
Reference

Kahle JT, Orriola JJ, Johnston W, Highsmith MJ.

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The effects of vacuum-assisted suspension on residual limb physiology, wound healing, and function: A systematic review

Technology and Innovation 2014; 15(4):333-341.

Products

Vacuum-assisted socket system* (VASS)

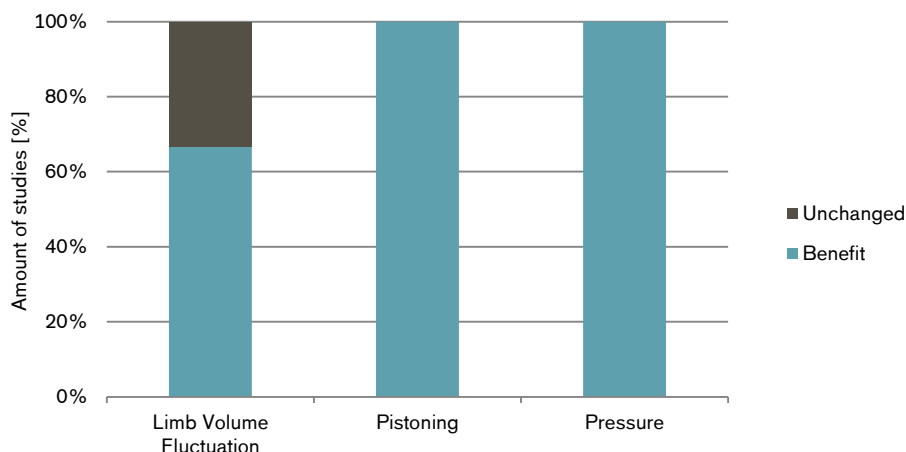
* different suppliers

Major Findings

With VASS:

- **Allows for early fitting without inhibiting wound healing or increasing pain**
- **Residual limb volume increased by 3.7% during walking**
- **Twofold increase in symmetry of step length and stance duration compared to suction socket system**
- **Decreased risk of stumbles and falls**
 - Activities-specific balance confidence scale (ABC) score increased by 23% compared to pin suspension system
- **Reduced pistoning compared to suction socket system and pin suspension system**
- **Pressure impulse was decreased by 7.5% in stance phase and increased by 27% in swing phase compared to suction socket system**

Improved residual limb physiology with VASS compared to other socket systems



Studies related to residual limb physiology include categories limb volume fluctuation (n=3), pistoning (n=1) and pressure measurement (n=1). Included were studies comparing VASS to other socket systems.

Population

Subjects: 60 transtibial and 10 transfemoral amputees
Mean age: 49 yrs

Study Design

Review Article

Results

Body Function				Activity			Participation	Others	
Wound Healing	Limb Volume Fluctuation	Pain	Comfort, Limb Health	Level Walking	Balance	Activity, Mobility, ADLs	Preference, Satisfaction, QoL	Pistoning	Pressure Measurement

Category	Results for VASS	Reference
Wound healing	VASS allows for early fitting without inhibiting wound healing.	Traballesi <i>et al</i> 2012
Limb Volume Fluctuation	<p>The residual limb volume increased 3.7% with VASS and decreased 6.5% with the suction socket system after walking for 30 min (n=10).</p> <p>With VASS the residual limb mean volume increased by 92, 93, and 58 cc in the undersized, neutral, and oversized socket (n=7) after physical activity.</p> <p>No difference in volume of the residual limb between VASS and pin suspension system after walking for 30 min (n=5).</p>	<p>Board <i>et al</i> 2001</p> <p>Goswami <i>et al</i> 2003</p> <p>Klute <i>et al</i> 2011</p>
Level Walking	Twofold increase in symmetry of step length and stance duration with VASS compared to suction socket system.	Board <i>et al</i> 2001
Balance	Improvement of Activities-specific balance confidence scale (ABC) score by 23% with VASS compared to pin suspension system.	Ferraro 2011
Activity, Mobility, Activities of daily living (ADLs)	<p>Locomotor Capability Index (LCI) was increased with VASS compared to suction socket system during a 12 week rehabilitation program (LCI score 42 vs 21) including subjects with open ulcer.</p> <p>Less step activity when utilizing VASS compared to pin suspension system.</p>	<p>Traballesi <i>et al</i> 2012</p> <p>Klute <i>et al</i> 2011</p>
Pistoning	<p>Pistoning was reduced with VASS compared to pin suspension system (13 mm vs 64 mm).</p> <p>Tibial displacement was 0.7 cm less with VASS compared to suction socket system.</p> <p>Liner displacement was 0.4 cm less with VASS compared to suction socket system.</p> <p>A trend towards increased mean lateral shifting and a trend towards decreased mean vertical shifting with brimless compared to ischial ramus containment (IRC) socket design tested on transfemoral amputees using VASS.</p>	<p>Klute <i>et al</i> 2011</p> <p>Board <i>et al</i> 2001</p> <p>Kahle and Highsmith 2014</p>
Pressure Measurement	<p>Medial proximal pressure was reduced when using brimless compared to ischial ramus containment (IRC) socket design with VASS.</p> <p>Pressure impulse was reduced by 7.5% and peak positive pressure was reduced by 4.2% with VASS compared to suction socket system during stance phase. Pressure impulse was increased by 27%, average pressure was increased by 25% and peak pressure was in-</p>	<p>Kahle and Highsmith 2014</p> <p>Beil <i>et al</i> 2002</p>

Category	Results for VASS	Reference
	creased by 27% with VASS compared to suction socket system during swing phase.	

* no difference (0), positive trend (+), negative trend (-), significant (++/--), not applicable (n.a.)

Author's Conclusion

"The strongest evidence supporting the clinical outcomes of VASS for the prosthetic user was in the topic of residual limb (RL) physiology. There is currently limited evidence supporting the use of VASS regarding wound healing and function. The mechanical principles of VASS applied to prosthetic use may have physiological and functional merit. Applying the associated principles to prosthetic design may create alternative interface design configurations for both the transtibial amputees and the transfemoral amputees." (Kahle et al. 2014)

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