A Biomechanical study comparing the dynamic hip screw with an X-Bolt in an unstable intertrochanteric fracture model of the proximal femur

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Introduction
Lag screw cut-out following fixation of unstable intertrochanteric fractures in osteoporotic bone remains an unsolved challenge. Failure of fixation can result in revision surgery, prolonged inpatient stay and has major socio-economic consequences. There are many new devices on the market to help deal with this problem. The X-Bolt is one such device, which is an expanding bolt that may offer superior fixation in osteoporotic bone compared to the standard DHS screw type device.

Aim
The aim of this study was to test if there was a difference in cut-out using the X-Bolt implant compared with the standard DHS system in an unstable fracture model.

Methods
An unstable fracture model (AO 31-A2) was created using low density surrogate bone (5pcf, Sawbones®), into which either an X-Bolt or DHS screw was implanted. The fracture model was tested with incremental cyclical sinusoidal loading at 3Hz (cyclic loading from 10% - 100% of the input load). The programme started at 600N (equivalent to 60kg) and increased by 100N every 1000 cycles. Displacement, cycle count and force exerted were continuously recorded until cut-out of the implant. This incremental loading method ensured that cut-out failure would occur and results for the number of cycles and the maximum force exerted obtained.
**Results**
All specimens failed by varus collapse with superior cut-out. The mean cycle count to cut-out in the DHS and X-Bolt specimen groups were 4345 and 6898, respectively. The mean force achieved at cut-out in the DHS and X-Bolt groups were 1025N and 1275N, respectively. A statistically significant difference was observed with a P-value of 0.005 and a power of 87% with respect to cycle count and a P-value of 0.008 and power 85% with respect to force exerted at failure.

<table>
<thead>
<tr>
<th></th>
<th>DHS</th>
<th>X-BOLT</th>
<th>p-value</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number per group</td>
<td>8</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEAN CYCLE COUNT</td>
<td>4,345</td>
<td>6,898</td>
<td>0.005</td>
<td>+2,553 cycles</td>
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<tr>
<td>(S.D.)</td>
<td>(1,442)</td>
<td>(1,834)</td>
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<td></td>
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<td>MEAN FORCE (N)</td>
<td>1,030</td>
<td>1,280</td>
<td>0.008</td>
<td>+24%</td>
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<tr>
<td>(S.D.)</td>
<td>(150)</td>
<td>(180)</td>
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**Conclusion**
The X-Bolt device demonstrated superior resistance to cut-out and withstood greater loads compared to the DHS in low density surrogate bone in an unstable fracture model under cyclical axial loading. These results would support the use of an X-Bolt device in clinical studies to further assess it as a viable and better performing option in treating unstable fractures in osteoporotic bone.

**References**

**Conflict of Interest Statement**
The DHS kit and screws were supplied by AO Synthes. X-Bolt implants and surrogate bone blocks were provided by SOTA Orthopaedics Ltd. Other than providing the implants and bone blocks there was no other financial support from either company.