CHANGES IN MECHANO- AND ELECTROMYOGRAM DURING LOW-FORCE STATIC CONTRACTION IN SUBJECTS WITH UNILATERAL EPICONDYLITIS LATERALIS

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INTRODUCTION

In modern information society an increasing number of jobs induce musculoskeletal disorders (MSD) even though the work is characterized by low physical exposure levels. Development of prediagnostic tools may be a step towards efficient strategies aiming to prevent MSD as well as improving the understanding of the basic mechanisms of muscle pain and disorders induced by low-force contractions.

In order to identify possible precursors to muscle pain and disorders, the electromyogram (EMG) has been used to identify muscle fatigue development for prevention purposes. However, during low-force work tasks such as computer work the sensitivity and the ability of the EMG to detect muscle fatigue is limited. Recently, the mechanomyogram (MMG), suggested to reflect the "mechanical counterpart" to the motor unit electrical activity, has been shown to be a promising method for detection of muscle fatigue during such low-force contractions [1]. Since experimentally induced muscle pain seems to be reflected in the MMG rather than the EMG activity [2], it is in this study hypothesized that a low-force contraction of a painful muscle compared to a no pain muscle may evoke a different MMG response. Further, that this pain related difference will be more pronounced in the MMG than in the EMG response.

METHODS

Eight patients (5 females, 3 males) with unilateral epicondylitis lateralis were sitting with the elbows flexed 90 degrees, the forearms pronated and resting on horizontal platforms. In this position they performed static wrist extension at 10% of maximal voluntary contraction (MVC) for 10 min against a force transducer with both the afflicted arm (AA) and the non-afflicted arm (NA) in a random order. During the static contraction, MMG was recorded by an accelerometer placed on m. extensor carpi radialis (ECR) and bipolar surface EMG was recorded from ECR, m. extensor carpi ulnaris (ECU), and a forearm flexor muscle (FLEX). The MMG and EMG were analyzed for root mean square amplitude (MMGrms and EMGrms). Furthermore, subjective perceived exertion was rated by the Borg scale from 0 (no perceived exertion) to 10 (maximum perceived exertion) during the 10% MVC contraction.

RESULTS AND DISCUSSION

The performed force level was on average 9.9 (SD 0.2)% MVC for AA and 10.1 (SD 0.5)% MVC for NA with no significant difference, showing that the task of meeting the target force of 10% MVC was accomplished successfully for both arms. Despite of that, the subjects reported significantly higher level of perceived exertion during the contraction in the AA compare to the NA trial.

EMGrms of ECR increased with time from 45.7 (SD 15.3) to 63.1 (SD 29.5) μV in AA and from 48.6 (SD 18.5) to 58.4 (SD 23.2) μV in NA, with no significant difference between AA and NA. However, the MMGrms of ECR tended to increase more in the AA trial (from 0.05 (SD 0.03) to 0.16 (SD 0.14) $m*s^{-2}$) during the contraction compared to the NA trial (from 0.04 (SD 0.02) to 0.08 (SD 0.06) $m*s^{-2}$). Increase in MMGrms has previously been shown simultaneously with a decreased twitch force [1]. In accordance with this, the pronounced time wise change in the ECR MMGrms of AA during the 10% MVC contraction in the present study may be interpreted as a decreased force output of the activated low-threshold motor units. In order to meet the same force level either an increased activation of the ECR or of some of the synergist muscles is necessary. In line with this, the ECU EMGrms of AA increased significantly from 51.6 (SD 19.5) to 68.8 (SD 18.3) μV while no change was seen with time for NA. For FLEX EMGrms no difference was found between AA and NA. These findings may support the *pain adaptation model* proposing a change in muscle activation due to pain [3]. The increased activation of ECU in AA was not a compensation for a larger antagonist activity. Rather, it may be considered to make up for the corresponding force deficit of the fatigued ECR muscle. A faster fatigue development of the AA was evidenced by the larger increase in perceived exertion.

CONCLUSIONS

The results indicate that the MMG activity in contrast to the EMG is modulated in the afflicted arm of patients with epicondylitis lateralis. MMG could possibly be useful as a non-invasive method to investigate changes in the neuromuscular system and may be developed to serve as a prediagnostic tool for objective identification of MSD.

REFERENCES

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