ASSESSING REPEATED DISLOCATIONS WITH CONSTRAINED ACETABULAR COMPONENTS

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**Methods:**

Eight constrained polyethylene liners (ZTT1, DePuy Orthopaedics, Inc., Warsaw, IN) were pre-soaked for 24 hours in a 37°C bovine serum bath. Loading was conducted in the temperature controlled bath on an Instron testing machine (model 8500) using a modification of ASTM standard F04.22.17.[6] The load protocol simulated femoral neck impingement with the liner lip acting as a fulcrum for lever out dislocation. A 52 mm acetabular cup was cemented into a holding fixture and the liners secured with 3 peripheral screws. A 28 mm femoral head was inserted into the polyethylene liner and the metal retaining ring snapped on the rim according to the manufacturer’s instructions. The femoral stem was then positioned horizontal to the liner and the cup holding fixture was placed on thrust bearings to maintain a 29 mm lever arm throughout dislocation. The stem was loaded at a rate of 1°/sec. until the femoral head dislocated from the liner/ring assembly. The dislocation force was measured and the dislocation torque calculated. Subsequently, the femoral head was poised above the liner rim for relocation. A controlled load at 1 mm/sec. was applied vertically in line with the femoral neck until the head snapped across the locking ring/liner assembly and the maximum relocation force was measured. Clinically, there is a treatment delay between dislocation and closed reduction (relocation) during which some elastic recovery of the polyethylene liner can occur. This effect was evaluated by testing 4 inserts without any time delay and 4 inserts with a 10 hour time delay between each dislocation and relocation. Each liner/ring assembly was subjected to 3 dislocations and 2 relocations.

**Results:**

The force to dislocate the femoral head was significantly lower after multiple dislocations for all polyethylene liners tested (Figure 1), and an average of 69 Nm of torque was required to initially dislocate the femoral heads. The dislocation torque for the 10 hour time delay group decreased an average of 26% from the initial dislocation to the second dislocation (Table 1). This decrease was significantly less than the 34% decrease observed for the no delay group, indicating that elastic recovery does occur after dislocation and restores some of the capture mechanism constraint. Less than an additional 10% decrease occurred on the subsequent dislocation for both groups. The effect of elastic recovery was also evident in the significantly higher relocation force required for the 10 hour time delay group (Figure 1).

**Discussion:**

Despite some polyethylene rim damage that occurred due to neck impingement during dislocation, nearly 75% of the capture mechanism strength was maintained after initial dislocation and 10 hours of elastic recovery. Although some disruption of the constraining mechanism occurred, the performance of these constrained liners may be clinically adequate. In a recent clinical follow-up series of THA revision for chronic dislocation, 17% of the patients who received ZTT 1 constrained polyethylene liners experienced subsequent dislocation. Four patients were successfully treated with closed reduction and remain stable without any further dislocations after more than 2 years.[3] These clinical data suggest that in cases of THA dislocation, closed reduction of constrained polyethylene liners can be successful without predisposing patients to further dislocations. Based on these mechanical test results and the clinical data, it appears that the ZTT1 constrained polyethylene liner can provide sufficient constraint even after dislocation and closed reduction has occurred.

**Table 1: Average torque to dislocate the head from the constrained liners**

<table>
<thead>
<tr>
<th>Dislocate</th>
<th>Torque (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 hour delay</td>
<td>69+4</td>
</tr>
<tr>
<td></td>
<td>51+4</td>
</tr>
<tr>
<td></td>
<td>46+4</td>
</tr>
<tr>
<td>No delay</td>
<td>70+3</td>
</tr>
<tr>
<td></td>
<td>46+1</td>
</tr>
<tr>
<td></td>
<td>42+2</td>
</tr>
</tbody>
</table>

* * significantly less than the initial dislocation (Dislocate 1), t-test p<0.05

**References:**


**Figure 1: Average force to dislocate and relocate the femoral heads**

- 10 hour time delay
- No time delay
- Dislocate 1
- Relocate 1
- Dislocate 2
- Relocate 2
- Dislocate 3

* significantly less than the initial dislocation force (Dislocate 1), t-test p<0.05
** significantly different between the two groups, t-test p<0.05