Reference

Rábago CA, Aldridge Whitehead J, Wilken JM.

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Evaluation of a Powered Ankle-Foot Prosthesis during Slope Ascent Gait

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Products

BiOM (Bionic powered ankle-foot prosthesis)

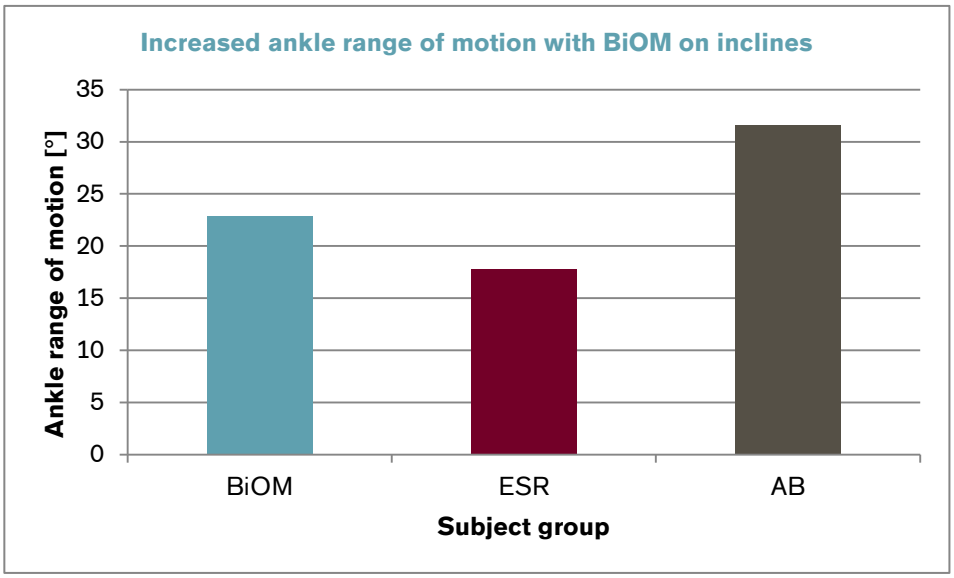
Major Findings

With BiOM compared to passive, energy-storing-returning prosthetic ankle foot (ESR) and matched able-bodied subjects (AB):

→ **Increased ankle range of motion with BiOM on inclines**
by 29% compared to ESR

→ **Improved push-off with BiOM compared to ESR**
Plantarflexion improved by 283.5%
Ankle power generation increased by 102.7%

→ **Less demand on the intact limb knee with BiOM**
44.7% lower knee power generation compared to ESR

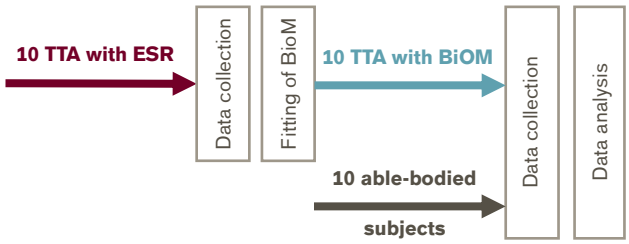


Population

Subjects:	10 unilateral, transtibial amputees (TTA) 10 matched able-bodied subjects (AB)
Previous prosthetic foot:	Re-Flex VSP (5), Renegade (3), Flexfoot (1)and Pathfinder (1)
Mean age:	TTA: 30.2 ± 5.3 years AB: 23.3 ± 4.1 years
Mean height:	TTA: 1.83 ± 0.1 m AB: 1.8 ± 0.09 m
Mean weight:	TTA: 96.1 ± 6.8 kg AB: 94.9 ± 8.8 kg

Study Design

Interventional, pre- to post design:



Participants with TTA attended two separate gait analysis sessions using their ESR as well as the BiOM. Participants with TTA were given three weeks to acclimate to the BiOM. The AB subjects attended a single gait analysis session. During data collections, participants walked up a 5m long, 5° sloped ramp

Results

Functions and Activities						Participation			Environment
Level walking	Stairs	Ramps, Hills	Uneven ground, Obstacles	Cognitive demand	Metabolic energy consump-tion	Safety	Activity, Mobility, ADLs	Preference, Satisfac-tion, QoL	Health Economics

Category	Outcomes	Results for BiOM vs ESR vs AB	Sig.*
Ramps, Hills	Self-selected velocity [m/s]	**Faster with BiOM (+17.8%) and ESR (+11.9%) compared to AB.**	++
		No difference with BiOM compared to ESR (+5.3%).	0
	Step length [m]	**Longer step length for prosthetic limb with BiOM compared to ESR (+3.7%) and AB (+15.1%).**	++
	Ankle range of motion [°]	**Increased for prosthetic limb with BiOM compared to ESR by +29%.**	++
		Decreased with BiOM (-27.6%) and ESR (-43.8%) compared to AB.	––
	Transitioning ONTO the prosthetic limb	***Prosthetic limb:***	
		Dorsiflexion [°]:	
		Decreased by 23.9% with BiOM compared to ESR.	––
		No difference for BiOM (-14.3%) and ESR (12.5%) compared to AB.	0
		Ankle power absorption [W/kg]:	
		Lower with BiOM compared to AB by 200%	––
		Decreased by 60% with BiOM compared to ESR.	–
		Hip power generation [W/kg]:	
		Higher with BiOM (+76.8%) and ESR (72.3%) compared to AB.	––
		No difference with BiOM compared to ESR (+2.6%).	0
		Intact limb:	
		Ankle power generation [W/kg]:	
		Increased by 47% with BiOM compared to AB.	––
		No difference with BiOM compared to ESR (+5.5%).	0

Category	Outcomes	Results for BiOM vs ESR vs AB	Sig.*
	Transitioning OFF the prosthetic limb (Push-off)	***Prosthetic limb:***	
		Plantarflexion [°]:	
		Improved with BiOM compared to ESR by 283.5%.	**++**
		Decreased for BiOM (-44.3%) and ESR (-130.4%) compared to AB.	**––**
		Ankle power generation [W/kg]:	
		Increased with BiOM compared to ESR by 102.7%.	**++**
		No difference with BiOM compared to AB (+27.2%).	0
		Intact limb:	
		Knee power generation [W/kg]:	
		Lower by 44.7% with BiOM compared to ESR.	**++**
		No difference with BiOM compared to AB (-1.7%).	0

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

Author's Conclusion

"While the PWR (*Note: BiOM*) provided active ankle plantarflexion and push-off power when transitioning off the prosthetic limb, it was not capable of active dorsiflexion. Thus, the PWR functioned similar to a passive ESR device during the transition onto the prosthetic limb resulting in similar prosthetic limb hip and intact limb ankle compensations. In contrast, when transitioning off the prosthetic limb, the increased ankle plantarflexion and push-off power provided by the PWR contributed to decreased intact limb knee extensor power production, lessening demand on the intact limb knee. Further work is needed to determine whether the provided active ankle plantarflexion and push-off power would improve slope descent gait mechanics." (Rábago et al., 2016)