A simple movement based control approach to ease the control of a myoelectric elbow prosthetics in transhumeral amputees.

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Background and aims: Common myoelectric control strategy remains complex to use and produce unnatural gestures since it does not allow simultaneous movements of several joints. This is especially an issue for the transhumeral amputees who can use an active elbow in addition to active prosthetic wrist and hand. Since most transhumeral amputees have a mobile residual limb, an interesting approach aims at utilizing this mobility to control the elbow. We thus developed a simple electronic device relying on an inertial measurement unit, that can be interfaced with existing commercial myoelectric elbows and which convert chosen displacements of the residual limb into control signals, offering an intuitive way of controlling an active elbow prosthesis whilst allowing a simultaneous myoelectric control of the wrist and hand.

Methods: We performed an experiment with one transhumeral amputee wearing his myoelectric prosthetic (active elbow, wrist and hand) who was asked to grasp and transfer different objects several times while being recorded with a motion capture system. Theses task were performed twice: with a conventional full myoelectric control and with the proposed movement based control. Several metrics (position error, time, smoothness, along with body compensatory strategies) were used to quantify the performances obtained with these two modes.

Results: Analyses showed that the participant was able to perform the tasks in both condition, but that the movement based control approach allowed a reduction in task time and in exhibited body compensatory strategies, by offering an easier access to adjustments of the elbow posture compared to the full myoelectric control approach.

Conclusions: This work illustrates the potential of using residual limb mobility in the control of prosthetics, to make it more natural and intuitive, and how this can have an indirect but positive impact on the whole body compensatory strategies exhibited by amputated subjects.