Role of Socket Design, Flexibility and Suspension in Transfemoral Sockets during Walking
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INTRODUCTION
Ischial Containment (IC) sockets encompass the pelvis and hip joint limiting hip range of motion and compromising comfort (Tranberg et al. 2011). With the advent of vacuum-assisted suspension (VAS) there has been an increasing interest inrimpless sockets (Kahle 2002; Fairley 2008; Strachan et al. 2011; Kahle & Highsmith 2011, 2012). The purpose of this case study was to assess the role the brim and flexibility of the socket have on stability, comfort, suspension and gait parameters during walking.

METHOD
Subject: 29 year old male with a unilateral transfemoral amputation due to trauma (height 182cm; weight 83.3kg). Relatively long residual limb (48% of leg length) with average to firm skin tissue.

Apparatus: 8 camera motion analysis system (Motion Analysis Corporation) with 6 force plates (AMTI) embedded in the middle of a 12m walkway.

An IC socket with modified NU/RIC design, silicone seal-in suction suspension and one-way valve was used as the starting point (Fig 1). Socket was constructed of (1) a rigid carbon frame with posterior U-shaped fenestration and 1.5” Dacron strap over gluteal region; and (2) flexible thermoplastic inner socket with ½” flexible brim extending proximal to the carbon frame. Subject was assessed by a Certified Prosthetist as having total contact and appropriate containment in the socket. Prosthetic alignment was unchanged for conditions 1 to 6. Prosthetic components for all test conditions included a C-leg with torsion pylon (Otto Bock) and Highlander foot (Freedom Innovations).

DISCUSSION/CONCLUSION
Subjective comments and data did not match exactly. No one condition clearly provided the greatest comfort, fastest speed, smallest step width and least coronal plane trunk motion for this subject. However, removing the lateral and medial walls affected stability as suggested by increased lateral trunk lean.

CLINICAL APPLICATIONS
Removing the brim of an IC socket appears to affect gait if VAS is not used.

REFERENCES
Kahle & Highsmith, 37th AAOP Meeting, 2011.
Strachan et al., 37th AAOP Meeting, 2011.
Kahle & Highsmith, 38th AAOP Meeting, 2012.

This work was funded by Department of Defense Award #W81XWH-10-1-0744.

American Academy of Orthotists & Prosthetists
39th Academy Annual Meeting and Scientific Symposium
February 20-23, 2013

Table 1. Results for conditions #1 to #7. Bold indicates “best” result for each variable, underline indicates the “worst” result. IT = ischial tuberosity. SCS = socket comfort score.

<table>
<thead>
<tr>
<th>Socket</th>
<th>SCS</th>
<th>Comment</th>
<th>Speed (m/s)</th>
<th>Step Width (cm)</th>
<th>Max Lateral Trunk Lean (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>2</td>
<td>Lots of pressure on IT</td>
<td>1.71</td>
<td>15.44</td>
<td>2.6</td>
</tr>
<tr>
<td>#2</td>
<td>2</td>
<td>Still pressure on IT</td>
<td>1.64</td>
<td>15.57</td>
<td>3.4</td>
</tr>
<tr>
<td>#3</td>
<td>5</td>
<td>Still pressure on IT but not as bad, alignment is off – toes are too in</td>
<td>1.65</td>
<td>14.23</td>
<td>4.3</td>
</tr>
<tr>
<td>#4</td>
<td>4</td>
<td>Socket more comfortable but foot feels too far back</td>
<td>1.69</td>
<td>15.13</td>
<td>4.0</td>
</tr>
<tr>
<td>#5</td>
<td>2</td>
<td>Socket feels like it wants to come off</td>
<td>1.63</td>
<td>17.94</td>
<td>3.2</td>
</tr>
<tr>
<td>#6</td>
<td>4</td>
<td>Way better, rotational wobble gone</td>
<td>1.71</td>
<td>14.98</td>
<td>3.3</td>
</tr>
<tr>
<td>#7</td>
<td>6</td>
<td>That’s more like it!</td>
<td>1.84</td>
<td>16.3</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Figure 1. Viewing angle: Condition 1: (a) posterior lateral (b) posterior medial. Condition 2: (c) lateral (d) anterior. Condition 3: (e) lateral (f) anterior. Condition 4: (g) anterior (h) superior. Condition 5: (i) anterior (j) medial (k) posterior (l) lateral.