

C-Leg in limited community ambulators

Ramps

Major Findings

With C-Leg compared to NMPKs:

→ **Improved walking velocity during ramp ambulation**

Walking velocity increased by 28% during ramp ascent

Walking velocity increased by 36% during ramp descent

→ **Improved ramp descent mobility**

Hill assessment index score improved from 5.4 to 7.5 (39% increase)

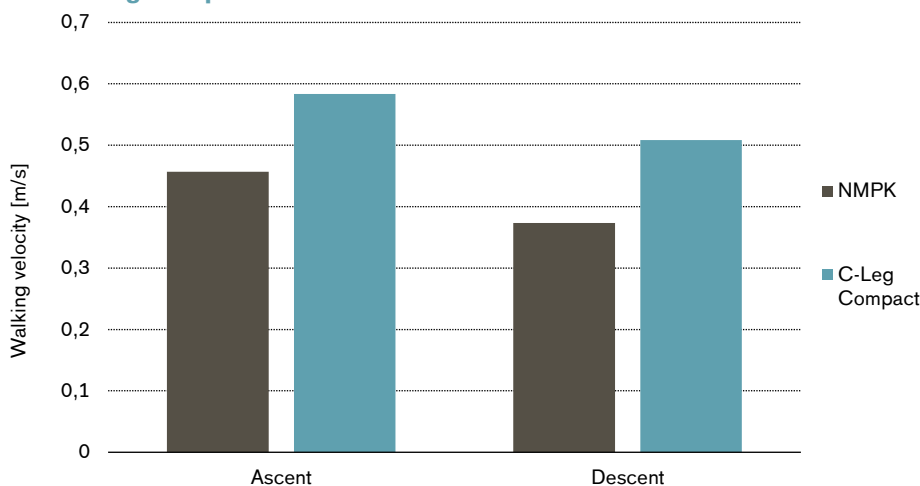
→ **Improved walking quality during descent of ramps**

→ **More symmetrical gait pattern during ramp ambulation**

Duration of single limb support phase on prosthetic side increased by 17% during ascent and descent

→ **Reduced anterior tilt of pelvis during stance phase**

Increased walking velocity during ramp ascent and descent with C-Leg Compact



Each participant ascended and descended a 6.1 m ramp (12° slope) at their self-selected speed using their customary walking aid (Burnfield et al. 2012)

Clinical Relevance

Similar to stairs, ramps and hills need to be navigated by amputees to be able to ambulate in the community and participate in daily life. Biomechanical assessment was conducted to determine joint angles and moments. The goal of prosthetic fitting is to try to allow for a natural gait pattern, which includes symmetrical gait characteristics and a loading distributed between the two limbs as even as possible. The ramp mobility is assessed by evaluating the walking speed as well as the dependence on hand rail and the chosen pattern by the Hill Assessment Index (HAI).

Summary

The Hill assessment index (HAI) score for hill descent improved in K2 subjects from 5.4 to 7.5 points with C-Leg compared to NMPKs, where 5 points stand for 'step a little past with assistive device use' and 8 points stand for 'step-to-step pattern without assistive device use' (Hafner et al. 2009).

Additionally to the HAI, time required to descent a hill was investigated. Walking velocity increased with C-Leg Compact by 28% for ramp ascent and by 36% for ramp descent compared to NMPKs, both due to increased stride length and cadence. Furthermore, the duration of single limb support on the prosthetic side increased both during ramp ascent and descent and therefore with C-Leg Compact a more symmetrical gait pattern is achieved compared to NMPKs (Burnfield et al. 2012, Kannenberg et al. 2014).

The anterior tilt of the pelvis was reduced in K2 subjects with C-Leg Compact compared to NMPKs as measured by increased hip and thigh extension on the sound side during single limb support phase during ramp ascent and descent (Burnfield et al. 2012).

References of summarized studies

Burnfield, J. M., Eberly, V. J., Gronely, J. K., Perry, J., Yule, W. J., & Mulroy, S. J. (2012). Impact of stance phase microprocessor-controlled knee prosthesis on ramp negotiation and community walking function in K2 level transfemoral amputees. *Prosthetics and Orthotics International*, 36(1), 95–104. doi:10.1177/0309364611431611

Hafner, B. J., & Smith, D. G. (2009). Differences in function and safety between Medicare Functional Classification Level-2 and -3 transfemoral amputees and influence of prosthetic knee joint control. *The Journal of Rehabilitation Research and Development*, 46(3), 417–433.

Kannenberg, Andreas; Zacharias, Britta; Pröbsting, Eva (2014): Benefits of microprocessor-controlled prosthetic knees to limited community ambulators: Systematic review. In: *Journal of Rehabilitation Research & Development* 51 (10), S. 1469–1496. DOI: 10.1682/JRRD.2014.05.0118.

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