C-Leg vs MPKs

Safety

Major Findings

With C-Leg compared to MPCKs:

→ **Loading at abrupt stop is possible at any time without compensatory movements based on high flexion resistance before ground contact**

Rheo Knee: Switches to high flexion resistance at ground contact and resistance depends on the extend of load (i.e. cautiously loading leads to low resistance).
Compensatory movements are required.

Adaptive2: Might collapse and therefore risk of falling.

→ **Increased safety potential when stepping on an obstacle based on high flexion resistance before initial ground contact**

Rheo Knee: Switches to high stance phase flexion resistance at initial ground contact.

Adaptive2: Risk of falling when stepping with the heel first.

Hybrid Knee: Switches to high flexion resistance at ground contact.

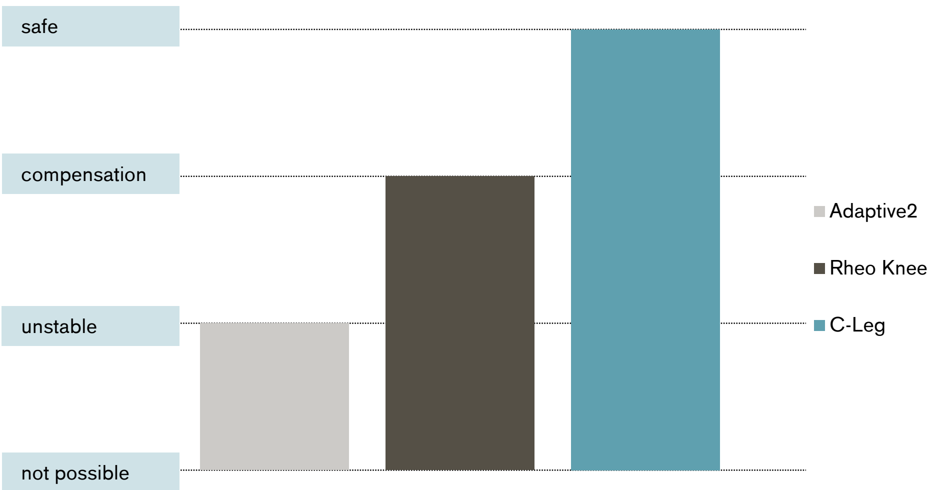
→ **Increased safety when stumbling since loading of the prosthesis is even possible in a flexed knee position**

Rheo Knee: High flexion resistance depends on reliability of stumble detection. Resistance might be too low to provide loading capacity. Increased risk of slipping when subjects continue to walking after stumbling.

Adaptive2: Collapses when stumbling occurs even in early swing phase.

Hybrid Knee (Synergy): Knee joint collapses when contacting ground with forefoot. Compensatory movements are required.

Highest safety potential with C-Leg when stopping



Blumentritt et al. (2011)

Clinical Relevance

Safety aspects of the prosthesis are highly relevant for the patients. Since the fear of falling can have a negative impact on activities of daily living as well as on participation, perceived safety is regarded as an important factor for quality of life of an amputee. Information about safety is gathered through observing subjects when they perform selected tasks and to assess how the prosthesis reacts.

Summary

The studies discussing safety of C-Leg compared to other MPKs assessed how safe the prostheses are when performing following activities: abrupt stopping, stepping on an object and stumbling.

When performing an abrupt stop, with C-Leg high resistance is already activated prior to ground contact. In comparison, Rheo Knee switches to low resistance when loading cautiously and Adaptive2 may not switch at all to high resistance (Bellmann et al 2009). These results were confirmed in a later study: stopping with C-Leg was not a problem at any time and therefore C-Leg presents the highest safety potential of the assessed MPKs. With Rheo Knee compensatory movements were necessary and Adaptive2 collapsed incidentally and therefore subjects were at risk of falling (Bellmann et al. 2010).

When stepping on an obstacle, high stance phase flexion resistance is already activated with C-Leg. With Hybrid Knee and Rheo Knee the system is switching to high stance phase flexion resistance at initial ground contact. Furthermore, when using Adaptive2, the prosthesis might collapse since it does not switch immediately to high flexion resistance. Subjects were able to step on an obstacle with C-Leg and Rheo Knee without problems in comparison to Adaptive2, where subjects are at risk of falling when stepping with the heel first (Bellmann et al. 2010).

Stumbling is imitated by disturbing the movement of the prosthesis in swing phase. C-Leg was tested to be the safest prosthesis since even in a flexed position it can be loaded at any time. In comparison, with Rheo Knee, Hybrid Knee and Adaptive2, the system first needs to be switched to stance phase settings. With Rheo Knee and Hybrid Knee this leads to a problem when the subject continues with the routine pattern; it results in a risk of slipping for Rheo Knee and in a risk of prosthesis collapse for Hybrid Knee. Adaptive2 collapses when the disruption occurs at an early stage of swing phase (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

Bellmann, M., Schmalz, T., & Blumentritt, S. (2009). Functional Principles of Current Microprocessor-Controlled Prosthetic Knee Joints. Orthopädie-Technik, 05, 1–6.

Blumentritt, S., & Bellmann, M. (2010). Potenzielle Sicherheit von aktuellen nicht-mikroprozessorund mikroprozessorgesteuerten Prothesenkniegelenken. Orthopädie-Technik, 11(10), 788–799.