REPRODUCIBILITY OF SURFACE EMG MEASUREMENTS IN CP CHILDREN

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INTRODUCTION

Clinical movement analysis as well as dynamic electromyography are accepted tools for evaluation of gait pathologies in CP children (1). In these patients, multi-level soft tissue surgery may be performed in order to improve gait function. The success of the intervention can again be evaluated with the above mentioned objective measurements. However, comparisons between pre and post intervention measurements rely on a certain consistency of EMG measurements. Therefore, it is mandatory to know how repeatable EMG data can be obtained in these patients. This was the objective of the present study.

METHODS

In eight patients that were submitted to our department for soft tissue surgery (Tab. 1), two measurements were recorded on separate days (PRE 1 and PRE2) in order to test for reliability and reproducibility. Electromyographic measurements were performed during free walking at self-selected speed with bipolar surface electrodes from the following six thigh and shank muscles: rectus femoris, vastus lateralis, semitendinosus, tibialis anterior, peroneus longus, gastrocnemius medialis. Data was sampled and digitized at 1000 Hz with 12 bit resolution. Data processing involved an automatic burst detection algorithm (2) for determination of amplitude and timing (onset and offset) of EMG activities for at least 20 gait cycles.

RESULTS

In total, 90 PRE 1 timing parameters were compared to 90 PRE2 timing parameters of eight subjects. In two subjects with hamstring tendon lengthening, the two pre-intervention recordings of the rectus femoris showed continuous activity. Therefore, no on- and offsets times and amplitudes outside the burst were found. The average difference between the PRE 1 and PRE2 timing parameters was 3.5±5.7 % of the gait cycle. Fig. 1 shows an example of two repeated recordings with the detected timing parameters for the semitendinosus and vastus lateralis. No significant timing differences can be seen between the PRE1 and PRE2 measurements. Thirteen of the paired timing parameters were significantly different ($p<0.05$). In one subject (#14) all six timing parameters were significantly different. However, the profiles were almost identical except they were shifted in time (mean 7.4 %). The lengths of the bursts were not significantly different. It seems that there was an irregularity in marking the heel strike events between the two trials. From the other 7 significantly different timing parameters, 4 were within 6 % of the gait cycle. The average difference in amplitude between PRE1 and PRE2 was 2.7±2.5 µV. This is 20±15 % with respect to the amplitudes in PRE1.

DISCUSSION & CONCLUSION

By studying the two pre-intervention recordings, it can be concluded that timing parameters in the repeated measurements before surgical intervention are sufficiently reproducible. 86 % of the measurements showed no significant differences between the two measurements. From the 14 % that do show significant differences, most (43 %) are due to systematic differences in one subject and 38 % are within 6 % of the gait cycle. The average difference in timing of 3.5 % appears adequate for gait analysis. Even though the absolute amplitude differences are within a few µV the relative differences are larger since the amplitudes in and outside the burst are relatively small. Differences in timing parameters between measurements can be explained by differences in muscle coordination and different walking speed. Further sources of differences may lie in irregularities in marking heel strike events, or estimation errors in burst detection.

REFERENCES

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Tab. 1: Subject data and type of surgical procedures that were performed in 8 subjects.

	Age [years]	Height [cm]	Body mass [kg]	Operated limb(s)	Surgery performed*
Joh04	17,9	172	53	Right	Ham
Joh05	18,6	189	69	Right	Ham, ATL, TAT
Joh06	14,9	169	54	Both	Ham, ATL, Add
Joh07	12,9			Both	Ham,Add
Joh08	13,8	158	44	Both	ATL, & others
Joh11	9,3	139	43	Both	Ham, ATL, Add
Joh13	18,0	165	55	Right	ATL, TAT,
Joh14	15,3	163	67	Both	ATL
Mean	15,1	165,0	55,0		
SD	3,1	15,1	10,1		

*Ham = Hamstring lengthening, ATL = Achilles tendon lengthmg, TAT= tibialis anterior transfer, Add = Adductor lengthenmg.

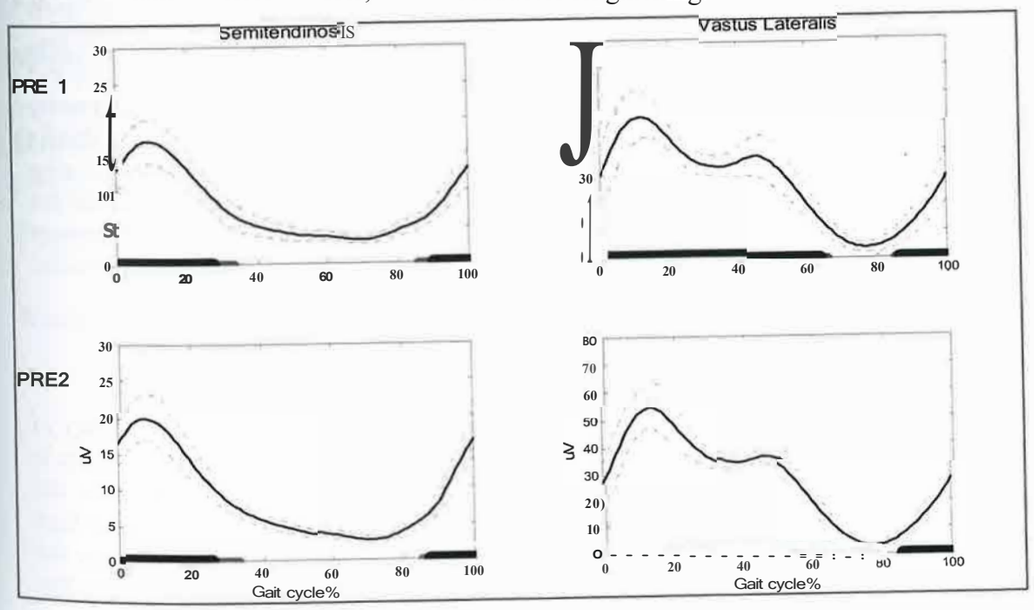

Fig. 1: Above, 1st recording; below, 2nd recording; left: semitendinosus, right: vastus lateralis.