
Reference

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Differences in Gait Patterns of Unilateral Transtibial Amputees With Two Types of Energy Storing Prosthetic Feet

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Products

1C30 Trias vs. 1C60 Triton

Major Findings

With 1C30 Trias compared to 1C60 Triton:

→ **more normal gait characteristics with 1C60 Triton than 1C30 Trias:**

- closer to typical human gait stance-swing ratio with 1C60 Triton (61.8% stance) than with 1C30 Trias (64.3% stance)
- closer to normal ankle dorsiflexion through mid-stance with 1C60 Triton ($15.28^\circ \pm 3.23^\circ$) than with 1C30 Trias ($19.46^\circ \pm 3.58^\circ$)

→ **symmetric gait with both 1C30 Trias and 1C60 Triton**

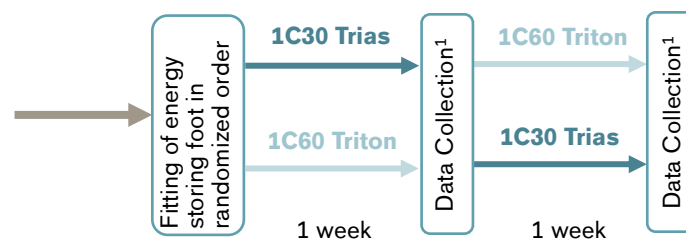
- no significant differences either between the prosthetic foot models or between limbs when comparing cadence, step width, and step length
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Population

Subjects:	10 participants (all male)
Amputation level:	unilateral transtibial
Previous prosthetic foot:	prosthetic foot without energy storing
Mean age:	63.80 ± 2.49 years
Mean time since amputation:	36.57 ± 9.71 months
MFCL:	K3 (n=6), K2 (n=4)

Study Design

Interventional, randomized crossover design:



¹ Participants walked along a 10-meter walkway (self-selected pace) with 3 embedded force plates while gait analysis was performed

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 IC30 Trias compared to IC60 Triton	Sig. ^{a,b}
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Level Walking	Spatiotemporal Parameters	Side to side comparison:	
		- Slight cadence asymmetry with 1C30 Trias	
		Comparison between prosthetics:	
		- Closer to normal ratio of stance and swing phase with 1C60 Triton than with 1C30 Trias	

	IC30 Trias		IC60 Triton		
	Intact	Prosthetic	Intact	Prosthetic	
Cadence [steps/min]	105.9 ± 9.2 *	103.9 ± 9.6 *	105.8 ± 8.6	104.9 ± 8.8	--
Speed [cm/s]	110.23 ± 13.30	111.11 ± 13.13	113.52 ± 15.68	113.56 ± 13.47	0
Step width [cm]	16.0 ± 3.1	16.0 ± 3.1	15.8 ± 3.1	15.8 ± 3.1	0
Step length [cm]	62.2 ± 9.3	65.9 ± 9.4	65.5 ± 11.9	67.3 ± 7.2	0
Stance [% circle]	64.0 ± 5.0	64.3 ± 3.2 *	62.4 ± 6.3	61.8 ± 2.9 *	--
Swing [% circle]	35.9 ± 5.0	35.7 ± 3.3 *	37.5 ± 6.3	38.2 ± 2.7 *	++

Kinematic parameters	Side to side comparison:	
	- Ankle plantarflexion angle at the end of stance and ankle supination at the onset of the pre-swing was generally decreased in the prosthetic side	
	Comparison between prosthetics:	
	- Ankle dorsiflexion angle through midstance was far closer to normal with 1C60 Triton than 1C30 Trias	
	- 1C30 Trias showed a dorsiflexion angle that exceeded normal range	

	IC30 Trias		IC60 Triton		
	Intact	Prosthetic	Intact	Prosthetic	
Ankle plantarflexion angle at initial contact [°]	-4.93 ± 4.54	-5.83 ± 5.28	-5.08 ± 2.54	-5.89 ± 3.45	0
Ankle dorsiflexion angle through midstance [°]	17.12 ± 3.81	19.46 ± 3.58 *	14.98 ± 4.15	15.28 ± 3.23 *	--
Ankle plantarflexion angle at end of stance [°]	-12.41 ± 5.52 *	0.40 ± 5.97 *	-13.13 ± 6.24 *	0.61 ± 5.84 *	++
Ankle pronation angle during early midstance [°]	2.02 ± 1.30	2.30 ± 1.57	2.09 ± 1.18	2.17 ± 1.32	0
Ankle supination at onset of preswing [°]	-2.94 ± 1.92 *	-0.91 ± 0.83 *	-3.63 ± 2.78 *	-0.77 ± 1.03 *	--
Hip extension angle at terminal stance [°]	-7.81 ± 8.13	-6.99 ± 8.37	-6.56 ± 8.00	-6.40 ± 8.90	0

Category	Outcomes	Results for IC30 Trias compared to IC60 Triton				Sig. ^{a,b}
	Hip flexion angle at mid swing [°]	34.85 ± 4.98	35.67 ± 4.95	33.98 ± 4.76	35.61 ± 6.38	0
	Knee flexion angle at terminal stance [°]	3.06 ± 4.75	2.97 ± 4.01	4.29 ± 4.45	3.17 ± 3.52	0
	Knee flexion angle at mid swing [°]	62.72 ± 2.67	59.62 ± 5.05	61.62 ± 5.96	61.31 ± 5.02	0
Kinetics	No sig. difference neither between sides nor prosthetics					
		IC30 Trias		IC60 Triton		
		Intact	Prosthetic	Intact	Prosthetic	
	Ankle plantarflexion moment at end of stance (Nm/kg) ^b	1.63 ± 0.64	1.04 ± 0.54	1.76 ± 0.51	1.11 ± 0.24	0

^a No difference (0), positive trend (+), negative trend (-), significant (++/--), not applicable (n.a.). Significance set at $p < 0.05$; trends set at $0.1 > p > 0.05$.

^b $n = 5$ due to technical issues.

* Marks pairs with significant differences.

Author's Conclusion

"Energy storing feet implement symmetric gait in unilateral transtibial amputees who are functionally independent in daily living. The 1C60 Triton showed a gait pattern closer to normal than the 1C30 Trias in the aspect of stance-swing ratio and ankle dorsiflexion angle. The more complex shape might mean higher initial costs as well as higher maintenance costs. Based on the increased understanding of each prosthetic, it is necessary to prescribe a proper prosthetic considering individual characteristics such as functional level, living environment, and socio-economic status." (Yang et al., 2018)

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