

## Reference

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# Effects of elevated vacuum on in-socket residual limb fluid volume: Case study results using bioimpedance analysis

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## Products

### Vacuum-assisted socket system\* (VASS) and electronic vacuum-assisted socket system\*\* (eVASS) vs Suction socket system (SSS) and Pin suspension system (PSS)

\*Harmony, Otto Bock

\*\* ePulse, Otto Bock; eVAC, Smith Global

## Major Findings

With VASS and eVASS:

### → 3 out of 3 subjects showed a more positive limb volume change during activity compared to PSS

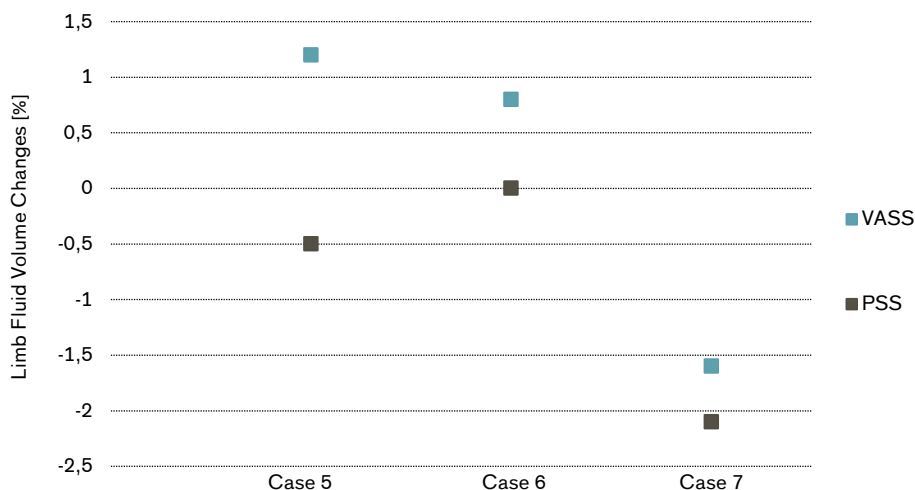
The difference in limb fluid volume change between VASS and PSS was up to 1.7%

### → 2 out of 3 subjects showed an increase in limb fluid volume during activity

The limb fluid volume increase was 1.2%, respectively 0.4%

Caution: This article includes 7 case reports. Subjects were tested with different protocol and different vacuum systems.

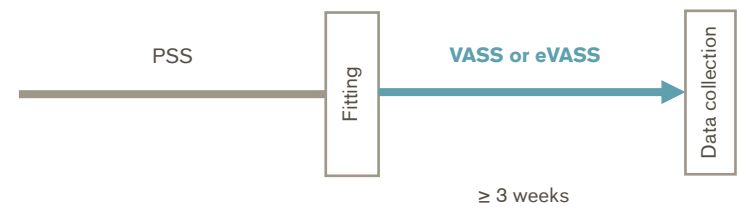
### Limb volume changes over session are more positive with VASS



The session was composed of 2 min sitting, 5 min standing, 5 min treadmill walking, 2 min sitting, 5 min standing, and 5 min treadmill walking. The volume change was calculated by subtracting the fluid volume after the second walk from the fluid volume at the outset of the first stand. The test session was performed with vacuum-assisted socket system (VASS) and pin suspension system (PSS). Case 5 and 6 were fitted with electronic VASS and case 7 was fitted with mechanical VASS.

<b>Population</b>	Subjects:	7 transtibial amputees
	Previous socket system:	71% PSS, 14% VASS, 14% neoprene suspension system
	Amputation causes:	86% trauma, 14% ulcer
	Mean age:	46 ± 14 yrs
	Mean time since amputation:	7.4 ± 7.5 yrs
	MFCL:	14% K1, 28% K3, 57% K4

**Study Design** 7 case studies:



**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	Outcomes	Results for VASS	Sig.*
Limb Volume Fluctuation	Extracellular fluid volume changes measured by bioimpedance: With the difference in response of different biological structures to electrical current, fluid volumes can be determined.		
	3 min walking with SSS, 3 min walking with VASS, 2 min sitting, 3 min walking with VASS, 3 min walking with SSS (n = 3)	For two out of three subjects, limb fluid volume during walking with VASS increased by 1.2%, respectively by 0.4%. The limb volume change during walking with SSS was comparable.	n.a.
	2 min sitting, 5 min standing, 5 min walking, 2 min sitting, 5 min standing, 5 min walking. Test session performed with both VASS and PSS (n = 3)	For all three subjects, limb fluid volume during the test session tended to be more positive with VASS compared to PSS. The difference in limb fluid volume change between VASS and PSS was up to 1.7%.	n.a.

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

**Author's Conclusion** "This series of case studies on seven subjects showed that some subjects demonstrated less decrease (or more increase) in limb fluid volume using sockets with elevated vacuum compared with suction sockets or lock-and-pin suspension sockets, while others did not. Some measures of limb fluid volume changed consistently, while others did not. A number of variables may affect limb fluid volume change. When designing future research studies, investigators need to consider these variables in study design, particularly when comparing elevated vacuum to another socket design." (Sanders et al. 2011)

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