

# Genium vs C-Leg

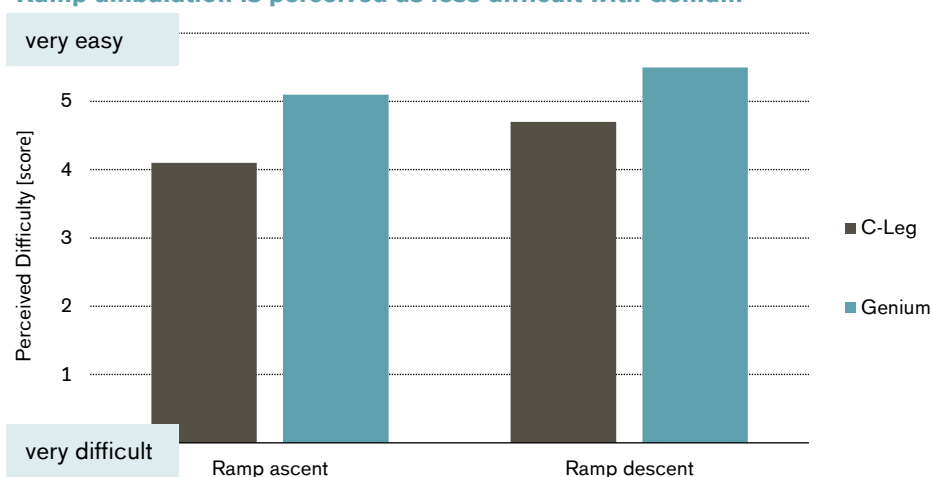
## Ramps / Hills

### Major Findings

#### **With Genium compared to C-Leg:**

- **Ease of ascending and descending ramps is improved by 24% and 17%**
- **Improved toe clearance during ramp ascent and descent**
  - Knee angle in swing phase increased by 14° during ramp ascent
  - Knee angle in swing phase increased by 13° during ramp descent
- **Improved symmetry of knee moment while ascending and descending ramps**
  - Ascent: significantly lower at slow and fast walking speed
  - Descent: significantly lower at slow and self-selected walking speed
- **More balanced and safer stance on ramps**

#### **Ramp ambulation is perceived as less difficult with Genium**



Kannenberg et al. (2013)

### Clinical Relevance

Similar to stairs, ramps and hills need to be navigated by amputees with a wide range of activity levels to be able to participate in daily life. Biomechanical assessment is conducted to determine joint angles. The maximum knee flexion angle in swing phase was of special interest. To minimize the risk of stumbling, it is required to have an increased maximum flexion angle relative to level walking to ensure an adequate foot clearance.

### Summary

Maximum knee angle was increased by 7° when ascending and by 8° when descending a ramp with Genium compared to C-Leg (Bellmann et al. 2012 and Blumentritt et al. 2012). Increased maximum knee angle in swing phase leads to an increased foot clearance which further decreases the risk of stumbling.

Besides increased safety, patients reported that ascending and descending ramps is less difficult to perform with Genium than with C-Leg (Kannenberg et al. 2013) and also that it's more comfortable. When ascending ramps, less focal pressure near the anterior aspect of the hip was experienced (Highsmith et al. 2014).

Highsmith et al. (2014) observed that when subjects with Genium descended a ramp with only a slight decline such as 5°, a walking pattern similar to level walking characterized by two knee flexion peaks was facilitated. This feature of Genium is enabled through an adapted resistance in stance phase; it allows for a flexion angle

which is higher than the maximum knee angle when level walking (17°). In comparison to C-Leg, peak knee flexion angle during descending a slope of 5° was with Genium in swing phase increased by up to 8° and during stance phase increased by up to 4° over a variety of gait velocities from slow to fast. Peak knee flexion angles of the prosthetic side are therefore closer to peak knee flexion angles of the intact leg and therefore a more normalized, anatomic movement pattern is achieved with Genium (Lura et al. 2015). Similar results were reported by Bell et al. (2016) where additionally more knee flexion at initial heel strike and swing phase were observed as well as faster walking speed by 0.1 m/s compared to other MPKs. Also the knee moment while ascending and descending ramps was more symmetrically with Genium (Highsmith et al. 2016). The values were significant at slow and fast walking speed when ascending a ramp and at slow and self-selected walking speed when descending.

Furthermore, when walking on ramps swing phase release occurs even when the prosthesis is in a flexed and loaded position (Kampas et al. 2011). Overall, a more natural gait pattern on ramps is achieved with Genium.

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. Descent from ramps presented a very clear responsiveness in 59 % of subject's perception. Ascent (57.4%) and standing on ramps (76.4 %) presented also a very clear responsiveness as performance indicators. However, none of the factors qualified as predictor for performance.

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## References of summarized studies

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\* Systematic Reviews

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