Interface pressures during ambulation using suction and vacuum-assisted prosthetic sockets


Products

Vacuum-assisted socket system* (VASS) vs suction socket system (SSS)

TEC, later acquired by Otto Bock and sold as Harmony

Major Findings

With VASS compared to SSS:

→ Positive pressure (compression of the residual limb) is reduced in stance phase
  Pressure impulse decreased by 7%
  Peak pressure decreased by 4%

→ Negative pressure (pull on the residual limb) is increased in swing phase
  Negative pressure impulse increased by 27%
  Negative peak pressure increased by 27%

Decreased positive pressure impulse and increased negative pressure impulse with VASS

During stance phase pressure impulse values measured with five contact sensors. During swing phase values measured with one air pressure sensor. Measurements were conducted with a vacuum-assisted socket system (VASS) and with a suction socket system (SSS).

Population

Subjects: 9 unilateral, transtibial amputees
Previous socket system: total-surface weight bearing socket
Amputation causes: not reported
Mean age: 46 yrs (33 - 65 yrs)
Mean time since amputation: 18 yrs (6 - 32 yrs)
MFCL: not reported

Reference

Beil TL, Street GM, Covey SJ.
Human Performance Laboratory and the Department of Mechanical and Manufacturing Engineering, St. Cloud State University, MN, USA
Study Design

Interventional, randomized crossover design:

Subjects walked 20 meters with one socket system, changed to the other socket system and walked 20 meters. This was repeated three times.

Results

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<table>
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<th>Category</th>
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<th>Results for VASS compared to SSS</th>
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<td><strong>Pressure Measurement</strong></td>
<td>Data from 5 force-sensing resistors (for positive pressure) and 1 air pressure sensor (for negative pressure) during 5 steps at 4 km/h</td>
<td>Stance phase (compression of the residual limb): <strong>Pressure impulse decreased by 7%</strong>. <strong>Peak pressure decreased by 4%</strong>. Swing phase (pull on the residual limb): <strong>Magnitude of negative pressure impulse increased by 27%</strong>. <strong>Magnitude of negative average impulse increased by 25%</strong>. <strong>Magnitude of negative peak pressure increased by 27%</strong>.</td>
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* no difference (0), positive trend (+), negative trend (−), significant (++/−−), not applicable (n.a.)

Author’s Conclusion

“Use of the VASS changes the positive and negative pressures exerted on the residual limb during ambulation. Pressure impulse and peak positive pressures are reduced during the stance phase, while the magnitude of the impulse, average, and peak negative pressures is increased during the swing phase.” (Beil et al. 2002)

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