

Effect of computer workstation height on EMG distribution over the trapezius muscle

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INTRODUCTION

Non-ergonomically designed workstations are among the causes of work-related musculoskeletal disorders. In computer workers, non-optimal table and keyboard positions may induce prolonged low-level trapezius activation, localized muscle fatigue, and eventually trapezius myalgia and neck pain [1,2]. In this study, we use **high-density sEMG** to quantify the effect of table height on the degree, timing and localization of trapezius activity during a simulated working task.

METHODS

A **16x4 grid of electrodes (10mm apart)** was placed over the trapezius with the **3rd row of electrodes over the line C7-acromion** (Fig. 1).

24 subjects were asked to **type** a standard text in two randomized, experimental conditions (Fig. 2):

- (i) **"Table Low"** - the height of the table was defined according to ergonomic standards [3],
- (ii) **"Table High"** - the table height was 10cm higher than (i).

Duration of each task was 50min with at least 10min of rest between tasks.

The **RMSs** of each sEMG signal were computed for **30ms epochs**. For each epoch, the active regions were defined as the group of adjacent sEMG channels whose RMS was $>3 \times \text{STDEV}$ of the noise.

The degree and timing of muscle activity was described with:

- (i) the **RMS of sEMG in the active regions**,
- (ii) the **location of their centroid**,
- (iii) the **area** (n. of channels) **of the active regions**
- (iv) the **number of active epochs**.

RESULTS

Fig. 3. shows typical muscle activity in both conditions separately. We report the results for the most proximal region (**upper trapezius**) for its important role in the **development of work-related neck pain**. Using Wilcoxon pairs test we observed that the **activation duration** (number of active epochs in % of the total number of epochs) and the **activation level** (RMS of the active regions) were **significantly higher ($p < 0.05$) during the Table High** condition (Fig. 4a and Fig. 4b). A **significantly smaller size of the active regions ($p < 0.05$)** was also observed for the **Table High** condition (Fig. 4c). The position of the active areas (i.e. proximal-distal centroid) was not affected by the experimental condition.

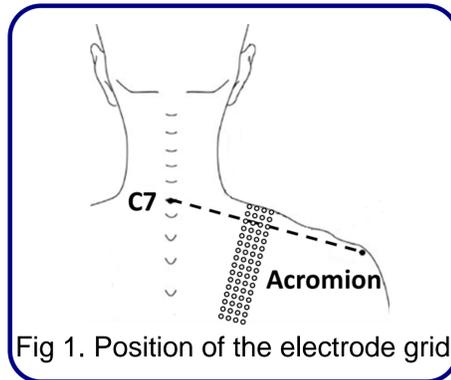


Fig 1. Position of the electrode grid

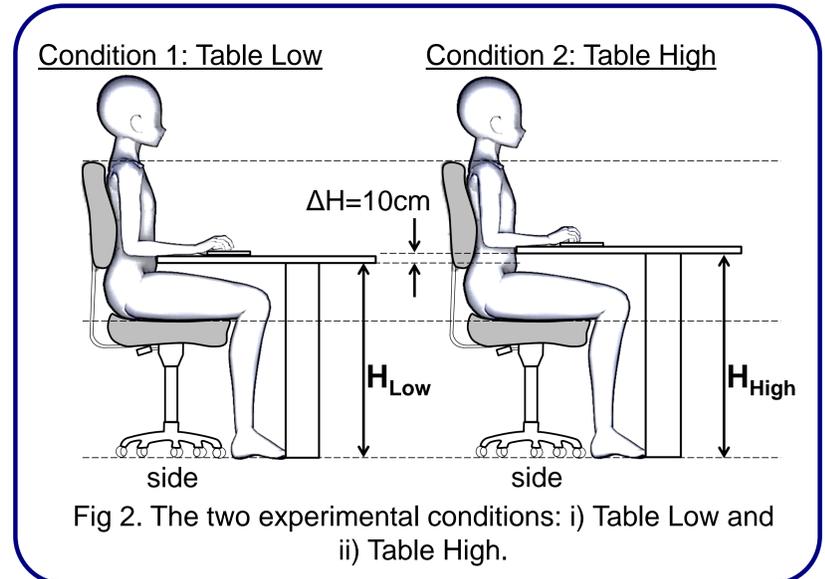


Fig 2. The two experimental conditions: i) Table Low and ii) Table High.

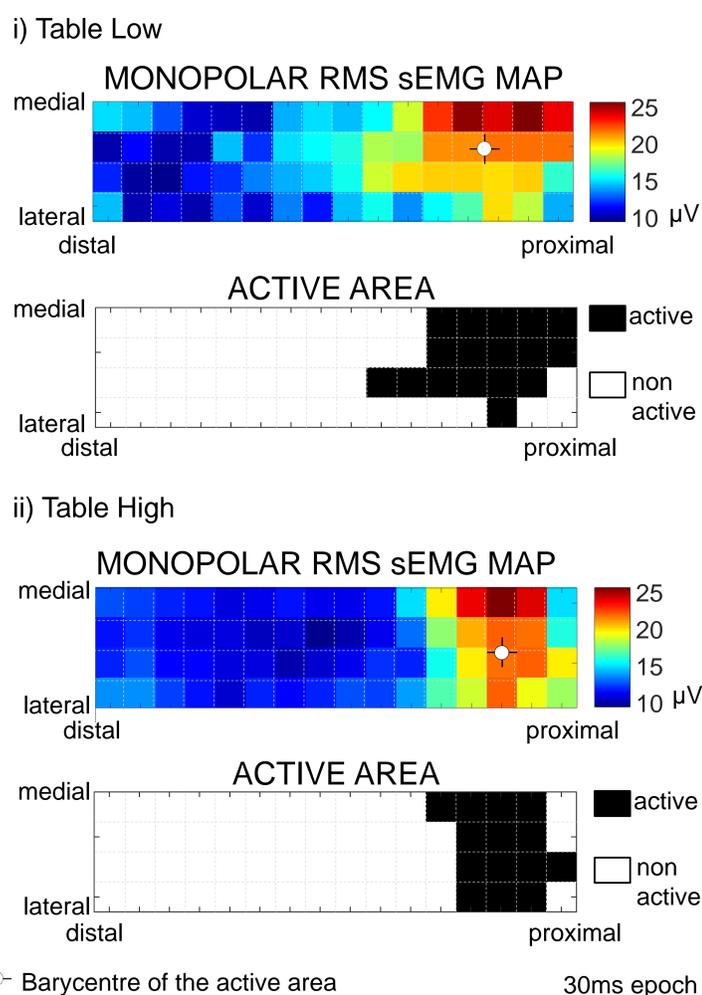


Fig 3. Typical monopolar RMS sEMG map at: i) Table low and ii) Table high. The RMS value of each channel was computed within 30ms epoch.

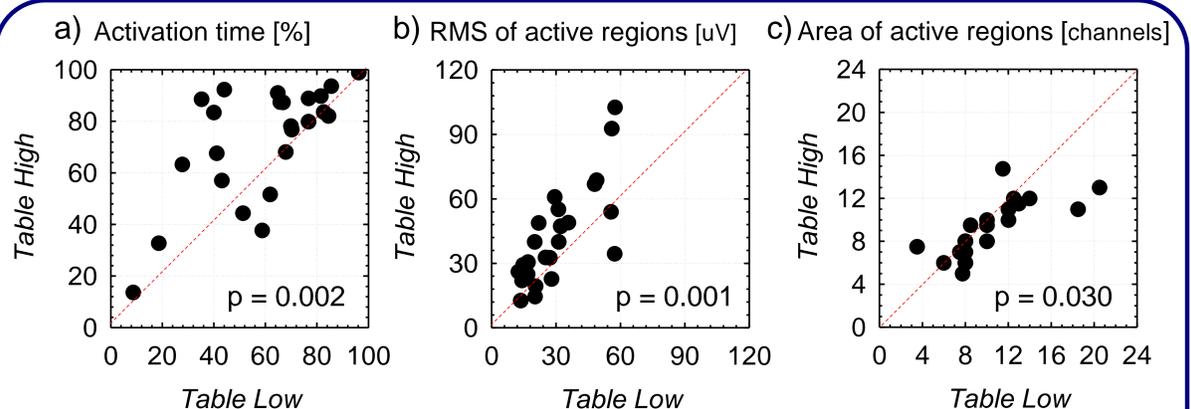


Fig 4. Median value of a) Activation time, b) RMS of active regions and c) Area of active regions obtained from 24 subjects while performing 50min typing task in two conditions: Table low and Table high. Wilcoxon matched pairs test shows that in Table high condition the activation time and RMS of the active region of Upper Trapezius muscle is significantly higher than in Table Low condition yet having a significantly smaller area of active regions.

CONCLUSIONS

The effect of workstation height on muscle pain and activation has been previously quantified through psychometric evaluations and intramuscular EMGs [1,2]. In this study, we confirmed the observation of **higher and more prolonged EMG activity during computer typing in non-ergonomically designed workstations**. Moreover, we showed that in this condition the **spatial distribution of EMG** over the upper trapezius **is more localized** (smaller area of active regions), indicating the continuous activation of specific subgroup of MUs, a well-known risk factor for the **development of work-related neck pain**.

REFERENCES

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