Reference	Beck ON, Taboga P, Grabowski AM. Department of Integrative Physiology, University of Colorado, Boulder CO / Department of Veterans Affairs, Eastern Colorado Healthcare System, Denver, CO.

Prosthetic model, but not stiffness or height, affects the metabolic cost of running for athletes with unilateral transtibial amputations.

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Products

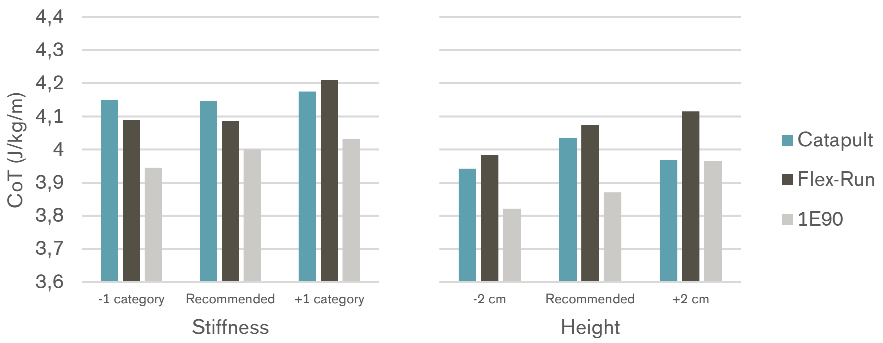
IE90 Sprinter Foot

Major Findings

With IE90 compared to Catapult FX6 (Freedom Innovations) and Flex-Run (Össur):

→ **Reduced metabolic cost by 4.3 % using IE90 compared to Catapult FX6 and 3.4 % compared to Flex-Run.**
→ **Prosthetic stiffness and height had no significant effect on metabolic cost of running; prosthetic model and biomechanics contributed more to the reduction of metabolic cost.**

Impact of Stiffness, Height and Prosthesis Model on the Metabolic Cost of Transport (CoT) (lower is better)



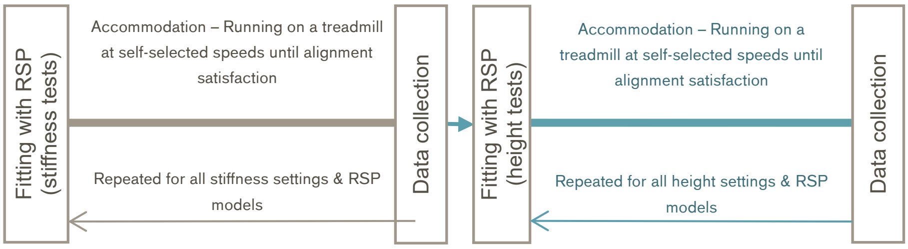
Neither prosthetic stiffness nor height affected the net CoT. Only the prosthetic model had a significant effect on net CoT.

Population

Subjects:	10 unilateral, transtibial amputee athletes (7 M, 3 F)
Previous prosthesis:	passive-elastic running-specific prosthesis (RSP)
Amputation causes:	not reported
Mean age:	33.4 ± 6.1 years
Mean time since amputation:	not reported
MFCL:	not reported

Study Design

Interventional, randomized, crossover trial



"Participants performed a five minute standing trial (using their personal walking prosthesis) and up to six, five minute running trials per session with at least five minutes of rest between trials. Each participant ran using 15 different combinations of prosthetic model, stiffness category and height. […] Once a participant completed trials at all three stiffness categories for a prosthetic model at the recommended affected leg length, the height alteration trials for the respective prosthetic model at the optimal stiffness category were randomly inserted into the trial order."

Results

Activities		Participation				Body function			Other
Sprinting, running, jumping	Other sports	Leisure / recreational sports	Competitive sports	Paralympic sports	Preference, satisfaction, QoL	Biomechanics (kinematics / kinetics)	**Clinical (metabolic / performance)**	Medical (pain, injuries)	Technical aspects / alignment

Category	Outcomes	Results for IE90 Sprinter	Sig.*
Clinical (Metabolic / Performance)	Effect of prosthetic features on net metabolic cost of transport (CoT)	**Prosthetic model** had a significant effect ($p < 0.05$) compared to recommended prosthetic stiffness ($p=0.180$), actual prosthetic stiffness ($p=0.327$) and height ($p=0.062$)	++
	Reduction of net CoT	IE90 use reduced metabolic cost of running by 4.3 % compared to Catapult and by 3.4 % compared to Flex-Run.	++

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

Author's Conclusion

"Prosthetic model, but not stiffness or height, affected the metabolic cost of running for athletes with unilateral transtibial amputations. The use of a J-shaped, 1E90 Sprinter prosthesis elicited lower metabolic costs during running compared to the use of C-shaped prostheses. Furthermore, athletes with transtibial amputations appear to modulate biological leg stiffness with altered in-series stiffness differently than non-amputees. As such, changes to in-series prosthetic stiffness and surface stiffness likely alter the running mechanics of athletes with unilateral transtibial amputations. Despite the current prescriptions of running-specific prostheses, which aim to mitigate kinematic asymmetries between the affected and unaffected legs of athletes with unilateral transtibial amputations, the metabolic cost of running was independent of stride kinematic asymmetries, and only related to one kinetic asymmetry (peak vertical GRFs). Instead, the metabolic cost of running was reduced with decreased overall (affected and unaffected leg average) peak and stance average vertical GRFs, prolonged ground contact times, and reduced leg stiffness. Therefore, current prosthetic manufacturer recommendations do not necessarily reduce the metabolic cost of running (or optimize distance running performance). Instead, recommendations based on prosthetic design and the affected and unaffected leg's average biomechanics, rather than asymmetries, likely optimize distance-running performance for athletes with unilateral transtibial amputations." (Beck et al. 2017)