

Reference

Ferris A*, Aldridge J*, Rábago C*, Wilken J* .

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Evaluation of a Powered Ankle-Foot Prosthetic System During Walking

Arch Phys Med Rehabil 93 (11), S. 1911–1918, 2012. DOI: 10.1016/j.apmr.2012.06.009.

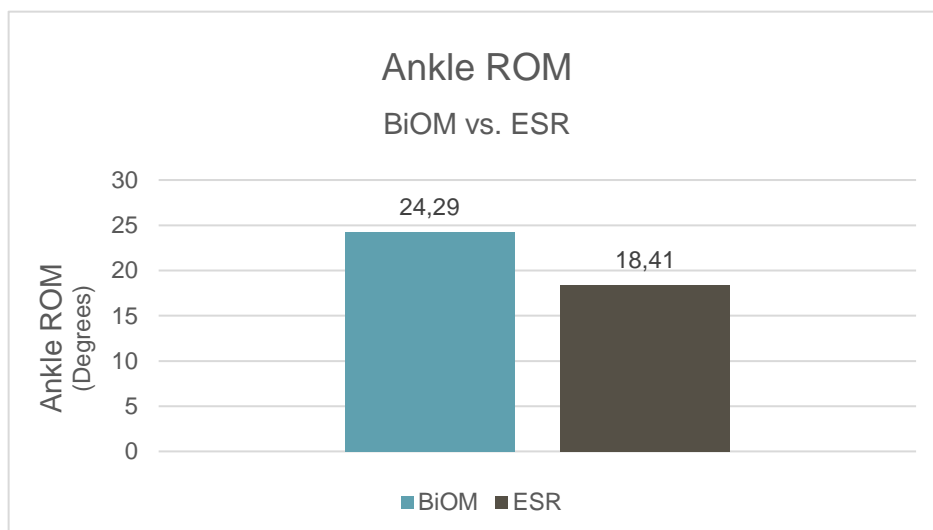
Products

BiOM (predecessor to Empower) , ESR

Major Findings

With BiOM (PowerFoot BiOM prosthetic device) compared to ESR (Energy-storing and returning foot prosthesis), the contralateral intact limb and matched control subjects:

- **Ankle range of motion (ROM) and peak ankle power increased**
- **Peak knee power absorption increased**
- **Limb peak hip power generation at preswing increased**
- **Walking velocity increased**

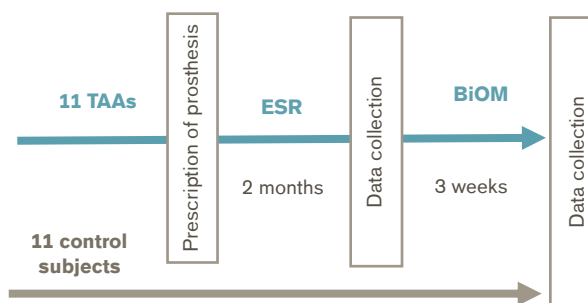


Population

Subjects:	11 unilateral transtibial amputees (TAA) and 11 matched control subjects
Previous foot prosthesis:	Energy-storing and returning foot prosthesis (ESR)
Amputation causes:	Trauma
Mean age:	29.8 ± 5.3 (TAA); 23.4 ± 3.9 (control group)
Mean time since amputation:	not reported
MFCL:	K2 and K3

Study Design

Interventional study, pre-post design:



Subjects were tested in a gait analysis laboratory and walked at self-selected velocity and controlled velocity (controlled velocity was calculated on the basis of individual leg length). Temporal-spatial values, walking velocity and kinematics were used for biomechanical analysis. Physical performance was analysed with:

- T-Test (10-meter forward run, 5-meter side-shuffle to right, 10-meter side-shuffle to left, 10-meter backward run)
- Four Square Step Test (moving through 4 quadrants in a clockwise pattern)
- Hill and Stair Assessment test (descending a 16-step staircase and a 10-degree slope)

User satisfaction was evaluated with the Prosthetic Preference Questionnaire (ambulation, frustration, perceived response, sounds, utility, well-being).

Results

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

Category	Outcomes	Results for BiOM	Sig.*
Level walking	Temporal-Spatial	Step length longer than intact limb	++
	Joint Angle		
	Ankle	30%↑ than ESR	++
	Knee	↓ than intact limb	++
	Hip	↑ than intact limb	++
	Joint Moments		
	Ankle	Peak dorsiflexor moment 40%↑ than ESR	++
	Knee	Peak knee flexor moment ↓ than intact limb	++
	Hip	↓ than intact limb	++
	Joint Powers		
	Ankle	Peak power 125%↑ than ESR	++
	Knee	Peak knee power absorption ↑ than ESR	+
	Hip	Peak hip power ↑ than ESR	+

Category	Outcomes	Results for BiOM	Sig.*
Activity, Mobility, ADLs	T-Test (s)	1.4 ↓ than ESR	0
	Four-Square Step Test (s)	0.3 ↓ than ESR	0
Preference, Satisfaction, QoL	Ambulation	7.3% ↑ than ESR	+
	Frustration	3.4% ↑ than ESR	+
	Perceived response	9.6% ↑ than ESR	+
	Sounds	27.9% ↓ than ESR	+
	Utility	3.5% ↑ than ESR	+
	Well-being	9.2% ↑ than ESR	+

Author's Conclusion

"The BiOM demonstrated significantly greater ankle ROM and power generation than the ESR. Proximal joint asymmetries and the introduction of additional asymmetries with BiOM use may result from the uniaxial function of the device. Device-specific training or design modifications may be needed to allow individuals with TTA to utilize the additional functionality of the device and minimize compensatory strategies." (Ferris et al., 2012)

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