Power support by an active knee orthosis during sit to stand

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Introduction
An active knee orthosis has been developed for assisting elderly in challenging ADL-tasks like stair-climbing or sit-to-stand (STS). In contrast to approaches of exo-skeletal devices, used in paraplegics without or with marginal motor function of the lower extremity, this orthosis aims to amplify joint moment in elderly with reduced muscle strength. Aim of this study was to test whether the user profits from the supportive function of this device. The support should be visible in reduced EMG-activation during STS when comparing to the situation without support.

Methods
A healthy subject was tested with a custom made pair of knee-ankle-foot-orthoses (KAFO) with an actuator attached to the orthosis at the right leg. Ten symmetric STS movements at self-selected velocity were performed with feet placed on separate force platforms. The subject stood up from a bench placed on a third platform to detect the seat-off-event (SO). Arm position was standardized in front of the trunk. Motion was captured via a 12-Camera-Vicon-System. Synchronously, EMG of M.rectus femoris and M.gluteus medius were recorded as well as torque, current and angle of the actuator. STS-movements were performed with support from the orthosis and with zero-moment-regulation of the motor. Kinematics, kinetics and EMG-patterns were compared between motorized and non-motorized side.

Results
The sagittal kinematics was similar in both conditions. With motor support providing 25% of the subjects’ maximum anatomic knee torque the extension phase started earlier. Consistently, the activation of the M.rectus femoris around SO-event was 26% lower in the supported condition compared to zero-moment-condition. The left side, with a similar but passive orthosis, showed no change in the amount of muscle activation.

Conclusion
Measuring the amount of muscle activation seems to be a sufficient method to show the supportive function of the active orthosis. Further measurements will be performed with additional subjects and motorized orthoses on both sides.