

A comparison of muscular activity during single and double mouse clicks

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Abstract

Previous research (Sogaard, et al., 2001) found higher motor unit (MU) activity and doublets when double clicking than when simulating single clicking a computer mouse using a quadripolar needle electrode. Since surface EMG (SEMG) sums the activity of all MUs within the recording volume, the present method should demonstrate higher SEMG levels during double clicking than during single clicking for the three areas studied, the right extensor digitorum communis (EDC), the right flexor carpi ulnaris (FCU), and the right and left upper trapezius. Data from three subjects, using a force-sensitive mouse over a 1-hour period, demonstrate that for the 90-percentile SEMG levels the single click is significantly higher ($P < 0.05$) than the double click for the EDC and bilateral trapezius. For the bilateral trapezius, also the median SEMG RMS values were higher during the single click than during the double click and were significant for 2 out of 3 subjects ($P < 0.001$). The results for the FCU show that the single and double clicks did not differ significantly, as would be expected for a primary wrist-moving muscle. These findings do not support the findings of Sogaard et al. (2001).

Keywords

Computer mouse work, double clicking, trapezius, forearm

1 INTRODUCTION

Muscle complaints in the shoulder/neck area and the upper extremities are a common and increasing problem among computer workers (Wigaeus Tornqvist et al., 2000).

Søgaard et al. (2001) investigated the motor unit (MU) firing pattern activity in the right extensor digitorum communis (EDC) muscle during a computer mouse work task. They compared double clicking with mere lifting and lowering of the right hand index and/or middle fingers from the resting position on the mouse, and found that double clicking may increase the MU activity in the muscle by an increased occurrence of MU doublets (MUs activated twice in a very short time). These MU doublets could, in turn, lead to a risk for muscular disorders in the long run, due to higher selective muscle loads.

Since surface electromyography (SEMG) sums the activity of all MUs within the recording volume, increased MU activity would be expected to introduce an higher

SEMG level in the muscle during double clicking, compared with a more simplified lifting and lowering finger task, e.g. single clicking with right hand index finger.

The present study was initiated to investigate whether double clicking increases overall muscle activity levels, in the forearm and the trapezius muscles, compared to single clicking.

2 METHODS AND MATERIALS

Four subjects (2 males and 2 females), all right-handed, participated in the study. Bipolar SEMG was recorded from the EDC and the flexor carpi ulnaris (FCU) muscles in the right forearm and from the left and right upper trapezius muscle during a combined mouse and keyboard work task. The task consisted of editing a text for 60 minutes. Every 20th word in the text was in boldface. The subject was asked to double click on each boldfaced word, single click on the “bold” icon and then retype the word. Each subject performed in total approximately 400 single and 400 double clicks over the 1-hour session.

The force applied to the left mouse button was measured by means of a force-sensitive standard PC mouse (Johnson et al., 2000). The force information was used to identify the occasions of single and double mouse clicks. SEMG root-mean-square (RMS) were calculated within a 0.5-second window centred on every single and double click occasion, and median and 90-percentile levels of each 0.5-second SEMG RMS curve were obtained. Within each subject, the median and 90-percentile values during single clicks were compared to the corresponding values during double clicks by using a Wilcoxon rank sum test. All calculations were carried out in MATLAB[®].

3 RESULTS

Subject 4 was excluded from the study since the mouse force signal was lost due to technical failure. For the same reason, the measurement time for subject 3 was reduced to the first 30 minutes of the performed work task.

For the 3 subjects analysed, the 90-percentile SEMG RMS values were significantly higher during single than double click periods in the EDC muscle ($P < 0.001$), as well as in the left and right trapezius muscle ($P < 0.05$, Table 1). The average differences in 90-percentile values between single and double clicks were 4.1, 1.1 and 5.1% MVE for the EDC, left and right trapezius muscle, respectively. For the left and right trapezius muscle also the median SEMG RMS values were, on average, higher during single click than during double click; significantly so for 2 out of 3 subjects ($P < 0.001$, Table 2). For the FCU muscle, there were no consistent significant differences in either median or 90-percentile SEMG RMS values between single and double clicks. EMG curves for one subject during single and double clicks, respectively, is shown in Figure 1.

Table 1. Average 90%-ile SEMG levels [%MVE] during single/double clicks in the left and right trapezius muscle and in the right EDC muscle for Subjects 1-3.

Subject	Left trapezius (single/double)	P- value	Right trapezius (single/double)	P- value	Right EDC (single/double)	P- value
1	3.7/3.6	<0.05	4.4/3.9	<0.05	23.8/21.3	<0.001
2	18.3/15.8	<0.001	19.7/16.5	<0.001	29.8/26.1	<0.001
3	2.6/2.0	<0.001	24.4/12.6	<0.001	17.0/10.9	<0.001

Table 2. Average median SEMG levels [%MVE] during single/double clicks in the left and right trapezius muscle and in the right EDC muscle for Subjects 1-3.

Subject	Left trapezius (single/double)	P- value	Right trapezius (single/double)	P- value	Right EDC (single/double)	P- value
1	2.3/2.2	NS	2.4/2.2	NS	14.5/13.0	<0.001
2	13.1/11.2	<0.001	12.8/12.0	<0.001	18.7/18.6	NS
3	1.5/1.1	<0.001	14.1/7.6	<0.001	6.6/6.9	<0.001

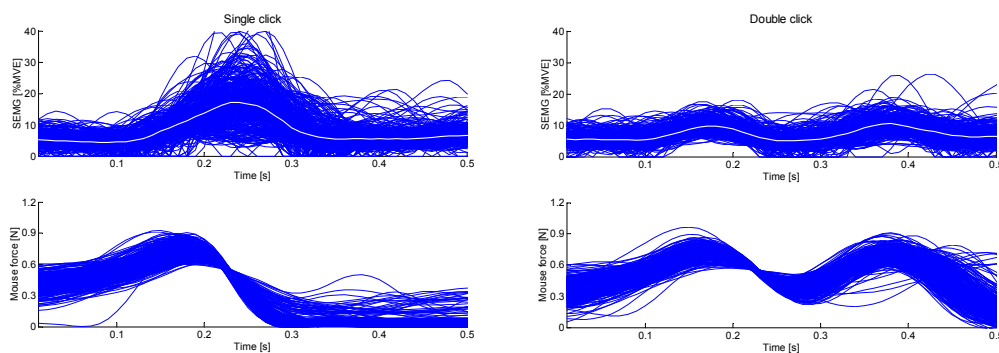


Figure 1. SEMG plots during single and double clicks for Subject 3, EDC muscle.

4 CONCLUSIONS

The findings of the SEMG levels in the present study are not consistent with what would be expected from the MU activity results presented by Sogaard et al. (2001). To the contrary, the results from the present study indicate that single clicks on the mouse produce higher muscle load levels in the EDC as well as bilaterally in the trapezius muscles, than double clicks do. One explanation for these dissimilar results could be that the mouse work methods vary between different individuals. Thereby, larger study groups are needed in order to draw conclusions about the muscle activity behaviour within a certain population. Furthermore, it would also be desirable to expand a future study to several different mouse work tasks in order to capture variations caused by methodological differences.

In conclusion, the results from the present study indicate that double clicking during computer work does not produce higher muscle loads than single clicking. More experiments are needed to confirm these findings.

References

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