C-Leg vs NMPKs

Level Walking

Major Findings

With C-Leg compared to NMPKs:

→ **Improved walking velocity**
Self-selected walking speed by up to 15%
Fastest possible walking speed by up to 17%

→ **Improved gait symmetry**
More symmetrical step length
More symmetrical hip, knee and ankle kinetics
Relief of the sound leg

→ **More natural gait pattern**
Knee flexion at initial stance phase
Maximum knee flexion angle in swing phase closer to the intact limb
Gait pattern harmonization (in 88-95% of subjects)

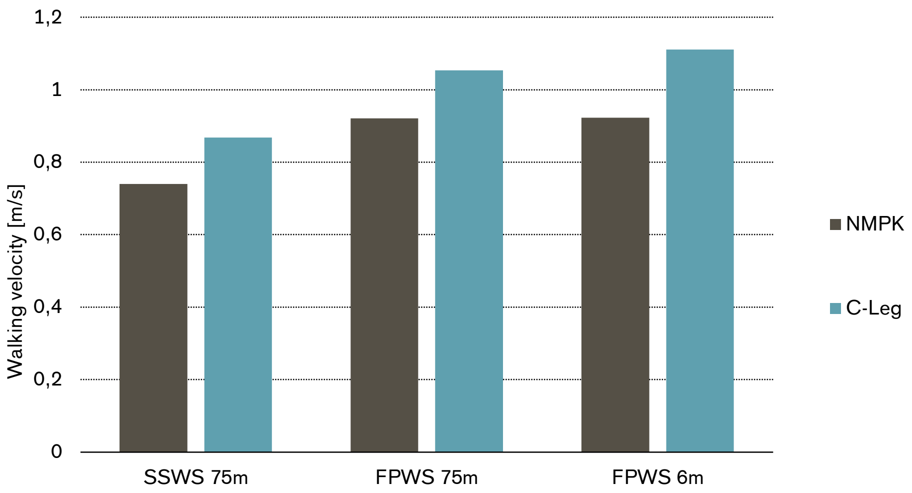
→ **Walking with variable gait speed**
71-93% of subjects
Improvement independent from age, mobility grade and etiology

→ **Reduction of walking aid use**
23-29% of subjects
Improvement independent from age, mobility grade and etiology

→ **Subjects trust to load prostheses to a higher extend**

→ **Decreased risk of falling in K2 subjects**
Time required to complete timed up and go (TUG) decreased by 38%

Improved walking velocity with C-Leg



Self-selected walking speed (SSWS) and fastest possible walking speed (FPWS) were measured over 75 meters and 6 meters (Kahle et al. 2008).

Clinical Relevance

The main aim of a prosthesis is the restoration of function. For lower extremities the most important function is ambulation. It influences the mobility grade of the subject, his/her participation and thus his/her quality of life. Furthermore, a natural gait pattern is to be pursued: the more physiological-like gait achieved with the prosthesis, the less compensatory movements needed and thus lower/less inappropriate loads on the sound side.

Summary

Reported improvements on self-selected walking speed range from 7.3% up to 18% (Orendurff et al. 2006, Segal et al. 2006, Kahle et al. 2008, Maaref et al. 2010); fastest possible walking speed improved by up to 17% (Kahle et al. 2008), with C-Leg compared to NMPKs. Maaref et al. (2010) reported improved walking velocity by up to 13% as a result of improved cadence, on both the prosthetic and the healthy limb. An increase in both self-selected and fast walking speed by 20% was found with C-Leg Compact compared to NMPKs (Eberly et al. 2014). Two case reports investigating walking speed both reported an increase in walking velocity with C-Leg compared to a NMPK as well (Barr et al. 2012, Tofts & Hamblin 2014). Hahn et al. (2015) reported an improvement in up to 93% subjects ability to walk with varying gait speeds, when fitted with C-Leg.

Step length symmetry was shown to be increased when using C-Leg compared to NMPKs (Petersen et al. 2010, Schaarschmidt et al.2012, Segal et al. 2006,). Increased symmetry with C-Leg compared to NMPKs was also reported regarding hip, knee, and ankle kinetics (Kaufman et al. 2012). An overall relief of the sound leg was observed in 95% of the subjects participating in an evaluation of 1200 C-Leg trial fittings in Germany (Hahn et al. 2015).

A more natural gait pattern, resulting from a peak knee flexion angle in swing phase closer to the intact limb compared to NMPKs, can be achieved with C-Leg (Johansson et al. 2005, Segal et al. 2006, Wetz et al. 2005). At the early stance phase, the knee flexion was measured when fitted with C-Leg, in comparison to the extended position in NMPKs (Kaufman et al. 2007). A decreased ground reaction force at early stance phase was also observed (Segal et al. 2006), leading to a more dampened heel contact. Furthermore, up to 95% of the patients reported an improved gait pattern harmonization when fitted with C-Leg (Hahn et al. 2015).

Hahn et al. (2015) also reported a reduction of walking aids used by the amputees fitted with C-Leg. Subjects trust to load C-Leg to a higher extant than NMPKs, as shown by increased knee flexion moments in early stance phase, which were closer to the moments measured in the intact limb (Segal et al. 2006). Another study reported increased knee flexion moments and increased peak power generation at the ankle in terminal stance phase with C-Leg Compact compared to NMPKs (Eberly et al. 2014) resulting in subjects trusting themselves to load their prosthesis to a higher extend in swing phase release.

The latency period, defined as the interval between the end of knee extension and initial ground contact of the heel, was shown to be decreased by 34% with C-Leg compared to NMPKs. Furthermore, it was shown that the longer the residual limb, the shorter the latency period (Maaref et al. 2010).

Perry et al. (2004) assessed the gait of a bilateral knee disarticulated amputee. Walking velocity was improved with C-Leg compared to NMPKs by 73% due to an increased stride length. Joint moments measured for hip, knee and ankle were lower compared to healthy subjects. Furthermore, range of motion in the ankle and knee of the bilateral amputee were lower compared to healthy subjects. An increase in step length on the prosthetic side when using C-Leg was also reported by Hafner et al. (2007).

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