MOTOR PLASTICITY IN RESPONSE TO MULTI DIGIT TENDON TRANSFERS: A CASE REPORT

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INTRODUCTION

The project aims at investigating cortical and motor plasticity in response to multi digit tendon transfers.
Currently, we focused on the motor plasticity. The analysis requires accurate assessment of salvaged impaired motor functions, particularly for co-contractions with the donor muscles.
A 70-years-hold male subject with an isolated high radial nerve palsy consecutive to a stabilized very severe cervical cord myelopathy participated in this study. The Tsuge's procedure [1] was performed to restore the extension of his right wrist, thumb and fingers. This abstract focused on static finger flexion and extension force productions at four different time-points: 1 month before surgery (t_{-1}), and 1.5, 3 and 6 months after surgery ($t_{+1.5}$, t_{+3} and t_{+6}).
We address two questions: (1) what is the finger force restoration following the transfers? (2) Is there co-contraction evidence with the donor muscle for finger flexion forces?

METHODS

Re-animated motor functions investigated:
We focused on the flexion and extension force produce by the long fingers. The extension was restored by releasing the tendon of the flexor carpi radialis and re-attaching it to the extensor digitorum communis tendon.

Experimental procedure:
Four parallel 3-D loads cells (Kistler, France) and kinematic device (Sony, CD-S70) were used. The subject applied three maximal palmar or dorsal forces at the distal or proximal phalanxes with each finger simultaneously. Three trials for 10s were required. Bipolar surface EMG electrodes (Biopac, France) recorded the Flexor digitorum superficialis, profundus and the Flexor carpi radialis (FDS and FDP and FCR) electrical activity during.

Co-contractions with the donor muscle:
We developed an index of co-contraction, as follows:
$\mathrm{ICO}_{\mathrm{EMG}} = M_{ext} / M_{fle}$ where $M_{fle} = a_{fle} EMG_{fle}$ is the resultant flexion moment and $M_{ext} = a_{ext} EMG_{ext}$ is the resultant extension moment predicted from EMG activities with a dynamic optimization procedure.

RESULTS AND DISCUSSION

Resultant finger force:
As expected by the surgeons, Fig.1 shows that the release of several flexor donor muscles does not affect the force production in flexion; instead the surgery does salvage a significant force production in extension.

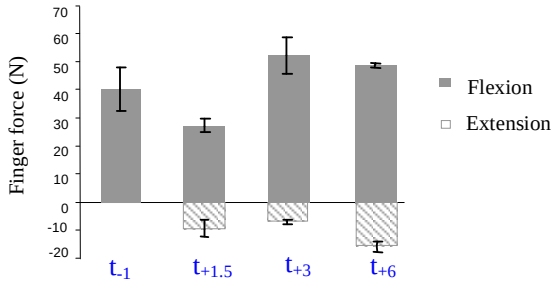

Figure 1: Resultant four-finger force production before and after the surgery

Co-contraction:
Results of co-contraction with the donor muscles are displayed on Fig.2. Co-contraction is observed just after the surgery (7%), while it decreases to 0% at t_{+3} and greatly increases until 22% at t_{+6}. Despite the important variability and the difficulties associated with the surface EMG signals, our results suggest a dynamical restoration of the finger force production. Just after the surgery, the FCR remains activated as a flexor muscle. At 3 months, the musle involvement seems to be completely disorganized with the FRC as a finger extensor. After 6 months, the muscle pattern appears to be stabilized with the FCR accurately used as an extensor finger muscle.

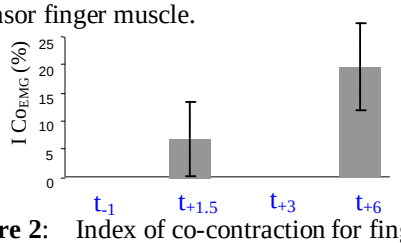

Figure 2: Index of co-contraction for finger flexion force

CONCLUSIONS

Results exhibit longitudinal adjustments in the finger force production and co-contractions with the donor muscle following tendon transfers surgery. Within the limits of this pilot study (one subject, weakness of the surface EMG for finger muscles), it appears that accurate force production in flexion and extension will be obtained throughout increased adequate co-contraction with the donor muscle. Consecutively to the tendon transfers investigated, it may be hypothesized that the motor plasticity will consist to develop a muscle pattern in this way. Finally, accurate assessment of cortical plasticity must integrate this finding.

ACKNOWLEDGEMENTS

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REFERENCES

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