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Surface EMG of the lumbar part of the erector trunci muscle in patients with fibromyalgia

C. Anders[1], H. Sprott[2,3], H.-C. Scholle[1]

[1]Motor Research Group, Institute of Pathophysiology and [2]Department of Internal Medicine IV, University of Jena, Medical Center, Jena, Germany; [3]Department of Rheumatology and Institute of Physical Medicine, University Hospital Zürich, Switzerland.

Christoph Anders, MD; Haiko Sprott, MD; Hans-C. Scholle, PhD.

Please address correspondence to: Haiko Sprott, M.D., Center of Experimental Rheumatology, Department Rheumatology and Institute of Physical Medicine, University Hospital Zürich, Gloriastrasse 25, CH-8091 Zürich, Switzerland.
E-mail: haiko.sprott@ruz.usz.ch

Please address reprint requests to: Christoph Anders, MD, Institute of Pathophysiology, Motor Research Group, D-07740 Jena, Germany.
E-mail: cand@moto.uni-jena.de

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ABSTRACT

Objective

To determine differences supposed in EMG parameters of the erector trunci region between patients with fibromyalgia and healthy subjects during defined investigation situations.

Methods

During sitting and standing in upright position surface EMG (SEMG) from 15 subjects with fibromyalgia and 10 healthy controls was performed using a 16-channel technique where the electrodes were applied in a well-defined grid pattern (gain 5000, 3 db points at 5 Hz and 700 Hz respectively). SEMG quantification was done by Fourier algorithm using 512 measurement points for calculation.

Results

An increased EMG amplitude could be recorded during rest in fibromyalgia patients compared with controls. Spatial amplitude differences (frequency range 100 - 500 Hz) in the low back region were significantly ($p < 0.01$) decreased in the patients' group during sitting.

Conclusion

It is the first time that a decreased difference in EMG amplitude of different parts within a certain muscle could be proven in patients with fibromyalgia. As far as is known from the literature this result seems to be a unique finding in fibromyalgia patients.

Introduction

Fibromyalgia (FM) is a chronic disorder of unknown etiology which occurs mainly in middle-aged women. It is characterized by widespread musculoskeletal pain and fatigue (1). The question of whether pain, the most dominant manifestation in FM is caused by central or peripheral factors or a combination of both has not been answered so far (2-4). In addition to widespread musculoskeletal pain, patients with FM consistently display low pain threshold levels at specific anatomic areas, so-called tender points (5). The hypothesis that altered neuromuscular properties are at least in part responsible for the pain symptoms of these patients remains to be elucidated (6). The aim of this study was to investigate clinically distensed regions in the erector muscle in rest and during isometric muscle contraction conditions by a monopolar surface EMG (SEMG) technique (7) which allows a high spatial resolution of muscular activation processes.

Methods

Ten healthy female volunteers (mean age of 29.3 ± 6.1 years) and 15 female patients with FM according to the criteria defined by the American College of Rheumatology [ACR (1), mean age 44.3 ± 14.1 years, $p = 0.0145$] were included in the study.

The subjects were investigated while staying in five different positions: In the first the subject lay in prone position; in the second she sat on a stool with 90° bend at the knee joint; the third situation involved simply standing in an upright position; the fourth, flexing the trunk at an angle of 30° and the last was a 60° flexion of the trunk. SEMG investigation was performed using a 16-channel surface SEMG-technique. The electrodes were arranged in a grid pattern in the lumbar region (Fig. 1) of the back and connected monopolarly to a reference electrode that was located on the iliac crest (spina iliaca anterior superior). A biomap system (biovision, Wehrheim, Germany) was used for signal acquisition (gain 5000, 3db points at 5 Hz and 700 Hz respectively). Analog digital conversion was performed with a sampling rate of 1000/s. Stationary artifact-free signals excluding electrocardiogram interference's were used for data analysis. SEMG quantification was calculated by fourier algorithm using 512 measuring points. Different band power values were calculated (10-500 Hz, 10-100 Hz, and 100-500 Hz). Non-parametric Mann-Whitney test (SPSS®) was used to compare the groups. Means and standard deviations are given. The variance of SEMG amplitude is given as a variation coefficient.

Results

FM patients showed an increased SEMG amplitude during rest in the whole frequency range as compared to healthy controls ($p < 0.025$). The spatial

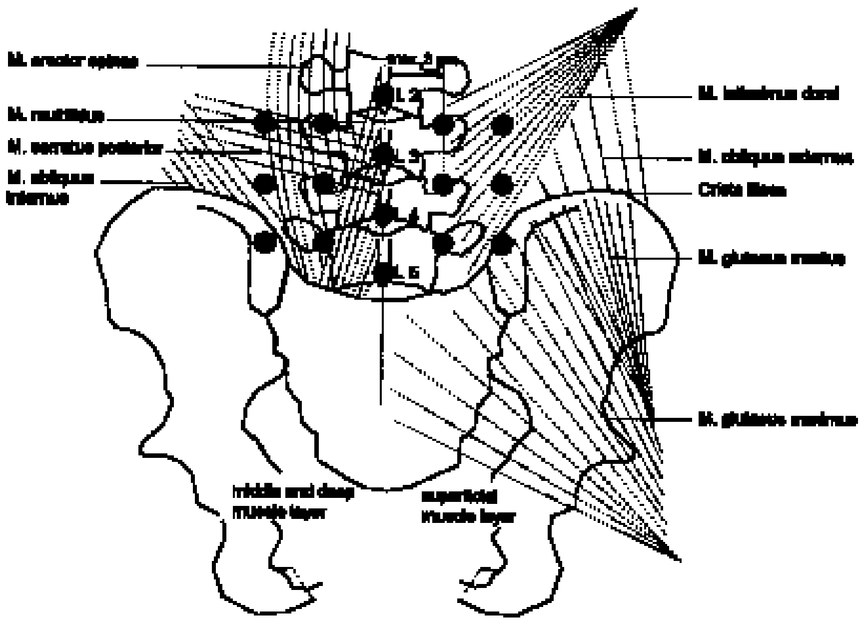

Fig. 1. Schematic superposition of EMG electrodes ( ) upon muscles of investigated area. L2 - L5 indicate the spinous processes of the lumbar vertebral bodies.

variance of SEMG amplitude (i.e., the intra-individual amplitude differences between all 16 electrodes of the grid) in the frequency range between 100 and 500 Hz was significantly decreased in the FM group ($p < 0.01$) (Fig. 2) during sitting. Similar to the results during rest, FM patients showed an increased SEMG amplitude during standing ($p < 0.025$).

Discussion

Tensed muscles can be observed clinically in FM patients, who often report persistent pain at these sites. There are no objective criteria or measurable parameters of muscular tension, in particular in FM patients. SEMG can provide useful information regarding a muscle's functional status. If properly applied the method gives reliable results (8, 9).

Previous studies failed to demonstrate differences between FM and healthy individuals (10-12). Because the erector muscle in the examined region is a tender point in FM and the back muscles are active the whole day through, they are of particular relevance. In our study, which for the mentioned reasons was particularly focussed on the lumbar muscles, we could show for the first time that there is an increased EMG amplitude at rest.

It is known from the literature that older people tend to show reduced SEMG amplitudes (13) during submaximal voluntary contraction conditions. Therefore, the observed increase of SEMG amplitude in the patient group cannot be attributed to age-related changes. Furthermore, a significantly decreased variance of EMG amplitude in FM patients if looking at spatial differences within the investigated region could be found. That means that FM patients in their lumbar region not only show increased muscle activation but also involvement of larger regions in this process. The applied high spatial measurement regime might be the reason for discrepancies to other studies.

In terms of muscle relaxation, this suggests that FM patients are not able to reach the "normal" baseline of healthy controls in rest and, of even greater note, they are not able to control spatial amplitude differences of their back muscles during sitting to "normal" ranges as seen in the controls. This disproportion could be a reason for the "vicious circle" tensed muscle - pain - tensed muscle in FM. Therefore, relaxation techniques could be a useful tool for minimizing pain in FM muscle.

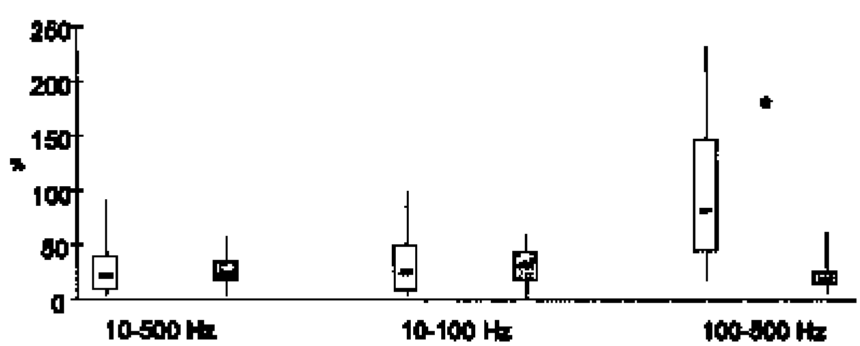

Fig. 2. Boxplots for variation coefficients of spatial amplitude variance for Fibromyalgia (grey) and healthy Controls (white) during sitting. Asterisk indicates the significant difference between both investigated groups.

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