Helix^{3D} Hip Joint System vs other prosthetic hip joints

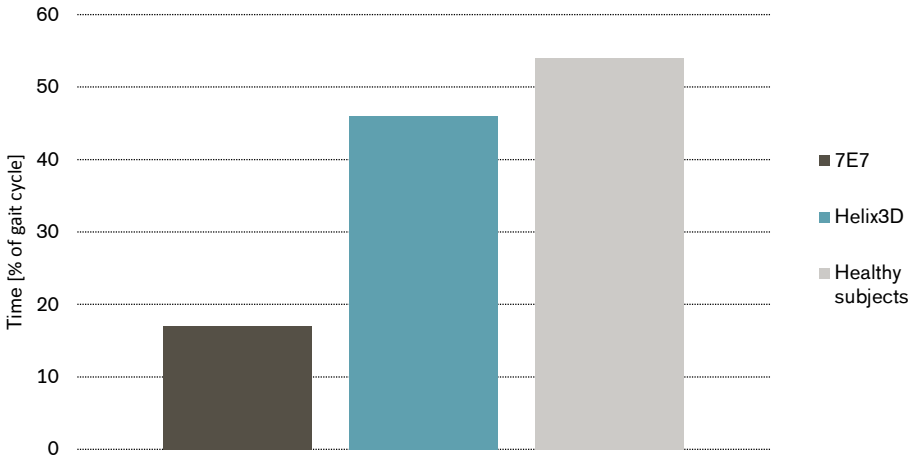
Level Walking

Major Findings

With Helix^{3D} Hip Joint System compared to other prosthetic hip joints:

→ Increased safety and higher stability due to generation of only hip extension movements during the whole stance phase.
→ Gait pattern closer to contralateral limb.
→ Increased symmetrical knee flexion during swing phase.
→ Reduced range of motion of pelvic tilt by 5° could help alleviate spinal pain syndromes.

Maximum hip extension angle is reached later in stance phase with Helix^{3D}



Ludwigs et al. (2010)

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.

Summary

Biomechanical analysis showed that with Helix^{3D} during the entire stance phase only extension sagittal moments act on the hip. In comparison, with 7E7 also flexion moments were measured which leads to a potential for prosthesis collapse (Ludwigs et al 2010). Helix^{3D} presents therefore an improved safety potential compared to 7E7. Furthermore, with Helix^{3D} the maximum extension angle of the hip joint is reached at the end of stand phase (46% of gait cycle) whereas it is reached with 7E7 already at 17% of gait cycle. This leads to a decreased hip angular velocity of the extension movement in stance phase with Helix^{3D} compared to 7E7 and a more natural gait pattern (Ludwigs et al 2010). The maximum extension knee angle is reached smoother through a hydraulic dampening mechanism in Helix^{3D}. Additionally, the flexion movement in swing phase is smoother with Helix^{3D} compared to 7E7 indicated through a decreased maximum hip angular velocity (Ludwigs et al. 2010 and Blumentritt et al. 2008). Swing phase initiation is supported since hip flexion

movement starts right at the beginning of stance phase enabled through the polyurethane elements in Helix^{3D} (Blumentritt et al. 2008).

The gait pattern with Helix3D is closer to the contralateral side than 7E7. This is achieved due to increased toe clearance with Helix^{3D} compared to 7E7 based on an increased maximum knee flexion angle in swing phase as well as due to an increased maximum knee flexion angle in stance phase (Ludwigs et al. 2010).

Maximum mean range of pelvic tilt is decreased by 5° when using Helix3D compared to 7E7. The reduction of range of motion in the anterior/posterior tilt could help reduce spinal pain symptoms, which hip disarticulation and hemipelvectomy amputees are often confronted with (Ludwigs et al. 2010).

No difference was detected in self-selected walking velocity between Helix^{3D} and 7E7 (Ludwigs et al 2010). A 10 meter walk test showed a trend towards increased walking velocity with Helix^{3D} compared to an old hip system (Ludwigs et al 2013). Furthermore, a case study showed that the subject could improve gait speed with Helix^{3D} by 90% relative to 7E7, measured by a 2-minute walk test (Nelson & Carbone 2011). Another group conducting the 2-minute walk test reported that two out of three subjects increased walking speed with Helix^{3D} compared to 7E7 (Gailledrat et al. 2013).

Nelson & Carbone (2011) observed a subject over a 15-week period starting with the day of Helix^{3D} fitting. Time used to perform the timed up and go (TUG) test decreased progressively over the 15 weeks by 35%. Therefore risk of falling decreased when the subjects got used to Helix^{3D}. However, gait speed measured by a 2-minute walk test did not change over the 15-week time period.

References of summarized studies

Blumentritt, S., Ludwigs, E., Bellmann, M., & Boiten H. (2008). Das neue Hüftgelenk Helix 3D. *Orthopädie-Technik*, (5), 1–6.

Gailledrat, E., Moineau, B., Seetha, V., DeAngelis, M., Saurel, B., Chabloz, P., . . . Pérennou, D. (2013). Does the new Helix 3D hip joint improve walking of hip disarticulated amputees? *Annals of Physical and Rehabilitation Medicine, 56*(5), 411–418. doi:10.1016/j.rehab.2013.05.001

Ludwigs, E., Bellmann, M., Schmalz, T., & Blumentritt, S. (2010). Biomechanical differences between two exoprosthetic hip joint systems during level walking. *Prosthetics and Orthotics International, 34*(4), 449–460.

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