Development of a Hybrid Body Powered Transradial Prosthesis with Myoelectric Switching

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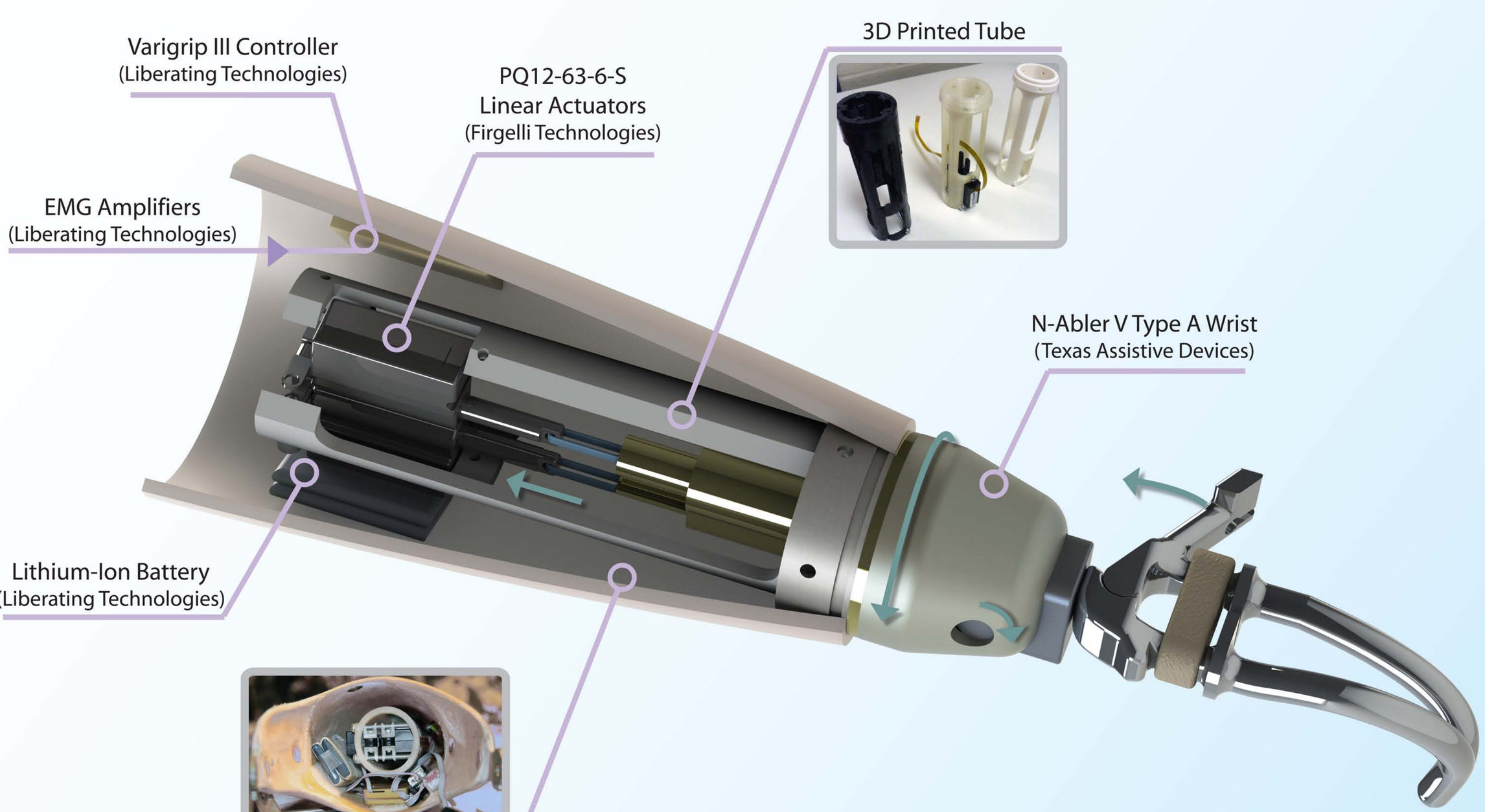
Background

A body powered prosthetic user with right transradial and left transhumeral amputations was having difficulty with wrist flexion and pronation on a multifunction wrist with right arm extended. Traditional control requires the patient to use biscapular abduction to create tension on the cable, which opens the hook, flexes the wrist or supinates the wrist. Switching between functions is achieved via mechanical switches that can be bumped against the side of the body or exterior surfaces. These switches pull on strings of the wrist unit to lock or unlock the wrist functions. A disadvantage to this setup is that the patient cannot lock or unlock their wrist functions while their prosthesis is fully extended which is required for some tasks such as operating a skidsteer loader.

Objective

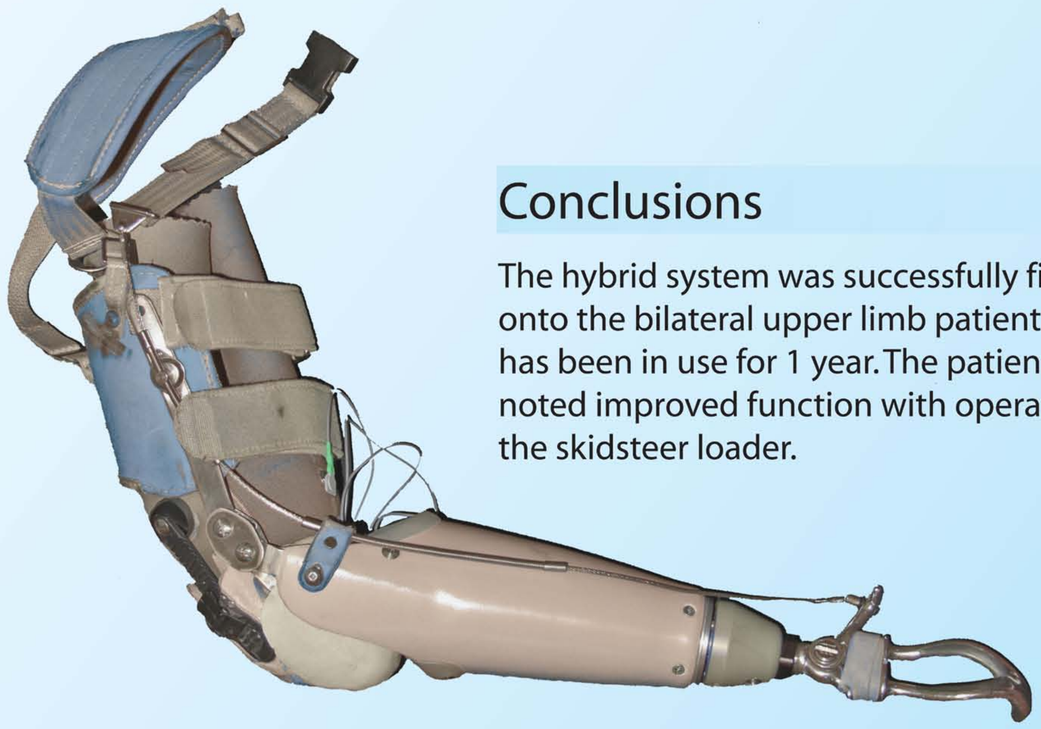
To design a hybrid myoelectric/body powered system to allow a bilateral upper limb amputee patient to use the muscle signals of their transradial residual limb to myoelectrically lock and unlock the wrist functions while still controlling the degrees of freedom directly with their body powered cable.



Laminated Forearm
(back view)

Methods

The controller was setup such that when one of the patient's EMG signals exceeded threshold a linear actuator retracted and pulled on the string to lock or unlock one of the wrist functions. When the patient relaxed their EMG signal below threshold the linear actuator was setup to automatically extend back to its original position. In order to allow both wrist functions to be locked/unlocked two linear actuators and EMG amplifiers were required. A custom 3d-printed tube mount was designed in order to closely align the strings of wrist unit with the shafts of the linear actuators and allow the entire system to be easily integrated into the forearm of the prosthesis. The total weight of the electronics and mounting hardware was less than 200g with an estimated run time of about 1 to 2 weeks.



Conclusions

The hybrid system was successfully fit onto the bilateral upper limb patient and has been in use for 1 year. The patient noted improved function with operating the skidsteer loader.