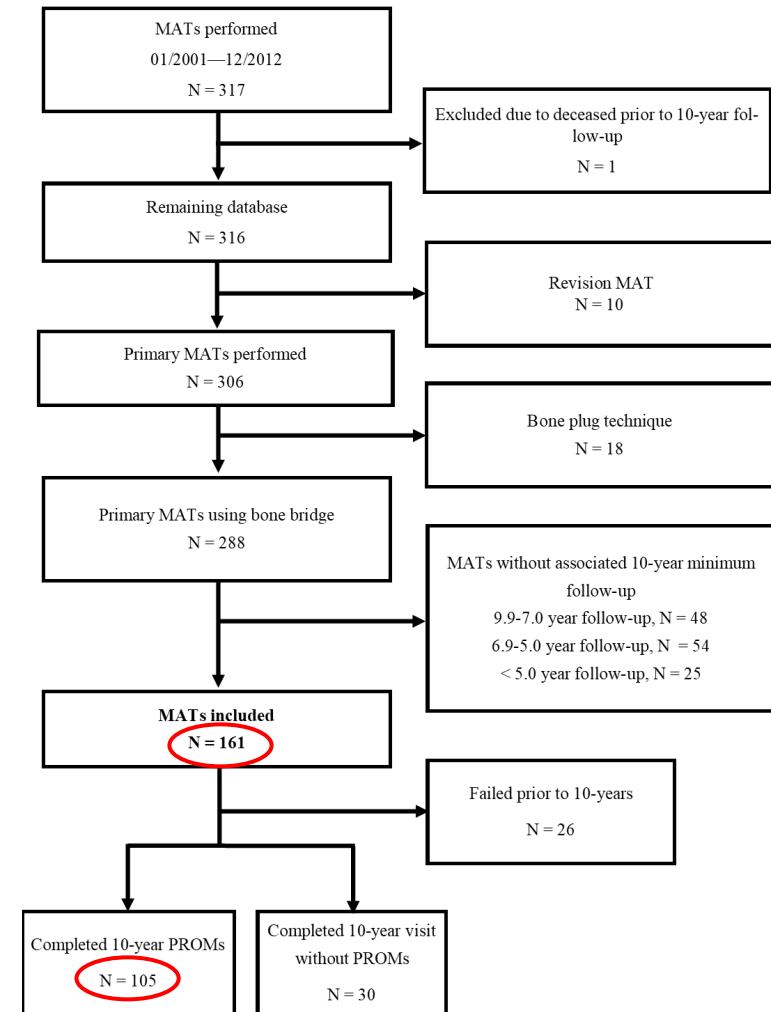
Methods

- Prospectively collected, single-surgeon database from 2001-2012
- **Inclusion Criteria:** primary MAT, fresh-frozen allograft, bridge-in-slot technique, and minimum 10-year follow-up
- **Exclusion Criteria:** <10-years follow-up or revision MAT
- Reoperation = partial or total meniscectomy or meniscal repair
- Failure = revision MAT or conversion to UKA or TKA



Results

- N = 317 MATs performed
 - Revision, bone plug, or deceased: 9% (N = 29/317)
 - Lost to follow-up: 44% (N = 127/288)
 - Included: N = 161
- 10-year PROMs available for 78% of those who did not fail prior to 10-year follow-up (N = 105/135)

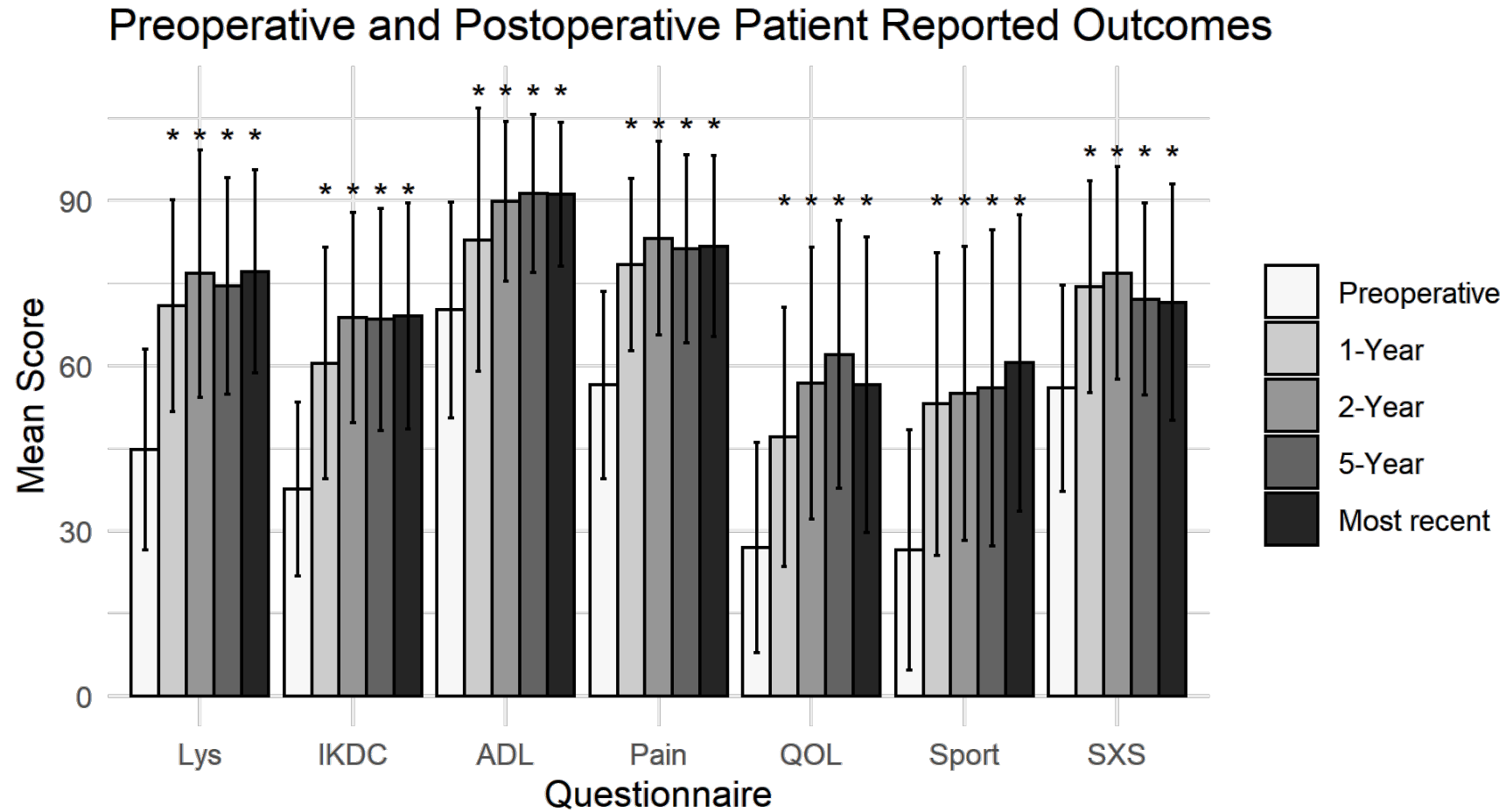


Results

- Mean f/u 12.6 years (range: 10.0-21.0)
- Mean age 28.2 years (range: 13.1 – 53.7)
 - Older age at surgery in those who failed
- N = 96/161 (60%) underwent concomitant procedures
 - More isolated MATs and fewer OCAs in reop at time of primary MAT

Demographics and Intraoperative Variables					
Characteristic	Post-op			P-values	
	None, N = 101 ¹	Reop, N = 22 ¹	Fail, N = 38 ¹	None vs. Reop ²	None vs. Failure ²
Sex (female)	50 (50%)	15 (68%)	22 (58%)	0.112	0.378
Age (years)	27 ± 9	24 ± 9	33 ± 10	0.074	0.006
BMI	25.8 ± 4.2	23.7 ± 4.2	26.0 ± 3.3	0.094	0.621
Meniscus transplanted (lateral)	55 (54%)	11 (50%)	15 (39%)	0.704	0.115
Concomitant procedure	64 (70%)	8 (42%)	24 (65%)	0.019	0.545
OCA	35 (38%)	1 (5.0%)	15 (39%)	0.004	0.879
OATS	1 (1.1%)	0 (0%)	1 (2.6%)	>0.999	0.501
ACI	15 (15%)	2 (9.1%)	2 (5.3%)	0.735	0.154
MFX	8 (8.7%)	1 (5.0%)	0 (0%)	>0.999	0.104
Denovo	1 (1.1%)	0 (0%)	1 (2.6%)	>0.999	0.501
HTO	7 (7.6%)	0 (0%)	4 (11%)	0.348	0.730
DFO	2 (2.2%)	1 (5.0%)	0 (0%)	0.449	>0.999
ACLR	7 (6.9%)	4 (18%)	6 (16%)	0.108	0.187
Follow-up (years)	12.6 ± 2.7	12.6 ± 2.8	7.5 ± 5.0		

Results



Lys, Lysholm; IKDC, International Knee Documentation Committee; Knee Injury and Osteoarthritis Outcome Score subscales are abbreviated as: ADL (activities of daily living), QOL (quality of life), and SXS (symptoms). Error bars represent standard deviation and * represent significant improvement, compared to preoperative scores ($p < .05$).

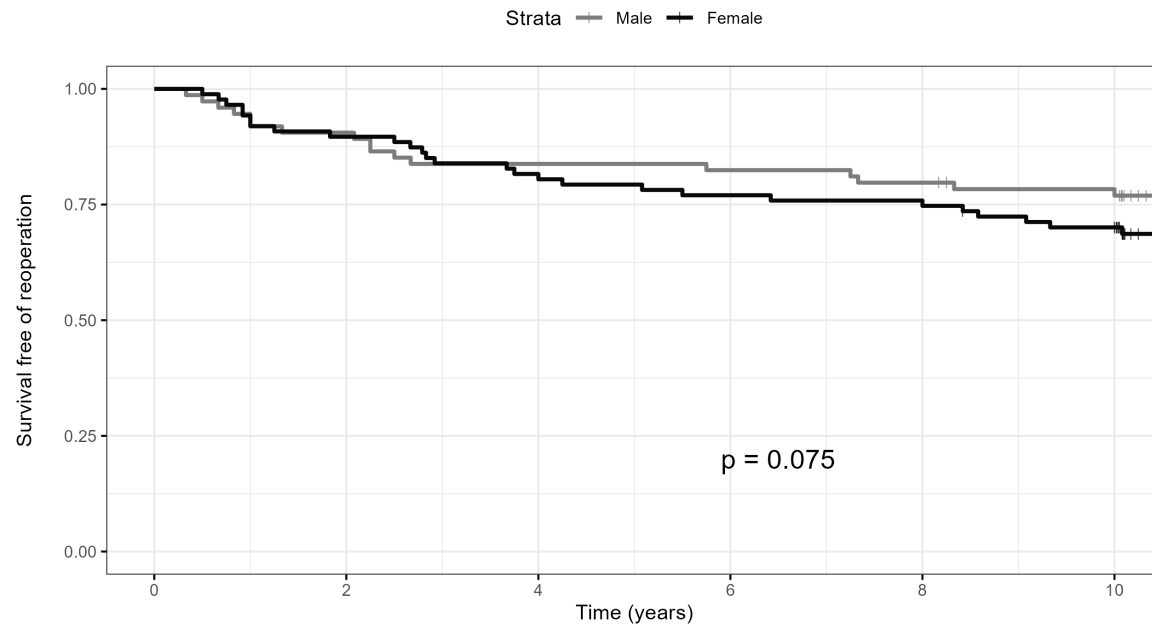
Results

	MCID		PASS					SCB				
	Thresho ld	% Achievi ng	Thresho ld	% Achievi ng	SN	SP	AU C	Thresho ld	% Achievi ng	SN	SP	AU C
Lyshol m	10.0	85.4%	71.5	75.7%	85.1	90.5	.947	32.0	35.5%	83.3	62.9	.681
IKDC	10.4	89.3%	55.7	70.7%	91.4	91.0	.945	37.7	48.2%	57.8	80.5	.718
COOS												
Pain	10.3	78.8%	72.2	79.0%	89.7	81.8	.871	25.1	46.9%	80.0	75.2	.843
SXS	11.5	61.4%	69.6	58.4%	68.6	90.9	.860	14.7	55.7%	75.0	65.5	.770
ADL	9.7	67.7%	95.7	57.0%	72.0	90.2	.850	15.3	50.8%	66.6	56.0	.619
Sport	13.3	75.0%	52.5	64.1%	76.4	89.7	.870	32.5	61.5%	86.6	52.1	.677
QOL	13.3	73.9%	46.8	66.3%	79.4	90.9	.899	31.1	49.3%	76.1	65.5	.751

Clinically Significant Outcomes at 10-year follow-up	
Variable	n / N (%)
MCID	
IKDC	
Lysholm	
COOS Pain	
COOS Symptoms	
COOS Sport	
COOS ADL	
COOS QOL	
PASS	
IKDC	
Lysholm	
COOS Pain	
COOS Symptoms	
COOS Sport	
COOS ADL	
COOS QOL	

Thresholds for minimal clinically important difference (MCID), patient acceptable symptomatic state (PASS), and substantial clinic benefit (SCB) were calculated for Lysholm, International Knee Documentation Committee (IKDC), and Knee Injury and Osteoarthritis Outcome Score (KOOS) subscales. ADL, activities of daily living; AUC, area under the curve; QOL, quality of life; SN, sensitivity; SP, specificity; SXS, symptoms.

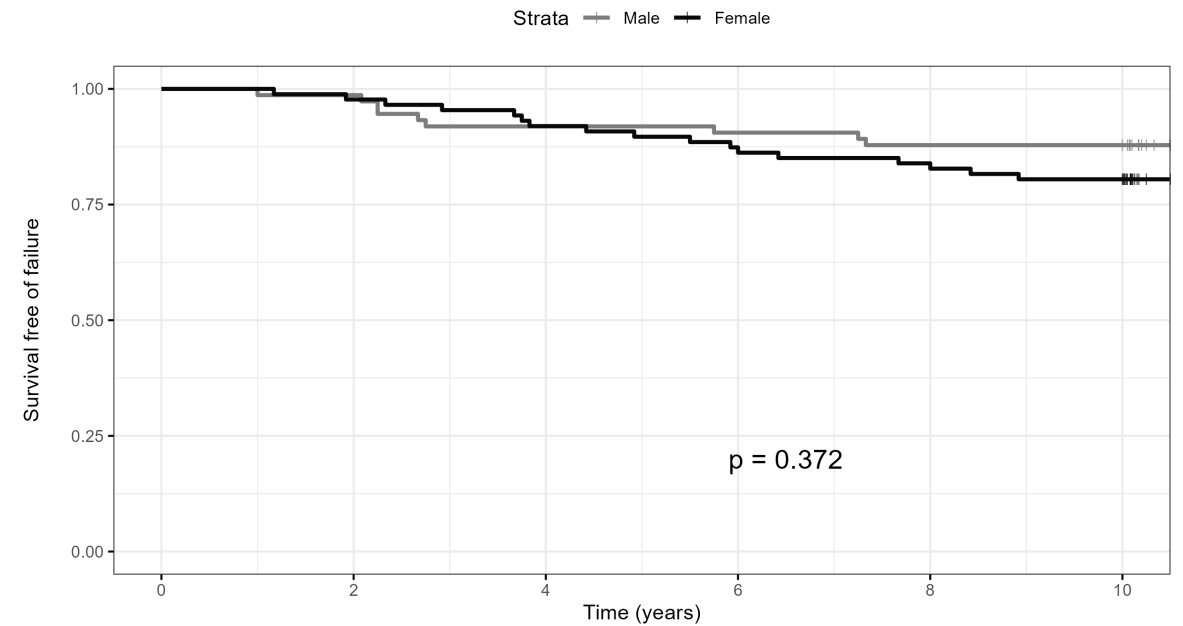
Results



Number at risk

Strata	0	2	4	6	8	10
Male	74	67	62	61	59	56
Female	87	78	71	67	66	60

Time (years)



Number at risk

Strata	0	2	4	6	8	10
Male	74	73	68	67	65	65
Female	87	85	80	76	73	70

Time (years)

Survival free from reoperation: 91.9%, 90.1%, 81.4%, 73.2%, and 58.6% at 1, 2, 5, 10, and 15 years, respectively.

Survival free from failure: 99.4%, 98.1%, 90.7%, 83.9%, and 70.3% at 1, 2, 5, 10, and 15 years, respectively.

Results

- Age associated with failure
- No association with BMI or sex
- No association with concomitant procedures

Cox regression analysis for variables associated with failure			
Characteristic	HR	95% CI	p-value
Age (years)	1.03	1.00, 1.06	0.047
Sex (female)	1.45	0.73, 2.86	0.280
BMI >25.0	1.29	0.61, 2.70	0.504
BMI >30.0	1.27	0.48, 3.33	0.634
Meniscus transplanted (lateral)	0.97	0.50, 1.88	0.917
Concomitant procedure	0.89	0.44, 1.78	0.735
Cartilage procedure	1.37	0.64, 2.95	0.431
OATS	0.98	0.13, 7.42	0.984
OCA	1.57	0.79, 3.13	0.205
ACI	0.33	0.08, 1.41	0.080
Particulated juvenile articular cartilage	2.73	0.37, 20.2	0.395
DFO	2.54	0.34, 18.8	0.425
HTO	1.31	0.40, 4.28	0.668
ACL reconstruction	1.00	0.39, 2.59	0.997

ACI, autologous chondrocyte implantation; ACL, anterior cruciate ligament; BMI, body mass index; CI, confidence interval; DFO, distal femoral osteotomy; HR, hazard ratio; HTO, high tibial osteotomy, OCA, osteochondral allograft transplantation; OATS, osteochondral autograft transplantation; MFX, microfracture

Discussion

Arthroscopy, 2019

Long-Term Survival Analysis and Outcomes of Meniscal Allograft Transplantation With Minimum 10-Year Follow-Up: A Systematic Review

João V Novaretti ¹, Neel K Patel ², Jayson Lian ³, Ravi Vaswani ², Darren de Sa ², Alan Getgood ⁴, Volker Musahl ⁵

Studies with 10-Year Minimum Follow-up						
Primary Author	Patients	Mean f/u (years)	Preservation	Fixation	Failure definition	Failure rate
Verdonk et al. (2006)	30	12.1	Fresh	Soft-tissue	Arthroplasty	18%
Hommen et al. (2007)	12	12.2	Cryopreserved	Soft-tissue or bone plugs	Lysholm <65*	35%
Van der Wal et al. (2009)	57	13.8	Cryopreserved	Soft-tissue	Complete graft resection	29%
Grassi et al. (2020)	46	10.8	Fresh-frozen	Soft-tissue	Meniscectomy, arthroplasty, or revision MAT**	14%
Carter et al. (2020)	48	NR; 20-year minimum	Cryopreserved	Bone plugs or keyhole	Meniscectomy or arthroplasty	44%
Torres-Claramunt et al. (2023)	38	17.4	Fresh-frozen	Soft-tissue or bone plugs	Meniscectomy, arthroplasty, or revision MAT	42%
<i>Present study</i>	161	12.8	Fresh-frozen	Bridge-in-slot	Arthroplasty or revision MAT	16%

*Included a separate failure definition (>50% meniscectomy, MRI grade III tear, and no PROM improvement), which showed 45% 10-year survivorship
 **Included a separate clinical failure definition (Lysholm <65), which showed 70% 10-year survivorship.
 NR, not reported.

Conclusions

- The primary finding from this investigation was that primary MAT demonstrates both efficacy and durability at minimum 10-year follow-up.
 - MCID and PASS were achieved by a majority of patients for all PROMs analyzed
 - While reoperation rates may approach 41% at 15 years, overall revision MAT rates and conversion to arthroplasty remain satisfactorily low at long-term follow-up.
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Thank you.

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