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Long Term Functional Outcomes of Meniscal Allograft Transplantation:

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Faculty Disclosure Information

- Nothing to disclose.

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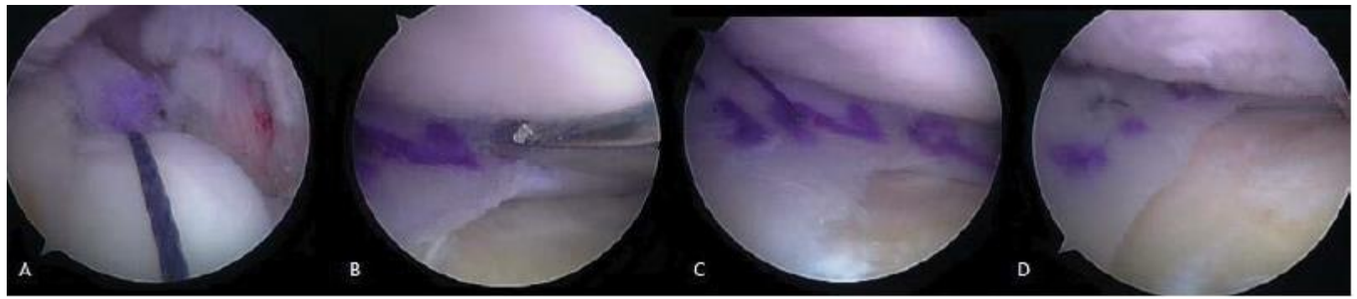
Abstract

This prospective study evaluated the long-term evolution of meniscal allografts in a cohort of patients using clinical scales, imaging, and mechanical alignment measures. From an ambispectively collected database, we analyzed 41 patients using magnetic resonance imaging T2 mapping (cartigram), extrusion measurements, mechanical axis deviation, and validated functional outcomes. Magnetic Resonance Imaging (MRI) appearance in Meniscal Transplant Scores (MIMS) declined significantly between follow-ups ($p < 0.0001$), and tibial cartilage hydration decreased over time. Patients reported a statistically significant reduction in pain ($p = 0.0004$), and coexisting anterior cruciate ligament rupture was associated with worse functional outcomes. Patients were followed from the date of surgery for up to 13 years. Tibial cartilage showed consistent protection, while femoral cartilage demonstrated early T2 relaxation time increases followed by partial recovery, then deterioration in the long term. Tibial cartilage hydration showed a more gradual decline, typically after 8 years. Structural degeneration (MIMS, extrusion) progressed over time but was not always associated with functional decline. In 13 patients with over 10 years of follow-up, function remained stable despite structural wear, suggesting MAT maintains chondroprotection.



Cruz-López et al., 2015

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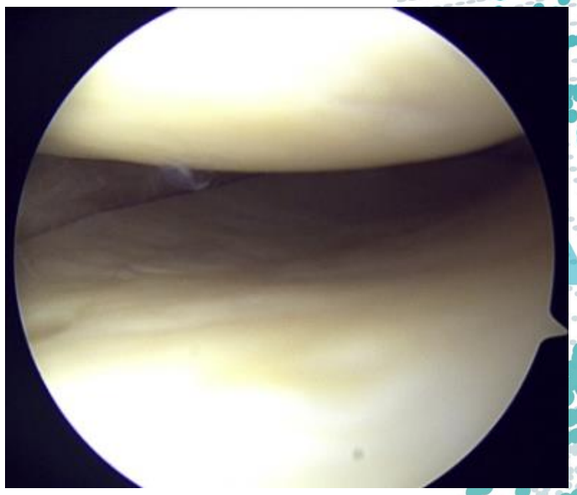
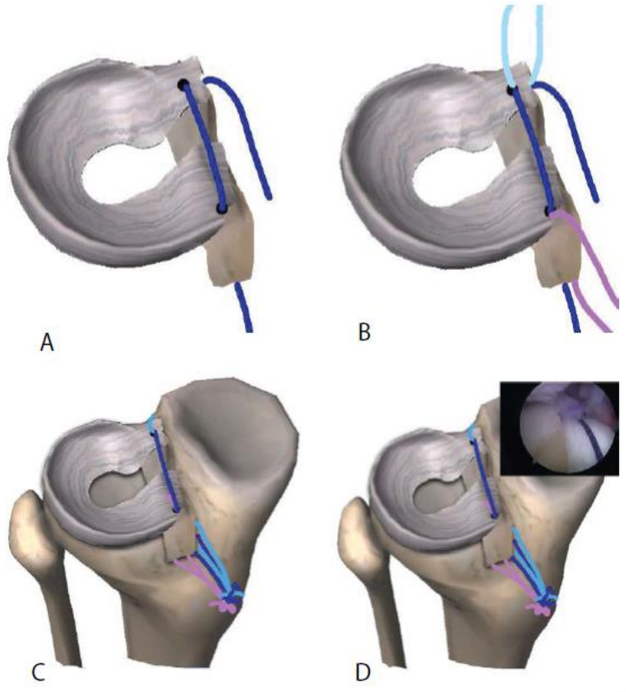
Introduction

- Meniscal allograft transplantation (MAT) is widely used for the symptomatic meniscus deficient knee.
- Aims to restore:
  - **Function**
  - **Alleviate pain**
  - **Delay the onset of osteoarthritis**



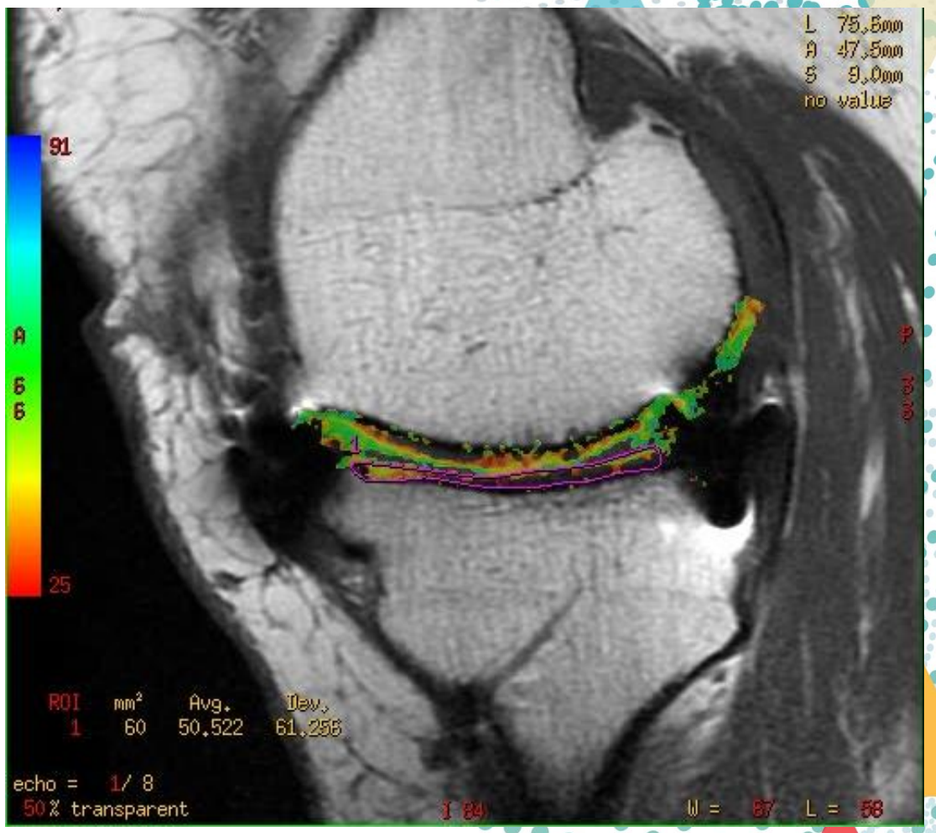


- Can be evaluated through clinical scores:
  - IKDC - Kujala
  - KOOS - Tegner
  - SF-36 - Lysholm

LaPrade, et al. 2010. Zaffagnini et al, 2019. Cruz-López, 2015

Introduction

- Cartilage can be evaluated through **T2 mapping** (cartigram) of magnetic resonance imaging (MRI).
- Measurement of **transverse relaxation times** in wáter molecules of the cartilage.
  - **Hydrated: <50 ms // Not hydrated: >50 ms.**
- **Meniscal extrusion > 3 mm** has been linked to cartilage deterioration and failure over time
  - → **Chondroprotective failure.**
- MRI appearance in Meniscal Transplant Score (MIMS):
  - Evaluates graft quality, extrusion, signal intensity, shape and fixation.



Song et al., 2023. Wang et al., 2022. Kijowski, et al., 2019. Mosher, 2004.

MRI appearance in Meniscal transplants Score

MIMS SCORE

(MRI appearance in Meniscal transplants Score)

SS-scoring system for MRI Appearance of meniscal transplants

EXTRUSION (0-2)			
Coronal	>5mm (0)	3-5mm (1)	<3mm (2)

Coronal measurement (Fig 1)

1. Perform measurement on mid-coronal slice defined as medial tibial spine of maximal diameter.
2. Where unable to identifying the maximal tibial spine width the slice with the maximal tibial width should be used.
3. Draw a reference line between medial and lateral osteochondral junctions on the tibia, at the joint margin excluding osteophytes.
4. Draw 4 gridlines at 90 degrees to this line (See figure 1)
5. Using these reference lines the meniscal coronal width (medial or lateral) and the meniscal extrusion width is measured.

Extrusion

6. <0mm = 3 (Meniscus remains anatomically positioned)
7. 0-5mm = 2 (Partial, Part of meniscus remains in contact with articular surface)
8. >5mm = 1

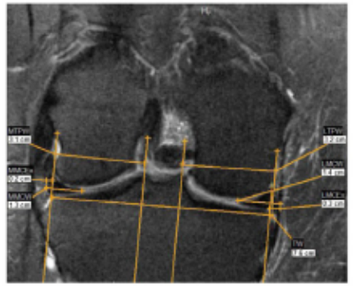
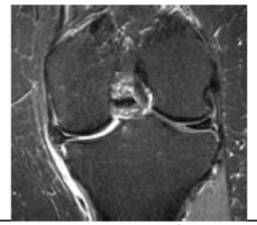


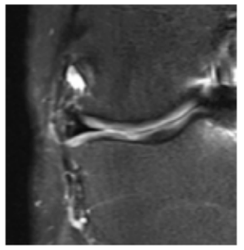
Fig. 1 Example MR Image illustrating the measures. *TW* tibial width, *MTPW* Medial tibia plateau width, *LTPW* lateral tibia plateau width, *MMCW* medial meniscal coronal width, *LMCW* lateral meniscal coronal width, *MMCEx* medial meniscal coronal extrusion, *LMCEx* lateral meniscal coronal extrusion

BONE MARROW OEDEMA (0-1)		
Femoral	Yes (0)	No (1)
Tibial	Yes (0)	No (1)

1. Identify any bone marrow oedema and score for both femur and tibia

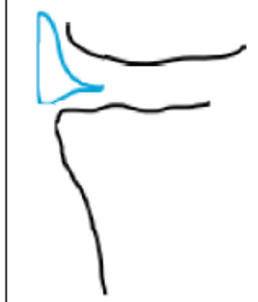
**MENISCAL SIGNAL CHANGE (Gd 0-3)			
Absent Transplant Meniscus (0)	High signal (1) (Not in the interface b/w transplant and rim)	Intermediate signal (2) (No evidence of a tear)	No signal or normal (3)





* Signal should be present on 2 or more continuous slices.
** Care should be taken when assessing the interface between meniscal graft transplant and remnant meniscus.
*** If there is more than one tear, score the tear that is more severe.

SHAPE OF MENISCUS (0-2)			
Using the midcoronal slice determine the shape of the meniscus	Grossly flattened/deformed (0)	Loss of triangular shape (1)	Normal appearance (2)



SYNOVITIS/EFFUSION (0-2)			
Effusion+/- Synovitis	Obvious fluid synovitis (0)	Fluid present in lateral/medial recess or suprapatellar pouch (1)	Normal appearance (2)

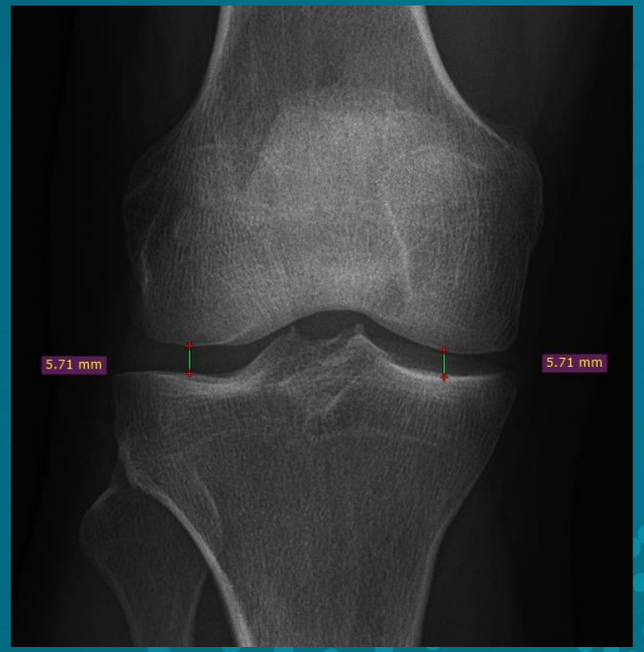
Total score:
Score range: 0 (Worst) – 11 (Best)

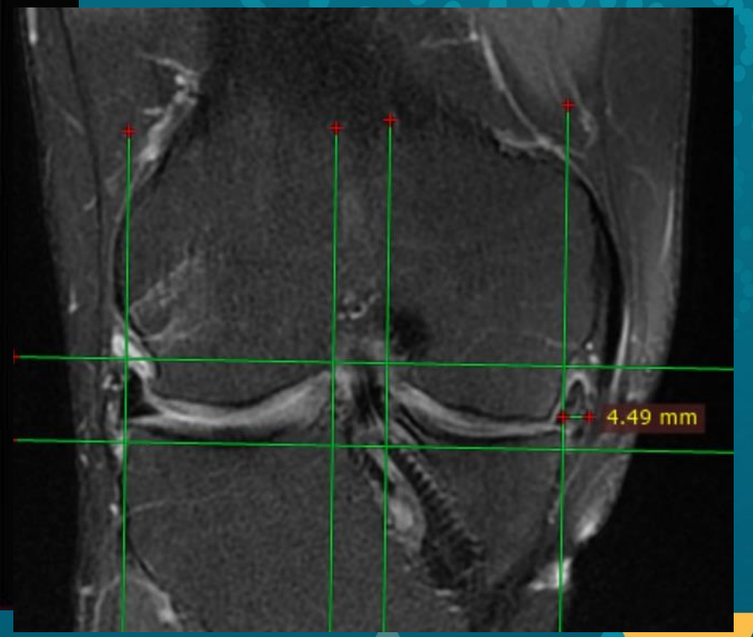
Damasena et al., 2022

Materials and methods

- **41 patients (42 knees) were included and followed up for up to 13 years.**
- **All patients underwent MAT and a second arthroscopic look one year after MAT.**
-
- **Variables Collected:**
  - Cartilage hydration via T2 mapping (cartigram): femoral and tibial compartments, at preoperative and multiple postoperative intervals
  - MIMS scores.
  - Meniscal extrusion in millimeters.
  - Mechanical axis deviation (varus/valgus, in degrees)
  - Joint space width (radiographic, in millimeters)
  - Functional outcomes: IKDC, SF-36, KOOS, Lysholm, Kujala, Tegner
  - Demographics: sex, age, compartment, activity level

- **Statistical analysis:**
  - Means and standard deviations for continuous variables.
  - Paired Student-s t test in normal distribution and Wilcoxon signed rank test when not normal.
  - Subgroup comparisons: ACL vs no-ACL rupture, medial vs lateral transplants, etc.
  - P value of < 0.05 was considered statistically significant.





Results

Demographic distribution of patients N=42 knees	
Male sex	56.1%
Mean age (at time of surgery)	31.4 ± 9.1 years
Medial meniscus transplant	58.5%
Discoid meniscus before MAT	11.9%
ACL repair during MAT	46.3%
OATS during MAT	9.4%
Microfractures during MAT	17.1%

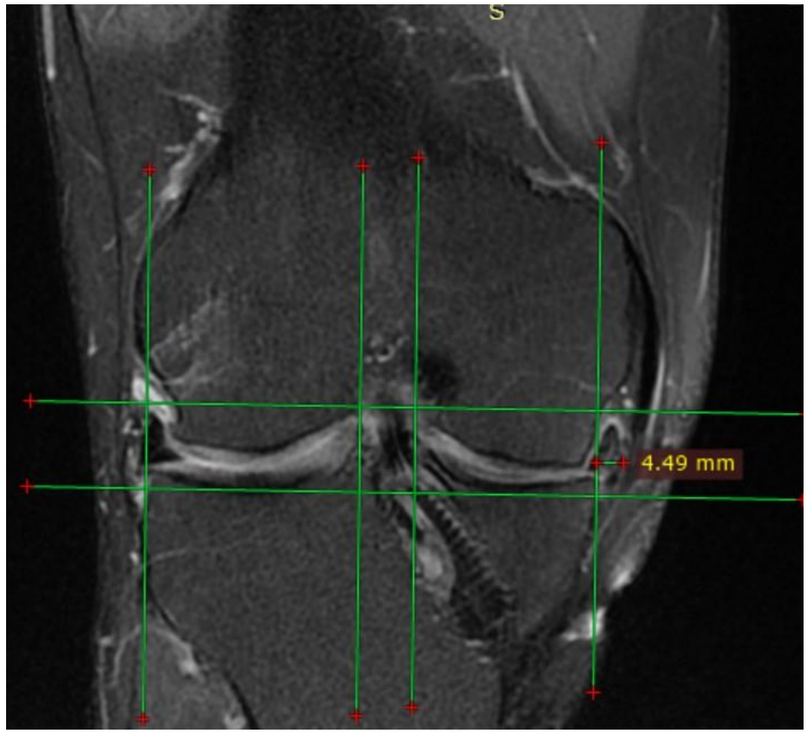
Time Point	Femoral T2 (ms)	Tibial T2 (ms)
Preoperative	41.1 (30.0–61.7)	41.2 (27.3–60.7)
6 months	50.6 (38.91–60.3)	46.7 (37.3–58.2)
12 months	43.7 (32.0–62.4)	41.4 (25.8–61.7)
2 years	42.2 (29.8–59.7)	42.8 (28.2–60.2)
6 years	43.9 (34.2–58.9)	45.5 (33.5–61.5)
8 years	45.9 (34.5–59.148)	47.1 (36.5–61.943)
Last follow-up	48.4 (29.8–92.077)	46.7 (28.2–65.413)
P-value	0.0007	0.0002

Test	Preoperative (mean [min–max])	Last Follow-Up (mean [min–max])	p-value
IKDC (Subjective)	45.3 (33.0–63.0)	63.9 (43.0–98.0)	**0.0007**
Lysholm	57.6 (27.0–99.0)	77.4 (42.0–100.0)	**0.0054**
SF-36 Physical	42.9 (10.0–80.0)	70.8 (10.0–90.0)	**0.0009**
SF-36 Emotional	49.2 (19.0–80.0)	59.8 (30.0–100.0)	0.0557
SF-36 Pain	54.1 (10.0–90.0)	72.2 (10.0–100.0)	**0.0233**
Tegner	2.7 (1.0–6.0)	5.1 (1.0–10.0)	**0.0012**
Kujala	51.3 (36.0–89.0)	71.3 (50.0–93.0)	**0.0387**
KOOS Pain	61.1 (14.0–94.0)	78.1 (50.0–97.0)	**0.0275**
KOOS Symptoms	64.4 (30.0–96.0)	74.1 (43.0–93.0)	0.0569
KOOS ADL	65.9 (21.0–99.0)	87.6 (56.0–100.0)	**0.0051**
KOOS Sport	40.0 (5.0–100.0)	60.4 (5.0–90.0)	0.0591
KOOS QOL	31.8 (6.0–69.0)	62.2 (19.0–94.0)	**0.0030**

MIMS Score over time

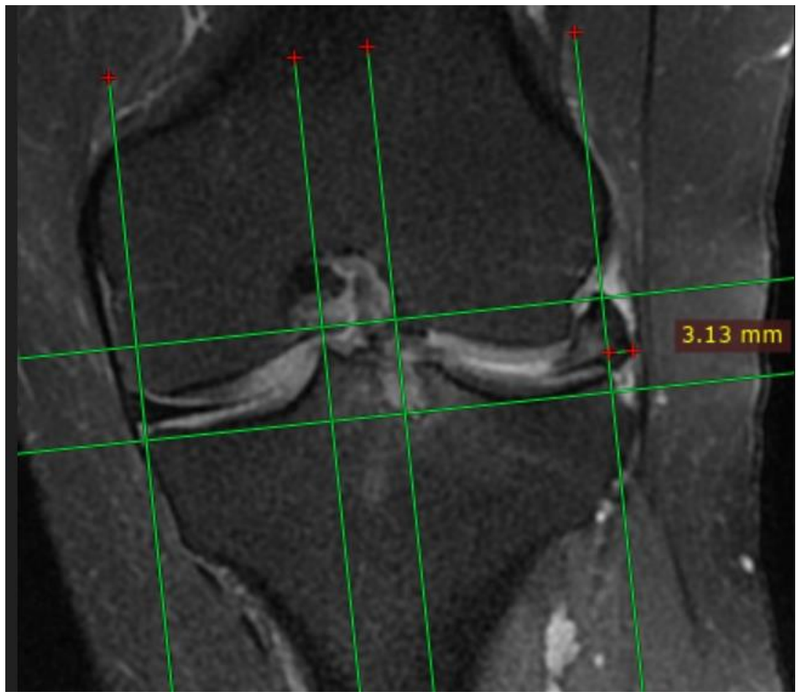
(Best is 11, 0 is worst)

Time Point	MIMS Score (mean [min–max])
Cut-off 1	6.4 (4–10)
Cut-off 2	5.8 (4–9)
Cut-off 3	5.3 (4–9)
P-value	<0.001



Meniscal extrusion over time

Time Point	Extrusion (mm) (mean [min–max])
First cut-off	3.6 (1.37–6.81)
Last follow-up	4.1 (2.04–7.1)
P-value	<0.001



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Discussion

- 13 patients continued at 13 years of follow-up.
- One patient died of unrelated causes (lung cancer).
- No grafts required refixation or revision.
- Femoral cartilage was demonstrated to be less chondroprotected by the MAT and hydration declined significantly at 6 years vs 8 years for tibial cartilage.
- Concomitant ACL rupture negatively impacted function of the transplant (p= 0.0215 for Kujala, p= 0.0240 for Tegner)
- Varus alignment of the knee was linked to medial graft failure, valgus to lateral failure.
- Pain improved significantly. (p = 0.0004)

Conclusions

- Our findings confirm **long term efficacy of MAT** in delaying joint degeneration and alleviating pain.
- Although Muzaffar et al. (2015), suggest a 2 mm extrusion threshold, we kept an extrusion threshold at >3 mm, since most grafts can be extruded **without clinical manifestations**.
- Consider that **concomitant ACL rupture is very common** and can lead to worse outcomes of MAT.
- Imaging degeneration may **precede** functional decline
  - Worth following patients up after 5-6 years, when degeneration of the graft usually sets in.

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