Agilium Freestep

Biomechanics – Static measures

Major Findings

With Agilium Freestep:

The knee angle in the frontal plane is significantly reduced

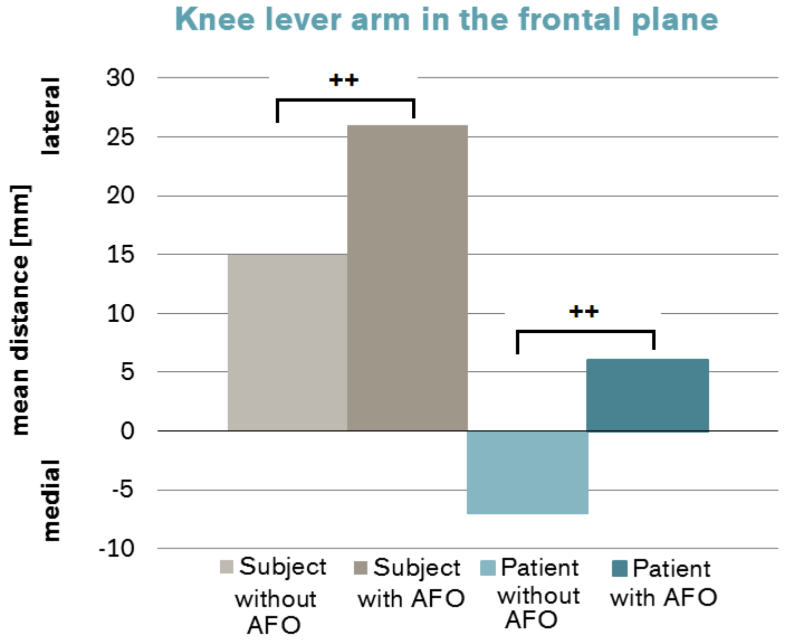
→ **Agilium Freestep in different adjustments: significant decreased knee angle in all conditions, indicating a change from varus to valgus position** (Fantini-Pagani et al. 2013)

The knee lever arm in the frontal plane is significantly reduced
Knee lever arm = distance between the joint center to the vector of the ground reaction force

→ **Patients: the knee lever arm shifts laterally by 11mm** (Schmalz et al. 2011)
→ **Subjects: the knee lever arm shifts laterally by 13mm** (Schmalz et al. 2011)

→ **Agilium Freestep + 10mm shoe wedge: significant reduced length of the knee lever arm with both, medial and lateral shoe wedge** (Schmalz et al. 2006)

→ **Agilium Freestep in different adjustments: significant reduced length of the knee lever arm in all conditions** (Fantini-Pagani et al. 2013)



++ = significant changes between the conditions with / without AFO for healthy subjects and patients with knee OA
[Schmalz et al. 2011]

Clinical Relevance

Osteoarthritis (OA) is a degenerative joint disease and the leading cause of pain and disability in elderly people worldwide (Hinman et al. 2005). The prevalence of OA increases with age (O'Reilly et al. 1998). Symptomatic knee OA affects 10% of persons over age 55 (Peat at al. 2001) and 12% of persons older than 60 years (Felson et al. 2009). The medial tibiofemoral compartment is affected most frequently (Chang et al. 2005).

Patients suffer from pain, stiffness, decreased range of joint motion and a sensation of instability and buckling of the affected knee. These problems may limit the ability to rise from a chair, stand comfortably, walk or climb stairs (Felson et al. 2009, Kaufman et al. 2001).

The cause of OA is a non-physiological load distribution due to kinematic changes in the knee joint. A rotational offset from the normal position causes a shift in the load-bearing articular surfaces. Furthermore, a varus deformity of the leg axis leads to a long lever arm between the knee joint center and the vector of the ground reaction force, inducing a high external adduction moment. In a long term, these mechanisms lead to a damaged cartilage (Andriacci et al. 2004, Felson et al. 2009, Vincent et al. 2012).

In easy words this means, that the forces, acting at the joint, are high, when the knee lever arm in the frontal plane is long, because of a varus malalignment. The length of the knee lever arm is correlated with a high knee adduction moment, which is an indicator for a high pressure in the knee.

The Agilium Freestep is used in unicompartimental OA. It is an AFO (ankle-foot-orthosis) that reduces the eversion of the foot. Biomechanical studies showed that this shifts the vector of the ground reaction force closer to the center of the knee joint. As a result, the external adduction moment is reduced (Schmalz et al. 2006, Schmalz et al. 2011, Fantini-Pagani et al. 2013).

Summary

Three biomechanical studies have evaluated the effectiveness of the Agilium Freestep:

Schmalz et al. (2006) observed a significant reduction of the knee lever arm of the GRF in the frontal plane and a significantly decreased knee adduction moment with Agilium Freestep in combination with shoe wedges.

Schmalz et al. (2011) investigated the Agilium Freestep without shoe wedges. Also here, a significant reduction of the knee lever arm of the GRF in the frontal plane and a significantly decreased knee adduction moment with Agilium Freestep could be shown.

Fantini-Pagani et al. (2013) conducted their study with subjects that showed a tendency towards a knee varus alignment. The former results could be confirmed. Significant reductions were seen in the knee lever arm and the knee adduction moment.

Furthermore, first clinical results show that pain was reduced by up to 51% (Schmalz et al. 2011).

Thus, Agilium Freestep can alter the load distribution within the knee joint and thereby relieve the affected compartment. The use of this AFO, designed to offload the medial or lateral knee compartment, represents an alternative for conservative treatment of knee OA.

References of summarized studies

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Schmalz, T., Blumentritt, S., Drewitz, H., Freslier, M. (2006). The influence of sole wedges on frontal plane knee kinetics, in isolation and in combination with representative rigid and semi-rigid ankle-foot-orthoses. *Clinical Biomechanics (Bristol, Avon)*, 21(6): 631-639. DOI: 10.1016/j.clinbiomech.2006.02.004.

Other References

Andriacchi, Thomas P., Mündermann, Annegret, Lane Smith, R., Alexander, Eugene J., Dyrby, Chris O., Koo, Seungbum (2004). A Framework for the in Vivo Pathomechanics of Osteoarthritis at the Knee. *Annals of Biomedical Engineering,* 32(3): 447–457.

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Peat, G., McCarney, R., Croft, P. (2001). Knee pain and osteoarthritis in older adults: a review of community burden and current use of primary health care. *Ann Rheum Dis*, 60(2): 91–97.

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