OBESITY AND MENISCAL TRANSPLANT FAILURE:
A RETROSPECTIVE COHORT STUDY

None of the authors report conflict of interests
INTRODUCTION

POST-MENISCECTOMY SYNDROME (PMS):
Persistent knee pain, swelling and loss of function after meniscectomy\textsuperscript{1, 2}.

MENISCAL ALLOGRAFT TRANSPLANTATION (MAT):
- Good treatment option for young active patients with PMS\textsuperscript{1-5}.
- Also prophylactic treatment in young postraumatic knees, and salvage procedure in young’s osteoarthritis\textsuperscript{6}.
- Good outcomes in the short and medium term\textsuperscript{1, 7-9}.
- Very few reports on patient-related factors influencing success rates\textsuperscript{10}.

OBESITY:
- International epidemic\textsuperscript{11}: more knee arthroscopic surgery in obese patients (OP).
- Similar outcomes in OP vs non-obese patients (NOP) after meniscal repair\textsuperscript{12}.
- Evidence on the effect of obesity on MAT is very limited.
PURPOSE

To analyze the effect of obesity and other clinical factors on patients undergoing MAT with transosseous fixation.

HYPOTHESIS

Obesity may worsen the clinical results of MAT.
MATERIALS AND METHODS

GENERAL FEATURES:

Retrospective cohort study. Min. 2-years FU
Physiological axis. No ligament instability.
Variables assessed: age, side, sex, meniscus,
BMI, smoking status and previous surgery

SURGICAL PROCEDURE: same surgeon

Cryopreserved allograft. Size of the allograft determined with preoperative MRI.
Fixation:

- Middle third: inside-out (Force fiber n. 2, Stryker, Kalamazoo, MI, USA)
- Posterior horn: all inside (FasT-Fix Ultra, Smith & Nephew, Andover, MA, USA)
- Anterior horn: outside-in (Force fiber n. 2, Stryker, Kalamazoo, MI, USA)
- Roots: transosseous fixation without bone blocks.
MATERIALS AND METHODS

REHABILITATION PROTOCOL: all patients followed the same

Non-weight bearing for 6 weeks (2 weeks full extension, flexion limited to 90º 4 more weeks). FU in out-patient clinic at 1, 3, 6, 12 and 24 months postoperatively.

CLINICAL EVALUATION:

- International Knee Documentation Committee (IKDC)
- Tegner’s activity score (0-10)
- Lysholm Knee Scoring Scale (0-100)

MAT failure: Lysholm score < 65 points, new meniscectomy or joint replacement. Patients were considered satisfied if they were ready to go through the same surgical procedure again.
MATERIALS AND METHODS

RADIOLOGICAL EVALUATION:

Preoperatively:
X-Rays: assessment of mechanical axis of lower limb and knee degenerative changes (Kellgren-Lawrence, 0-4).

Postoperatively:
Same X-Rays at FU. MRI scan at FU to evaluate the integrity of the MAT.

STATISTICAL ANALYSIS:
- SPSS 20.0 software (IBM, Chicago, IL)
- Shapiro-Wilk test. Differences: Student-t test or a Man-Whitney-U test. $P < 0.05$.
- Post-hoc power analysis: G* Power software (Universitat Dusseldorf, Germany)
- A Cox-Hazard binary multivariable analysis: hazard ratios (HRs) with 95% confidence intervals (CIs). Cut-off point for stratification according to BMI: sensitivity analysis.
RESULTS

<table>
<thead>
<tr>
<th></th>
<th>Total (n=35)</th>
<th>BMI ≥30 (n=9)</th>
<th>BMI &lt;30 (n=26)</th>
<th>P value</th>
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</thead>
<tbody>
<tr>
<td>AGE</td>
<td>36.6 SD 10.3</td>
<td>38.2 SD 9.8</td>
<td>36.4 SD 10.8</td>
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<tr>
<td>GENDER</td>
<td></td>
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<tr>
<td>Male</td>
<td>32 (91.4)</td>
<td>9 (100)</td>
<td>23 (88.4)</td>
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<tr>
<td>Female</td>
<td>3 (8.6)</td>
<td>0 (0)</td>
<td>3 (11.6)</td>
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<tr>
<td>MENISCUS</td>
<td></td>
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<tr>
<td>Medial</td>
<td>19 (54.3)</td>
<td>8 (88.9)</td>
<td>11 (42.3)</td>
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<tr>
<td>Lateral</td>
<td>16 (45.7)</td>
<td>1 (11.1)</td>
<td>15 (57.7)</td>
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</tr>
<tr>
<td>SIDE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>21 (60.0)</td>
<td>5 (55.6)</td>
<td>16 (61.6)</td>
<td>1.000</td>
</tr>
<tr>
<td>Left</td>
<td>14 (40.0)</td>
<td>4 (44.4)</td>
<td>10 (38.4)</td>
<td></td>
</tr>
<tr>
<td>SMOKING STATUS</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Yes</td>
<td>13 (37.1)</td>
<td>4 (44.4)</td>
<td>9 (34.6)</td>
<td>0.756</td>
</tr>
<tr>
<td>No</td>
<td>22 (62.9)</td>
<td>5 (55.6)</td>
<td>17 (65.4)</td>
<td></td>
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<tr>
<td>FOLLOW-UP TIME</td>
<td>75.7 SD 43.4</td>
<td>84.1 SD 45.5</td>
<td>74.0 SD 43.3</td>
<td>0.555</td>
</tr>
<tr>
<td>IKDC</td>
<td>58.6 SD 15.7</td>
<td>48.6 SD 19.9</td>
<td>61.7 SD 13.1</td>
<td>0.038*</td>
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<tr>
<td>SATISFACTION</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>26 (74.3)</td>
<td>5 (55.6)</td>
<td>21 (80.7)</td>
<td>0.136</td>
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<tr>
<td>No</td>
<td>9 (25.7)</td>
<td>4 (44.4)</td>
<td>5 (19.3)</td>
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<tr>
<td>LYSHELM</td>
<td>74.9 SD 17.3</td>
<td>60.3 SD 19.2</td>
<td>79.4 SD 14.3</td>
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<td>TEGNER</td>
<td>3.7 SD 1.8</td>
<td>2.8 SD 1.0</td>
<td>4.0 SD 1.9</td>
<td>0.104</td>
</tr>
</tbody>
</table>

Abbreviations: body mass index (kg/m2), BMI; International knee Documentation Committee, IKDC. Data presented as percentage No. (%). *Statistically significant. Significantly lower. Significantly higher
## RESULTS

<table>
<thead>
<tr>
<th></th>
<th>Total (n=35)</th>
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<th>BMI &lt;30 (n=26)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Postoperative MRI</strong></td>
<td></td>
<td></td>
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<tr>
<td>Intact graft</td>
<td>7 (20.0)</td>
<td>1 (11.1)</td>
<td>6 (23.1)</td>
<td>0.574</td>
</tr>
<tr>
<td>Arthritis/extrusion</td>
<td>28 (80.0)</td>
<td>8 (88.9)</td>
<td>20 (76.9)</td>
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</tr>
<tr>
<td><strong>Preoperative KL (0-4)</strong></td>
<td>1.38 SD 0.8</td>
<td><strong>1.57 SD 1.3</strong></td>
<td><strong>1.36 SD 0.7</strong></td>
<td>0.554</td>
</tr>
<tr>
<td><strong>Postoperative KL (0-4)</strong></td>
<td>1.94 SD 0.8</td>
<td><strong>2.44 SD 1.0</strong></td>
<td><strong>1.8 SD 0.7</strong></td>
<td>0.045</td>
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<td><strong>Preoperative axis</strong></td>
<td>0.89 SD 0.8</td>
<td>0.78 SD 0.6</td>
<td>0.96 SD 0.8</td>
<td>0.743</td>
</tr>
</tbody>
</table>

Abbreviations: body mass index (kg/m²), BMI; magnetic resonance imaging, MRI. Data presented as percentage No. (%). *Statistically significant. Significantly lower. Significantly higher.

<table>
<thead>
<tr>
<th></th>
<th>Total (n=35)</th>
<th>Failure (n=8)</th>
<th>Non-failure (n=27)</th>
<th>Crude hazard ratio</th>
<th>Adjusted hazard ratio (¥)</th>
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</thead>
<tbody>
<tr>
<td><strong>BMI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30 kg/m²</td>
<td>26 (74.3)</td>
<td>3 (33.3)</td>
<td>23 (85.1)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>≥30 kg/m²</td>
<td>5 (66.7)</td>
<td>4 (14.8)</td>
<td>9.6 (1.6-56.9)*</td>
<td>11.8 (1.5-91.4)*</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: body mass index, BMI. Data presented as No. (%). *Statistically significant. Significantly worse. Significantly better. Adjusted to age, gender, follow-up, preoperative degree of arthritis, and meniscus type (medial/ lateral).
DISCUSSION

OBESITY IS A MAJOR RISK FACTOR FOR MAT FAILURE
BMI ≥ 30 kg/m² increases the risk of MAT failure by 11-folds
Better knee functional results were observed in NOP

FAILURE:
Two types of failure: A. Need for revision surgery (i.e, uni or total knee arthroplasty, and meniscectomy); B. Lysholm test outcome <65 points.
- Failure rates in literature: 8.7 to 18.2 %\textsuperscript{14-16}. Higher failure rates in cryopreserved allografts\textsuperscript{15}.
- Present study: overall \textbf{22.8\%} failure rate (relatively high):

   Meniscal allografts cryopreserved and high prevalence of OP in this cohort.

\textit{Saltzman et al} \textarrow{worse outcomes in OP}\textsuperscript{17}. \textit{Other authors}: high BMI is not a risk factor for MAT failure\textsuperscript{10} \textarrow{NOP (BMI 18-25) and overweight patients (BMI> 25), not OP (BMI ≥30) vs NOP (BMI <30)}. 
DISCUSSION

SIDE:

*Lateral MAT more prevalent in non-obese patients (57.7%):*

Lower tolerance to lateral meniscectomy\(^1,18-19\), poorer results, more postop arthritis\(^20,21\), increase axial femoral compressive loads\(^21,22\).

*More medial MATs in OP(88.9%):*

More medial extrusion and medial osteoarthritis in OP\(^23-26\). Obesity \(\Rightarrow\) greater valgus\(^27\): more lateral injuries expected. Present study: MAT only with physiological axis \(\Rightarrow\) **medial MAT was more frequent in OP than in NOP.**

EXTRUSION:

80.0% of the patients (88.9% OP, 76.9% NOP): may be related to surgical technique, without bone blocks\(^28\).

Not clearly correlated with worse clinical outcome: 28 patients with extrusion, **only 5 failed** \(\Rightarrow\) meniscal extrusion didn’t lead to MAT failure. These findings match previous studies\(^28,29\).

Capsulodesis might improve MAT survival reducing extrusion; potential benefit still under question\(^30\).

ARTHritic PROGRESSION:

36.7% of patients, a rate similar to previous reports\(^31\). It was more frequent in OP.

Chondroprotective role of MAT: controversial\(^15,32-33\); arthritic progression doesn’t seem correlated to poorer outcomes\(^14\). However previous reports suggest preop cartilage status could be prognostic for MAT survival\(^15,32-33\).
LIMITATIONS

- **Observational and retrospective:** impedes the establishment of causality BMI - risk of MAT failure.
- **Sample size** relatively small; null hypothesis rejected with 88.7% statistical power (0.05 $\alpha$-error), Lysholm score
- **Not matched to demographic variables:** Cox hazard analysis included factors that could influence failure rates (age, sex, follow-up, preop arthritis and meniscus affected). Effect of a BMI $> 30$ kg/m$^2$ on the risk of failure evident in crude analysis, before adjusting to potential confounders.

CONCLUSIONS:

BMI $\geq 30$ kg/m$^2$ resulted in higher MAT failure rates.

Non-obese patients had better knee functional results compared with obese individuals.
REFERENCES


