Reference

Johansson JL, Sherrill DM, Riley PO, Bonato P, Herr H.

The Media Laboratory, Massachusetts Institute of Technology, MA, USA.

A clinical comparison of variable-damping and mechanically passive prosthetic knee devices

American Journal of Physical Medicine & Rehabilitation 2005; 84(8):563–575.

Products

C-Leg vs Rheo Knee vs NMPK

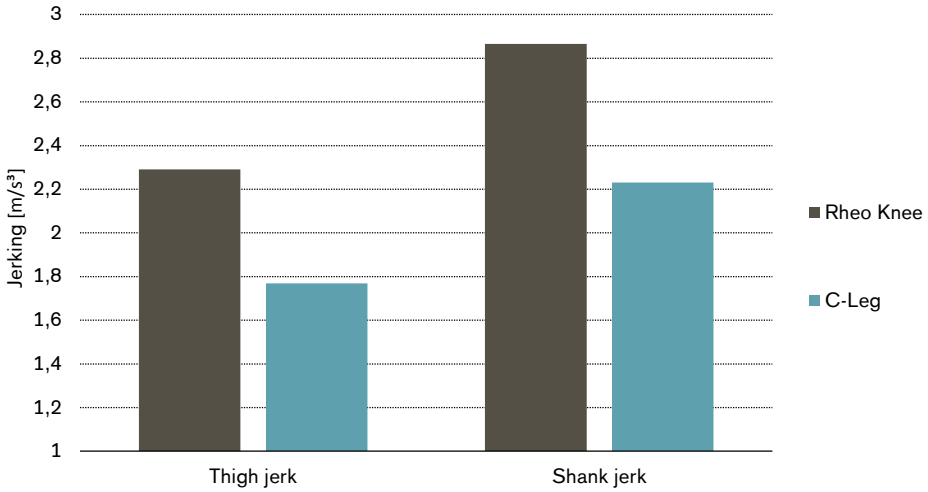
Major Findings

With C-Leg compared to Rheo Knee:

→ **Smoother transition from swing to stance phase**
Thigh jerk decreased by 23%
Shank jerk decreased by 22%
→ **Slightly flexed knee posture (2.7°) in the terminal swing phase results in decreased heel compression by 29% in early stance phase**

Caution: It is scientifically validated, that prosthetic alignment has a significant influence on the metabolic energy consumption – more than the prosthetic component itself. The study design doesn`t disclose the alignment of the test prosthesis. Some biomechanical results let assume that the alignment between prostheses differed. Therefore the validity of the findings is questionable.

Improved smoothness of gait in terminal swing phase with C-Leg



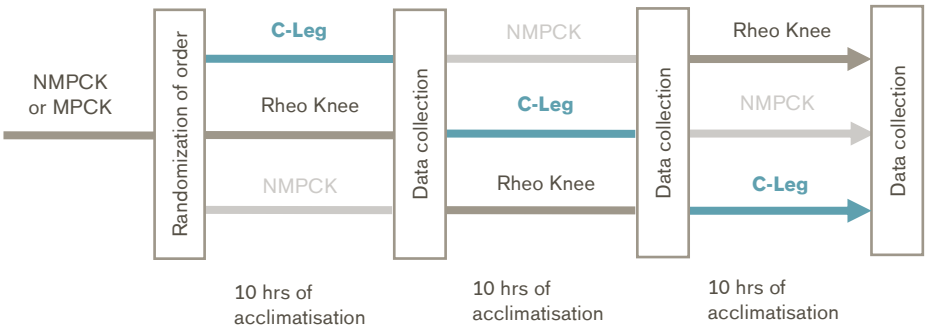
Acceleration signals were measured to calculate jerk, which was used to determine gait smoothness.

Population

Subjects:	8 unilateral, transfemoral amputees
Previous prosthesis:	different NMPCKs and MPCKs
Amputation causes:	37.5% trauma, 25% infection, 25% cancer, 12.5% congenital
Mean age:	44 yrs (range from 29–54 yrs)
Mean time since amputation:	not reported
MFCL:	K3–K4

Study Design

Interventional, double crossover design:



Results

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 C-Leg compared to Rheo Knee	Sig.*
Level Walking	Motion analysis	**Step time on the affected side decreased by 5.7%.**	++
		No difference in step length, single and double support time on the affected and unaffected side.	0
		Increased peak hip extension torque on the affected side in terminal swing phase.	– –
		Peak knee angle on the affected side in terminal swing phase was 3.5° higher.	++
		Decreased peak knee angular velocity on the affected side at toe-off.	++
		Decreased peak knee flexion torque on the affected side in mid-to-terminal stance phase.	++
		Increased peak knee flexion torque on the affected side in terminal swing phase.	– –
		Increased peak ankle dorsiflexion angle on the affected side in mid-to-terminal stance phase.	– –
		Decreased peak ankle plantar flexion angle on the affected side in early stance phase.	++
		Increased peak ankle plantar flexion torque on the affected side at 30% of gait cycle.	– –
		Foot compression on the affected side	++

Category	Outcomes	Results for C-Leg compared to Rheo Knee	Sig.*
		decreased by 29% in early stance phase.	
	EMG data	**Level of muscular activity increased for gluteus medius on the affected side.**	**– –**
	Jerking	Thigh jerk tends to be decreased by 23% in terminal swing phase. Shank jerk tends to be decreased by 22% in terminal swing phase. Thigh jerk tends to be increased by 6% at toe-off. Shank jerk tends to be increased by 11% at toe-off.	+ + – –
Metabolic energy consumption	Oxygen uptake	Oxygen consumption tends to be increased.	–

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

Author's Conclusion

"The results of this study indicate that variable-damping knee prostheses have significantly advantages over mechanically passive designs for unilateral transfemoral amputees walking at self-selected speeds. For the investigated variable-damping devices, the Rheo and C-Leg knee prostheses, we observe biomechanical advantages over the mechanically passive Mauch. These advantages include an enhanced smoothness of gait, a decrease in hip work, a lower peak hip flexion moment at terminal stance, and a reduction in peak hip power generation at toe-off. The study results further suggest that the magnetorheological-based Rheo may have advantages over the hydraulic-based C-Leg- When using the Rheo, metabolic rate decreases by 5% compared with the Mauch and by 3% compared with the C-Leg. In distinction, when using the C-Leg, metabolic rate decreases by 2% compared with the Mauch but the difference is not statistically significant. We consider these differences to be clinically relevant and anticipate a significant impact of such differences on mobility. It is our hope that this work will lead to further studies linking prosthetic design to clinical outcomes, resulting in an even wider range of locomotory performance advantages for contemporary prostheses." (Johansson et al. 2005)