

Biomechanical effect of a soft biomimetic exosuit developed to improve gait after stroke

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Background

Patients partial mobility limitations after suffering from a stroke need support for their remaining function, not substitution. To address this challenge subsequent prototypes of a soft modular biomimetic exosuit (XoSoft, www.xosoft.eu) have been developed. The prototypes varied concerning their support strategy, garment including attachment points for actuation, weight, and type of support at the hip and knee joint. The aim of this study was to assess the biomechanical effects of three prototype generations on the gait of one participant with stroke.

Methods

Study participant

- One 68 years old participant with gait impairments
- Right side affected
- Functional ambulation category of 4/5

Procedures

- Walking at self-selected speed without and with active support by XoSoft
- Biomechanical analysis of hip and knee kinematics with a 3-D optoelectronic camera system

Soft Exosuit (Figure 1)

The prototypes were characterized by:

- Actuation at hip or knee
- Backpack containing pneumatic actuation, controlled by shoe insole sensor

Three versions of XoSoft were tested Beta1, Beta2 and Gamma

Results

Walking in the soft modular exosuit improved the participants gait during swing phase, by increasing maximal knee flexion (Beta1) and by reducing a compensatory un-physiological movement in the hip and knee joint (Beta2) (Figure 2). This effect diminished while walking in Gamma (not shown).

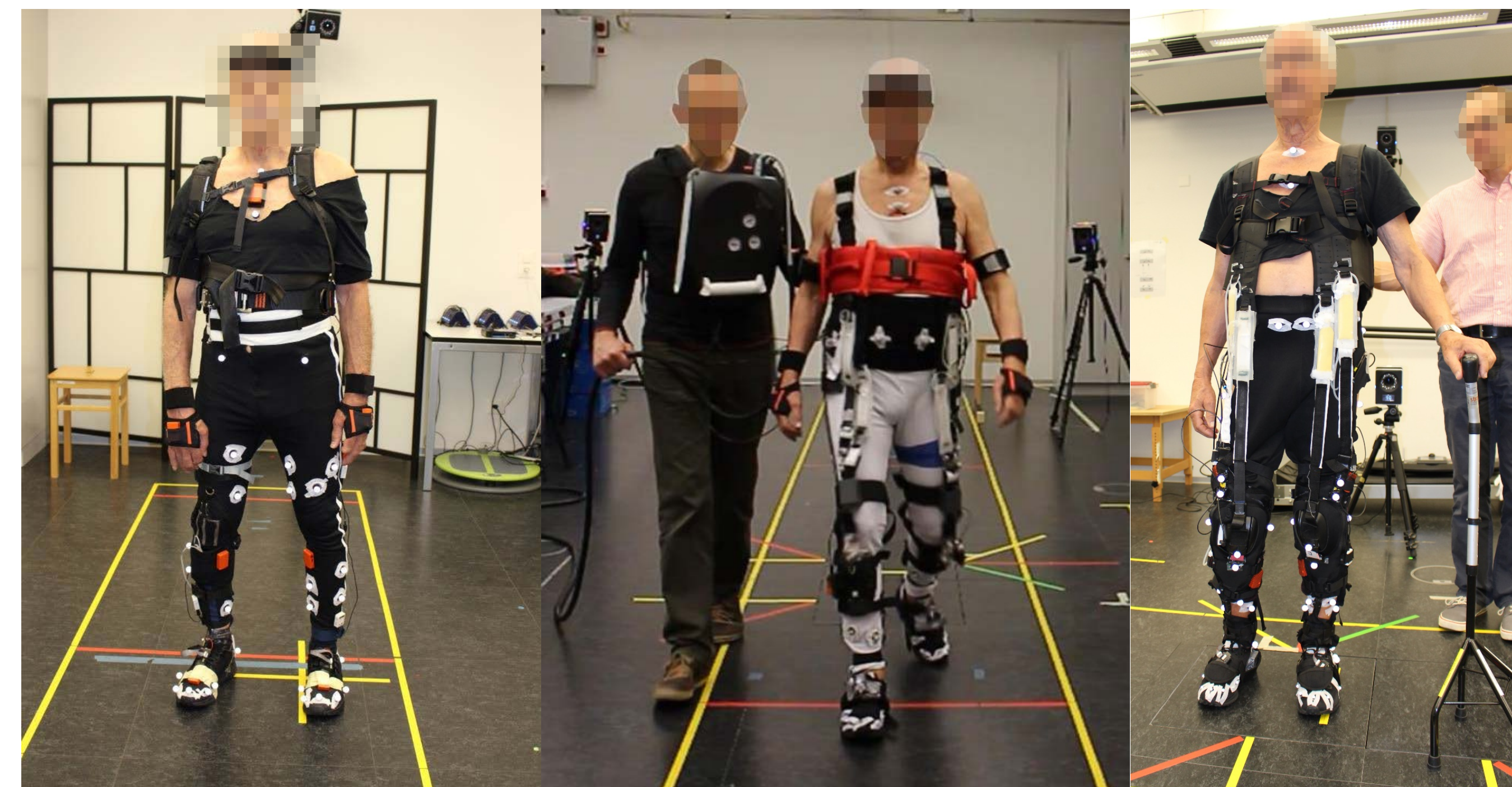


Figure 1: XoSoft (left: Beta1, middle: Beta 2, right: Gamma) worn by participant while walking (for Beta 2, accompanying person wearing backpack, for Gamma participant wearing the backpack).

Conclusion

The prototype soft exosuit improves gait. Increased knee flexion and reduced whipping during swing could signify increased efficiency, and reduced risk of tripping. The backpacks weight needs reducing. A soft modular biomimetic exosuit is useful to support and improve walking after stroke.

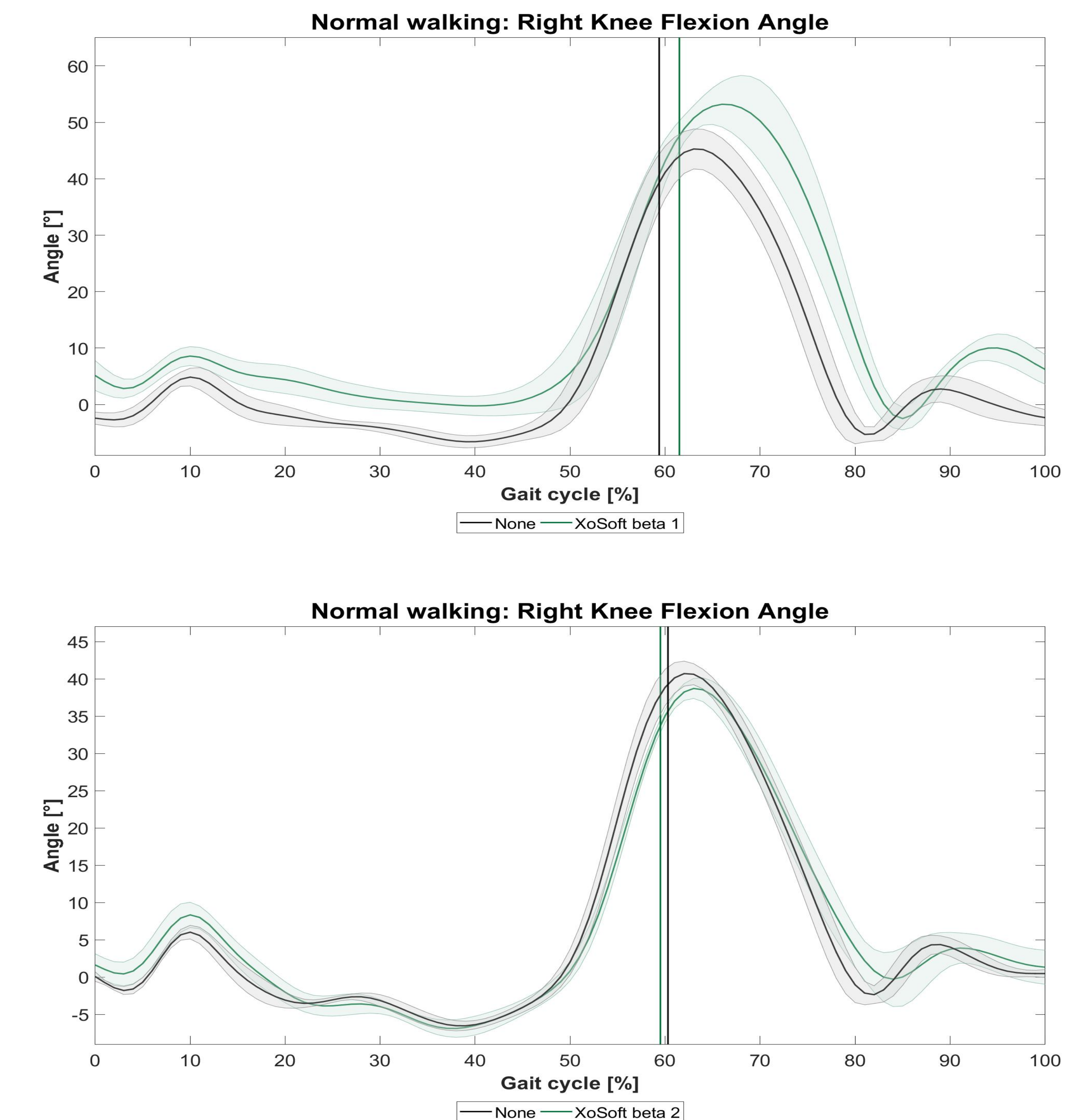


Figure 2: Right knee flexion angles while walking with Beta1 (top) and Beta2 (bottom)

An iterative user centred design approach with subsequent prototype generations is essential to develop successful support strategies, identify disadvantages, and advance this novel technology.

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