C-Leg vs MPKs

Ramps, Hills

Major Findings

With C-Leg **compared to Rheo Knee**:

→ 56% of subjects are less dependent on handrails during ramp descent (22 vs 78%)
→ Subjects trust to load the prosthesis to a higher extend
Knee flexion moments increased by 28%
→ Trend towards reduced loading on the contralateral side
Vertical ground reaction force on contralateral side decreased by 3%

With C-Leg **compared to Adaptive2**:

→ 78% of subjects are less dependent on handrails during ramp descent (22 vs 100%)
→ Subjects trust to load the prosthesis to a higher extend
Knee flexion moments increased by 74%
→ Trend towards reduced loading on the contralateral side
Vertical ground reaction force on contralateral side decreased by 9.7%

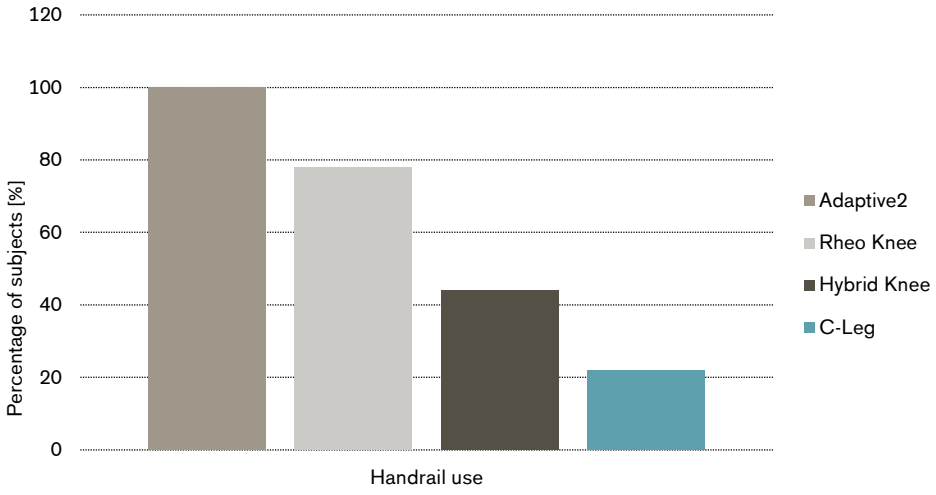
With C-Leg **compared to Hybrid Knee**:

→ 22% of subjects are less dependent on handrails during ramp descent (22 vs 44%)
→ Trend towards reduced loading on the contralateral side
Vertical ground reaction force on contralateral side decreased by 7.1%

With C-Leg **compared to Power Knee**:

→ Improved symmetry of gait pattern during ramp descent
Sound side stance phase is 6.7% shorter
Prosthetic side stance phase is 3.6% longer

Less use of handrail when descending ramps with C-Leg



Bellmann et al. (2010)

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 and moments. With the prosthesis fitting it is aimed 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 perceived safety, when descending ramps, is assessed by evaluating the use of handrail.

Summary

When descending a ramp, the sound side stance phase is 6.7% shorter and the prosthetic side stance phase is 3.6% longer with C-Leg compared to Power Knee. This results in improved gait symmetry with C-Leg. Furthermore, with C-Leg, the prosthetic side step length is increased and the sound side step length tends to be increased for ramp ascent and descent compared to Power Knee. The described improvements are achieved due to increased perceived safety of the subjects when using C-Leg compared to Power Knee (Wolf et al 2012).

Bellmann et al (2010) confirmed improvements in confidence with a decreased use of handrail with C-Leg compared to other MPCKs when descending ramps. Only 22% of subjects used a handrail with C-Leg, 44% with Hybrid Knee, 78% with Rheo Knee, and 100% with Adaptive2.

The increase in maximum knee flexion moments on the prosthetic side when descending ramps with C-Leg compared to Rheo Knee (28% higher with C-Leg) and Adaptive2 (74% higher with C-Leg) occurs since subjects trust to load the prosthesis to a higher extend. Thereby the load on the sound side tends to be reduced with C-Leg (Bellmann et al 2010).

References of summarized studies

Bellmann, M., Schmalz, T., & Blumentritt, S. (2010). Comparative biomechanical analysis of current microprocessor-controlled prosthetic knee joints. Archives of physical medicine and rehabilitation, 91(4), 644–652. doi:10.1016/j.apmr.2009.12.014

Wolf, E. J., Everding, V. Q., Linberg, A. L., Schnall, B. L., Czerniecki, J. M., & Gambel, J. M. (2012). Assessment of transfemoral amputees using C-Leg and Power Knee for ascending and descending inclines and steps. The Journal of Rehabilitation Research and Development, 49(6), 831. doi:10.1682/JRRD.2010.12.0234