Introduction: Transverse patellar fractures are a common fracture pattern with a multitude of fixation techniques, however a paucity of comparative biomechanical data exists. This study evaluated the stability of a new cable pin construct designed for patellar fractures and compared this to the two most commonly used techniques: modified anterior tension wiring and cannulated lag screw with anterior tension wiring.

Methods: We evaluated the biomechanical strength of three fixation techniques for transverse patellar fractures. A novel design was used whereby 24 custom 4th-generation composite patellae created from CT scan reconstructions were horizontally osteotomized to create transverse fracture patterns. These patellae were then randomly fixed by one of the techniques named above to form 3 groups of 8. All specimens were tested with a 60-degree knee flexion angle using a composite femoral condyle as a pivot point with polyester tension belt loops to simulate the patellar and quadriceps tendons. The constructs were loaded to complete failure of hardware or bone. Pre- and post-test fracture gap measurements along with failure load, stiffness, and failure modes were determined for each.

Results: A summary of the failure testing results is presented in Table 1. The mean load to failure for the Group I modified anterior tension wiring was 415.14 ± 150.10 N, while the mean load to failure of the Group II cannulated lag screw with anterior tension wiring was 814.37 ± 281.98 N; this nearly double load to failure difference was statistically different, p = 0.023. The mean load to failure of the Group III cable pin system was 1103.64 ± 358.70 N and also statistically higher than the Group I modified anterior tension wiring, p < 0.0001. Stiffness mean values for both the Group II cannulated lag screw with anterior tension wiring was 51.60 ± 5.01 N/mm and the Group III cable pin system was 46.53 ± 3.09 N/mm; both were statistically higher (p < 0.0001) than the Group I modified anterior tension wiring (23.86 ± 7.02 N/mm). Mean medial gapping in the Group III cable pin system (10.33 ± 6.50 mm) was statistically higher (p = 0.041) than that shown for the Group II cannulated lag screw with anterior tension wiring (4.59 ± 3.19 mm). No differences were detected for mean lateral gapping between any of the tested constructs.

Discussion: Transverse patellar fractures are common and a variety of fixation techniques exist, however a lack of comparative biomechanical data remains. In our study, the Group II cannulated lag screw with anterior tension wiring and the Group III cable pin system were statistically superior in failure load and stiffness compared with the Group I modified anterior tension wiring construct. The Group III cable pin system also exhibited the highest fixation strength of all constructs studied. While all constructs resulted in significantly different fixation strengths, other factors should be considered. These include reoperation rates due to symptomatic hardware, ease of implantation, and costs. Implantation
difficulty, time, and cost all increase in a stepwise fashion from Group I to Group II up to Group III. Further research is warranted to investigate the fixation strength needed for bone-implant constructs to withstand clinical failure along with further clinical correlation into long-term post-surgical effects using physiologic fatigue loads.

**Significance:** Transverse patellar fractures are common and a variety of fixation techniques exist, however a lack of comparative biomechanical data remains. In our study, a cannulated lag screw with anterior tension wiring and a cable pin system were statistically superior in failure load and stiffness compared with a modified anterior tension wiring construct. The cable pin system also exhibited the highest fixation strength of all constructs studied.

<table>
<thead>
<tr>
<th>Osteosynthesis</th>
<th>Failure Load (N)</th>
<th>Stiffness (N/mm)</th>
<th>Medial Gap (mm)</th>
<th>Lateral Gap (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified anterior tension wiring (MATW)</td>
<td>415.14 +/- 150.10</td>
<td>23.86 +/- 7.02</td>
<td>8.38 +/- 2.34</td>
<td>7.07 +/- 2.76</td>
</tr>
<tr>
<td>Cannulated lag screw with anterior tension wiring (CLS)</td>
<td>814.37 +/- 281.98a</td>
<td>51.60 +/- 5.01c</td>
<td>4.59 +/- 3.19</td>
<td>5.93 +/- 2.60</td>
</tr>
<tr>
<td>Cable pin system</td>
<td>1103.64 +/- 358.70b</td>
<td>46.53 +/- 3.09c</td>
<td>10.33 +/- 6.50d</td>
<td>9.51 +/- 8.05</td>
</tr>
</tbody>
</table>

aVs MATW p=0.023  
bVs MATW p<0.0001  
cVs MATW p<0.0001  
dVs CLS p=0.041

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