Reference	Thomas Schmalz, Bjoern Altenburg, Michael Ernst, Malte Bellmann, Dieter Rosen- baum.					
	Otto Bock Healthcare GmbH, Hermann-Rein-Straße 2a, 37075, Göttingen, Germany.					
	Lower limb ampu	itee gait characteristics on a				
	specifically desig	specifically designed test ramp: Preliminary				
	results of a biome	echanical comparison of two				
	prosthetic foot co	oncepts				
	Gait and Posture 68 (2019) 1	.61-167; DOI: 10.1016/j.gaitpost.2018.11.017				
Products	Meridium vs. current ESR feet vs. Non-Amputee control group					
Major Findings	The results show the advantages of MPF (Meridium, Ottobock) compared to ESR feet and the non-amputee control group:					
	 → MPF show significant decreased maximal knee extension moment during the changing cycle compared to ESR Max. knee extension moment: MPF: 0.42±0.12 [Nm/kg]; 0.71±0.13 [Nm/kg] → MPF show significant increased ankle dorsiflexion angle during the changing cycle compared to ESR Max. ankle dorsiflexion angle during changing cycle: MPF: 16.4±2.9°; ESR: 6.9±0.7° Ankle dorsiflexion angle of MPF is comparable to dorsiflexion angle of NA-group (15.6±2.3°). 					
						Ankle dorsifle
		24,0	Τ			
	20,0					
	18,0 	15,6				
		18,4				
	4,0	6,9				
	0,0					
	Prosthe	tic Side Sound Side				
	MPF ESR -NA group					
Population	Subjects:	4 male TT amputees; 10 non-amputees as control group (6 males, 4 females)				
	Previous TT prostheses:	Ottobock prosthetic feet: 1C30 Trias, 1C60 Triton, 2x				
	Amputation causes:	1C40 C-VVAIK trauma (N=3); peripheral arterial disease (N=1)				
	Mean age:	Amputees: 56±12 years; Control group: 23±3 years				
	MFCL:	10.0 ±10.4 years K3				

Study Design

Doculto

Monocentric prospective interventional study:



The biomechanical measurement took place on a specific ramp to simulate uneven ground. The ramp consists of a "3m downhill (10°) walkway followed by specific uphill and downhill elements with opposite inclination angles of 10°." Kinematic and kinetic gait parameters were measured via a motion capturing system and a force plate which is integrated in the uphill walkway element. Each subject has to repeatedly walk down the ramp until 8 trials with contacting the force plate with the prosthetic side and 8 trials with contacting the force plate with the sound side were measured. In the same way the non-amputee control group performed 16 measurements (8 per side). The last step before the uphill walkway is called preparing cycle (=PC) and the step on the force plate is called changing cycle (=CC).

Meridium vs. current ESR

feet vs. Non-Amputee

control group

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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 Eco nomics
Category		Outcor	Outcomes			Results for MPF, ESR and NA-Group		Sig.*	
Uneven Ground, Obstacle Course		Walking	Walking speed [m/s]			MPF: 1.00 ESR: 1.03 NA-Group ±0.04) ±0.03 ±0.05 : 1.19	0	
		Stance phase duration during force plate contact [% gait cycle]			MPF: 61.8 ±1.4 0 ESR: 61.0 ±1.2 NA-Group: 61.4 ±0.03				
	Ankle d	orsiflexion a	ngle [max.	CC °]	Prostheti MPF: 16.4 ESR: 6.9 -	c side: ↓±2.9 ±0.7	++		
					Sound sid MPF: 18.4 ESR: 16.7 NA-Group	le: ⊧ ±5.2 ±2.0 : 15.6 ±2.3	0		
	Knee fle	exion angle [stance CC	°]	Prostheti MPF: 9.8 ESR: 11.5	c side: ±6.1 ±6.6			
						Sound sid MPF: 22.7 ESR: 20.7 NA-Group	Je: ′ ±1.6 ±4.9 : 21.3 ±4.2	0	

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results of a biomechanical comparison of two prosthetic foot concepts

Category	Outcomes	Results for MPF, ESR and NA-Group	Sig.*	
	Hip extension angle [max. CC °]	Prosthetic side: MPF: 17.4 ±3.1 ESR: 10.5 ± 3.4	++	
		Sound side: MPF: 11.3 ±5.3 ESR: 9.3 ±3.6 NA-Group: 10.9 ±3.4	0	
	Vertical ground reaction force 1 st peak [% body weight]	Prosthetic side: MPF: 102 ±10 ESR: 106 ±18	0	
		Sound side: MPF: 128 ±5 ESR: 127 ±12 NA-Group: 124± 10	0	
	Anterior-posterior ground reaction force (min) [% body weight]	Prosthetic side: MPF: 13 ±6 ESR: 16 ±9	0	
		Sound side: MPF: 19 ±3 ESR: 21 ±3 NA-Group: 18± 4	0	
	Anterior-posterior ground reaction force (max) [% body weight]	Prosthetic side: MPF: 9 ±4 ESR: 14 ±4	0	
		Sound side: MPF: 18 ±6 ESR: 17 ±3 NA-Group: 22± 4	0	
	Ankle dorsiflexion moment (max) [Nm/kg]	Prosthetic side: MPF: 1.49 ±0.13 ESR: 1.36 ±0.10	0	
		Sound side: MPF: 1.56 ±0.31 ESR: 1.46 ±0.08 NA-Group: 1.39± 0.09	0	
	Knee flexion moment (max) [Nm/kg]	Sound side: MPF: 0.51 ±0.28 ESR: 0.67 ±0.42 NA-Group: 0.52± 0.19	0	
	Knee extension moment (max) [Nm/kg]	Prosthetic side: MPF: 0.42 ±0.12 ESR: 0.71 ±0.13		
		Sound side: MPF: 0.46 ±0.12 ESR: 0.38 ±0.08 NA-Group: 0.36± 0.07	0	

Category	Outcomes	Results for MPF, ESR and NA-Group	Sig.*
	Knee adduction moment (1 st peak)	Prosthetic side:	0
	[Nm/kg]	MPF: 0.28 ±0.19	
	-	ESR: 0.29 ±0.19	
		Sound side:	++ (MPF and ESR
		MPF: 0.59 ±0.14	compared to NA-
		ESR: 0.59 ±0.18	group)
		NA-Group: 0.43±	
		0.10	

* no difference (0), positive trend (+), negative trend (-), significant (++/--), not applicable (n.a.) CC=changing cycle; PC=preparing cycle

Author's Conclusion "The results of the present study show that the MPF can facilitate partly normalized walking biomechanics in TT amputees on terrain with changing inclination conditions compared to regular ESR feet. The real-time adaptable ankle joint motion of the MPF seems to be the crucial functionality for a more natural motion pattern and a reduction in sagittal knee joint loading on the prosthetic side. However, the typical increase in knee loading in the medial compartment of the sound side of TT amputees does not appear to be affected by the MPF." (Schmalz, 2019)

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