

Genium vs C-Leg

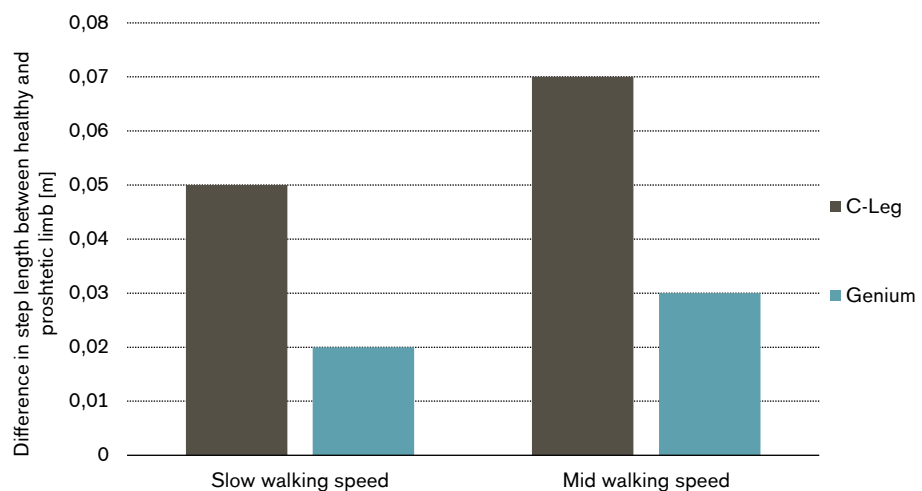
Level Walking

Major Findings

With Genium compared to C-Leg:

- **Increased toe clearance with more consistent maximum knee angle at 64° across different walking velocities**
- **Step length symmetry is improved by up to 60%**
- **Reduced impact forces through 4° “Preflex” at initial heel contact**
- **Increased toe clearance when walking with small steps**
Maximum knee flexion angle in swing phase is increased by 11%
- **Reliable swing phase release even when walking with small steps**
Swing phase is reliably released in 95% of all small steps
- **Difficulty of walking backwards is improved by 26%**
Safe loading when stepping backwards was in all tests possible

Reduced asymmetry of step length with Genium compared to C-Leg



Bellmann et al. (2012)

Clinical Relevance

The main aim of a prosthesis is the restoration of function. For lower extremities the most important function is ambulation. It has influence on the mobility grade of the subject, the participation of life and, therefore, general quality of life. Furthermore, a natural gait pattern is pursued, since it prevents the sound side from higher or inappropriate loads due to compensatory movements. Gait asymmetries can contribute to secondary diseases such as osteopenia or arthritis.

Summary

Walking velocities were investigated by Bellmann et al. (2012) as well as by Highsmith et al. (2014) at varying speeds and varying distances. No differences between Genium and C-Leg could be observed. However, subjects had the tendency to rate the perceived exertion lower with Genium compared to C-Leg (Highsmith et al. 2014).

Regarding biomechanical gait analysis, several improvements with Genium were documented. The maximum knee angle in swing phase is not influenced by gait speed and stays constant at 64° (Bellmann et al. 2012 & Blumentritt et al. 2012).

Therefore, adequate toe clearance is ensured even when walking slowly. Over the range from very slow to normal walking velocities, peak knee flexion angle in swing phase is increased by up to 7° with Genium compared to C-Leg. In stance phase, peak knee flexion angle is increased by 2° during slow and normal speed with Genium compared to C-Leg. Knee angles are due to accommodation, training and use of Genium closer to the intact limb and therefore a more physiological gait pattern is achieved (Lura et al. 2015). Furthermore, it was observed that, with Genium, the prosthetic knee is in a pre-flexed position of 4° at heel strike. The pre-flex leads to reduced braking forces which was proved by a decreased ground reaction force on the prosthetic side (Bellmann et al. 2012 & Blumentritt et al. 2012). In conclusion the improved gait characteristics of Genium resulted in a more normalized, anatomical movement pattern.

Walking with small steps is improved with Genium; not only is the maximum knee angle in swing phase increased compared to C-Leg, but also the swing phase is reliably released with Genium in 95% of all steps. With C-Leg, swing phase is released in 75% of all the steps (Bellmann et al. 2012 and Blumentritt et al. 2012).

When walking backwards, safe loading of the prosthesis is possible with Genium (Blumentritt et al. 2012). Moreover, subjects rated walking backwards as less difficult to perform with Genium than with C-Leg (Kannenberg et al. 2013).

In a retrospective, cross-sectional cohort analysis from Hahn et al. 2016, clinically important factors on performance using Genium were analysed based on 899 trial fittings. Variation of gait speed exhibit the highest number of sensitive confounders in the functional benefits category. However, the investigated variables failed to exhibit classifying power (e.g. variation of gait speed impacted by mobility grade presented a high significance ($p < 3 \times 10^{-26}$) but a very low r^2 (0.13)).

References of summarized studies

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* Systematic Reviews

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