Biomechanical comparison of vertical mattress and cross-stitch suture techniques, and single- and double-row configurations, for the treatment of bucket-handle medial meniscus tears.

Nakama GY\textsuperscript{1,2,3}, Kaleka CC\textsuperscript{4}, Franciozi CE\textsuperscript{2}, Astur DC\textsuperscript{2}, Debieux P\textsuperscript{2}, Krob JJ\textsuperscript{1}, Aman ZS\textsuperscript{1}, Kemler BR\textsuperscript{1}, Storaci HW\textsuperscript{1}, Dornan GJ\textsuperscript{1}, Cohen M\textsuperscript{2,4}, LaPrade RF\textsuperscript{5,6}

\textsuperscript{1}Steadman Philippon Research Institute, Vail, CO, USA
\textsuperscript{2}Departament of Orthopedics and Traumatology, Universidade Federal de São Paulo, SP, Brazil
\textsuperscript{3}Instituto Brasil de Tecnologias da Saúde, Rio de Janeiro, RJ, Brazil
\textsuperscript{4}Hospital Israelita Albert Einstein, São Paulo, SP, Brazil
\textsuperscript{5}The Steadman Clinic, Vail, CO, USA
\textsuperscript{6}Twin Cities Orthopedics, Edina, Minnesota
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<table>
<thead>
<tr>
<th>Name</th>
<th>Financial Conflicts</th>
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</thead>
<tbody>
<tr>
<td>Gilberto Y. Nakama, MD</td>
<td>No financial conflicts to disclose</td>
</tr>
<tr>
<td>Camilla C. Kaleka, MD</td>
<td>No financial conflicts to disclose</td>
</tr>
<tr>
<td>Carlos E. Franciozi, MD, PhD</td>
<td>Consultant for Smith &amp; Nephew</td>
</tr>
<tr>
<td>Diego C. Astur, MD, PhD</td>
<td>No financial conflicts to disclose</td>
</tr>
<tr>
<td>Pedro Debieux, MD, PhD</td>
<td>No financial conflicts to disclose</td>
</tr>
<tr>
<td>Joseph J. Krob, BA</td>
<td>No financial conflicts to disclose</td>
</tr>
<tr>
<td>Zachary S. Aman, BA</td>
<td>No financial conflicts to disclose</td>
</tr>
<tr>
<td>Bryson R. Kemler, MS</td>
<td>No financial conflicts to disclose</td>
</tr>
<tr>
<td>Hunter W. Storaci, MS</td>
<td>No financial conflicts to disclose</td>
</tr>
<tr>
<td>Grant J. Dornan, MS</td>
<td>No financial conflicts to disclose</td>
</tr>
<tr>
<td>Moises Cohen, MD, PhD</td>
<td>International consultant for Arthrex</td>
</tr>
<tr>
<td>Robert F. LaPrade, MD, PhD</td>
<td>Consultant and receives royalties from Arthrex, Ossur and Smith &amp; Nephew</td>
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Biomechanical comparison of vertical mattress and cross-stitch suture techniques, and single- and double-row configurations, for the treatment of bucket-handle medial meniscus tears.

Background: Due to a variety of suturing techniques for bucket-handle meniscal repair, it is important to assess which suturing technique best restores native biomechanics.
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**Purpose/Hypothesis:** To biomechanically compare vertical mattress and cross-stitch suture techniques, in single- and double-row configurations, in their ability to restore native knee kinematics in a bucket-handle medial meniscus tear model. Our hypothesis was that there would be no difference between the vertical mattress and cross-stitch double-row suture techniques, but that the double-row technique would provide significantly improved biomechanical parameters compared to the single-row technique.
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**Methods:** Ten matched pairs of human cadaver knees were randomly assigned to vertical mattress (n = 10) or cross-stitch (n = 10) repair groups. Each knee underwent four consecutive testing conditions: (1) intact, (2) displaced bucket-handle tear, (3) single-row suture configuration on the femoral meniscus surface, and (4) double-row suture configuration (repair of both femoral and tibial meniscus surfaces).
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Methods: Knees were loaded with a 1000 N axial compressive force at 0°, 30°, 60°, 90° and 120° of flexion for each condition. Resultant medial compartment contact area, average contact pressure, and peak contact pressure data were recorded.

A) Anterior view of the medial condyle osteotomy in a right knee, B) Anterior view of testing setup in a right knee depicting a medial condyle osteotomy, C) Anterior view of testing setup with right knee at 0° flexion and D) Posterior view of testing setup with right knee at 0° flexion.
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**Results:** Intact state contact area was not restored at 0° (P = 0.027) for the vertical double-row configuration and at 0° (P = 0.032), 60° (P < 0.001) and 90° (P = 0.007) of flexion for the cross-stitch double-row configuration. No significant differences were found in the average contact pressure and peak contact pressure between the intact state and the vertical mattress and cross-stitch repairs with either single- and double-row configurations at any flexion angles. When comparing the vertical and cross-stitch repairs across all flexion angles, no significant differences were observed in single-row configurations, but in double-row configurations, cross-stitch repair resulted in a significantly decreased contact area, average contact pressure and peak contact pressure (all P < 0.001).
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Results: Medial compartment contact area

A) Medial compartment contact area in the vertical mattress repair testing group and B) cross-stitch repair group for a bucket handle medial meniscus at all flexion angles. (* denotes p < 0.05)
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Results: Medial average contact pressure

Medial average pressure in the vertical repair testing group and B) the cross-stitch repair group for a bucket handle medial meniscus at all flexion angles. (* denotes $p < 0.05$)
Biomechanical comparison of vertical mattress and cross-stitch suture techniques, and single- and double-row configurations, for the treatment of bucket-handle medial meniscus tears.

Results: Medial peak contact pressure

Medial peak pressure in the cross-stitch repair testing group and B) cross-stitch repair group for a bucket handle medial meniscus at all flexion angles. (* denotes p < 0.05)
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**Conclusion:** Single- and double-row configurations of both vertical mattress and cross-stitch inside-out meniscal repair techniques restored native tibiofemoral pressure after a medial meniscus bucket-handle tear at all assessed knee flexion angles. Despite decreased contact area using a double-row configuration, mainly related to the cross-stitch repair, in comparison to the intact state, the cross-stitch double-row repair led to decreased pressure in comparison to the vertical double-row repair. These findings are only applicable at the time of the surgery.

**Clinical relevance:** Medial meniscus bucket-handle tears may be repaired with either single- or double-row configurations of either vertical mattress or cross-stitch sutures.
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