Muscle performance in patients with fibromyalgia

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ABSTRACT

Introduction: Fibromyalgia (FMS) is a syndrome expressed by chronic widespread body pain which leads to reduced physical function and frequent use of healthcare services. This study was performed to examine the muscle performance comprising abdominal and lumbar muscle strength, and measurement of chest expansion in osteoporotic patients with FMS; to evaluate the relation between muscle performance, pain severity, clinical findings and physical activity; and to compare the results with the osteoporotic control group.

Methods: 44 osteoporotic women with FMS and 46 osteoporotic women who were physically inactive underwent measurements of three parameters: abdominal and lumbar muscle strength, and chest expansion. Student's t-test was used for statistical analysis.

Results: The strength of lumbar muscles and measurement of chest expansion were significantly decreased in the FMS patients as compared to the controls (p-value is less than 0.001). However, lumbar and abdominal muscles strength was low in both patients and controls.

Conclusion: Our results indicate that osteoporotic patients with FMS have impairment in strength of lumbar and abdominal muscles and in measurement of chest expansion. Further studies are needed to investigate the mechanism of reduced muscle performance and the effects of aerobic exercise in this patient group.

Keywords: chest expansion, fibromyalgia, muscle performance, osteoporosis

Singapore Med J 2006; 47(9):752-756

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INTRODUCTION

Fibromyalgia syndrome (FMS) manifests as diffuse axial plus upper- and lower-segment muscle pain with a duration of at least three months[1]. Tenderness to palpation is found to be specific to soft tissue sites[1]. It is one of the most commonly-diagnosed problems in outpatient clinics. Despite the large population suffering from this condition, the underlying pathophysiological mechanism remains unknown[2]. Whether peripheral or central mechanisms are involved remains to be debated. Most patients have chronic fatigue and disorders in pain perception[3], as well as sleep architecture disturbances[4]. These symptoms are often modulated by weather, physical activity and stress[5].

It has been recognised that patients with FMS are relatively deconditioned, compared with normal subjects. This finding could reflect an abnormal physiological limitation of muscular exercise capacity because of an impairment in the capacity and utilisation of oxygen[6]. Abnormalities in muscle microcirculation and energy metabolism have been reported[7,8]. Objective as well as functional muscle strength and endurance have been shown to be lower than healthy age-matched controls[9-10]. Impaired maximal isometric and isokinetic muscle performance have been found in several studies[11]. A reduction of maximal voluntary isometric and isokinetic strength in the quadriceps muscle has been reported in previous studies and was supposed to be the result of a primary muscle dysfunction[12].

The aim of this study was to examine the muscle performance comprising abdominal and lumbar muscle strength, and measurement of chest expansion in osteoporotic patients with FMS; to evaluate the relation between muscle performance, pain severity, clinical findings and physical activity; and to compare the results with the osteoporotic control group.

METHODS

The study group consisted of 44 postmenopausal osteoporotic women meeting the American College of Rheumatology criteria for FMS[1] and who attended the outpatient osteoporotic clinic. 46 postmenopausal osteoporotic women took part in the control group in the study. Those with previous diagnosis of traumatic, other inflammatory rheumatic, infective, endocrine and malignant diseases were excluded. A laboratory screening test included erythrocyte sedimentation rate, blood cell count, electrolyte levels, creatine level, alkaline phosphatase, creatine kinase level and thyroid hormones.

They were all treated with either non-steriodal anti-inflammatory drugs, paracetamol or low dosage tricylic antidepressants in various combinations. Height and weight were measured and body mass index (BMI) was calculated as an index of body fat in both patients and controls. Bone mineral densitometry (BMD) of the antero-posterior (AP) spine and femoral neck was measured with DEXA by using a Lunar DPX (GE Lunar Corporation, Madison, WI, USA) bone densitometer.

The chest expansion was measured with patients and the controls standing with their hands on the hips, and the tape measure was placed at the fourth intercostal space. Chest expansion was taken as the difference between full expiration and inspiration. The scores for three attempts were recorded, and the best of these three was taken as the index of chest expansion. In the tender point examination, patients underwent a standardised physical examination including an assessment of nine tender points on both sides of the body and control points (mid-forehead, 2/3 distal portion of dominant forearm and dominant thumbnail) using digital palpation, including the occiput, low cervical area, trapezius muscle supraspinatus muscle, second rib, lateral epicondyles, greater trochanter, gluteal and knee.

All of the points were algometrically measured by using Fischer's tissue compliance meter, which is a manually-operated mechanical device and can also be used as a pressure algometer(13). The apparatus has a force-pressure handle connected to a rubber disc and is calibrated in kg/cm^2. Pressure was increased at a rate of 1 kg/s, after it was vertically applied on the tender points. Subjects were asked to say "yes" when pain was experienced. The sum of pain threshold of 21 points (18 tender points and three control points) were calculated as total myalgic score (TMS in kg/cm^2). Pain threshold was tested with algometer (kg/cm^2) at the tender points.

Fibromyalgia impact questionnaire (FIQ) is a brief ten-item self-administered instrument designed to evaluate physical functioning ability(14). Each item is standardised on a scale ranging from zero to ten. Function is assessed using ten questions on daily activities (DAS), and it also includes six visual analogue scales (VAS) for pain (range 0 [no pain] - 10 [worst possible pain]), fatigue, fatigue in the morning, stiffness, anxiety and depression. A high score indicates a severe effect on DAS.

The dynamic strength of abdominal and back muscles was assessed(15,16). Dynamic strength of abdominal muscles was measured by the curl-up test, in which the subject lay supine with knees at an angle of 90º. The performance was classified into five grades according to position of the different parts of the back from the table (grade 0 - nil, grade 1 - trace, grade 2 - poor, grade 3 - fair, grade 4 - good, and grade 5 - normal). The dynamic strength of the back muscle was measured by a test in which the subject lay prone. The performance was classified into five grades according to position of holding the upper body and head horizontal (grade 0 - nil, grade 1 - trace, grade 2 - poor, grade 3 - fair, grade 4 - good, and grade 5 - normal).

Informed consent was obtained for all participants. The protocol was reviewed by the local ethics committee. All statistical calculations were performed on the Statsitical Package for Social Sciences (SPSS) version 11.5 for Windows (Chicago, IL, USA). Results were expressed as mean ± standard deviation (SD). The data were mainly normally distributed. Differences in the variables between study and control groups were determined by two-tailed Student's t-test. Pearson product moment correlation coefficients were calculated to examine the relationship between variables.

RESULTS

The mean age of the FMS patients and the controls were 62.2 ± 5.4 years and 59.3 ± 7.6 years, respectively. The demographical data of the patients and controls is shown in Table I. The patients had generalised pain for a mean of 7.5 ± 1.5 years. The measurements of abdominal and lumbar muscle strength are shown in Table II. Abdominal strength was determined as follows: seven were in grade three, 28 were in grade two, and nine were in grade one. In back strength evaluation, three patients were found to be in grade four, three were in grade two, 35 were in grade two, and three were in grade one.

The mean VAS score was 4.7 ± 3.5 in patients and 5.0 ± 2.9 in control group. The mean DAS was 12.8 ± 5.3 in patients and 12.7 ± 5.2 in controls. The mean number of tender points for patients and controls were 14.3 ± 2.7 and 3.9 ± 2.8, and the mean TMS was 67.2 ± 12.0 kg/cm^2 in patients and 93.4 ± 5.8 kg/cm^2 in controls, respectively. The mean measurement of chest expansion was 1.8 ± 0.7 cm in patients with FMS and 3.3 ± 1.1 cm in controls. There was no

Table I. Characteristics of patients and controls.

	Patients (n=44)	Controls (n=46)	p-value
Age (years) (mean ± SD)	62.2 ± 5.4	59.3 ± 7.6	<0.038
Women/men	44/0	46/0	
Married/single	38/6	33/13	
BMI (kg/cm²) (mean ± SD)	29.9 ± 2.8	29.0	0.148
Duration of symptoms (years) (mean ± SD)	7.5 ± 1.5		
Lumbar t-value (mean ± SD)	-2.2 ± 1.3	-1.6 ± 1.5	<0.045
Femur neck t-value (mean ± SD)	-1.6 ± 1.4	-1.2 ± 1.0	0.219

Table II. Strength of abdominal and lumbar muscles.

(mean ± SD)	Grade 0 P/C	Grade 1 P/C	Grade 2 P/C	Grade 3 P/C	Grade 4 P/C	Grade 5 P/C
Strength of abdominal muscles	0/0	9/7	28/34	7/3	0/2	0/0
Strength of lumbar muscles	0/0	3/0	35/21	3/17	3/6	0/2

P: patients; C: controls

Table III. Comparison of parameters in patients with FMS and controls.

(mean ± SD)	Patients (n=44)	Controls (n=46)	p-value
Visual analogue scale (range 1-10)	4.7 ± 3.5	5.0 ± 2.9	0.638
Daily activities	12.8 ± 5.3	12.7 ± 5.2	0.789
Number of tender points	14.3 ± 2.7	3.9 ± 2.8	<0.0001
Total myalgic score (kg/cm²)	67.2 ± 12.0	93.4 ± 5.8	<0.0001
Chest expansion (cm)	1.8 ± 0.7	3.3 ± 1.1	<0.0001
Abdominal muscles strength (grades 0-5)	1.9 ± 0.6	2.0 ± 0.6	0.729
Lumbar muscles strength (grades 0-5)	2.1 ± 0.6	2.8 ± 0.8	<0.0001

Table IV. Correlation of clinical findings between chest expansion, and abdominal and lumbar muscles in patients with FMS.

	Abdominal muscle strength, r	Lumbar muscle strength, r	Chest expansion, r
Visual analogue scale	-0.180*	0.053*	0.059*
Daily activities	-0.319***	-0.500***	NS
Number of tender points	-0.102*	-0.182*	-0.337**
Total myalgic score	-0.420***	-0.139*	-0.172*

p>0.05*, p<0.05**, p<0.01***

Table V. Correlation of chest expansion between abdominal and lumbar muscles in patients with FMS.

	Abdominal muscle strength, r	Lumbar muscle strength, r
Chest expansion	-0.139*	0.165*

*p>0.05

significant difference between groups concerning VAS, DAS, and abdominal muscle strength ($p>0.05$), while there was significant difference between the groups for the number of tender points, TMS, lumbar muscle strength and chest expansion ($p<0.0001$) (Table III).

There was a negative correlation between DAS and the strength of abdominal ($r=-0.319$, $p<0.05$) and lumbar ($r=-0.500$, $p<0.001$) muscles. The number of tender points correlated negatively with chest expansion ($r=-0.337$, $p<0.05$) and TMS correlated negatively with the abdominal muscle strength ($r=-0.420$, $p<0.01$) (Table IV). There was no correlation between the chest expansion and the strength of abdominal and lumbar muscles ($p>0.05$) (Table V).

DISCUSSION

The strength of abdominal and lumbar muscles in patients with FMS was found to be lower than that in controls. However, the strength of the muscles was impaired in both patients and controls. As reported, patients with FMS have a lower maximum voluntary contraction than would be expected[17]. Jacobsen et al[17] showed that fibromyalgia patients have a lower isokinetic and isometric maximum voluntary muscle strength than expected. They suggested that FMS patients with a large number of tender points had a significant reduction in isokinetic knee extension peak torque. This was found in a larger proportion among patients with FMS than among healthy controls. Some of the mechanisms for such reduced muscle function in FMS may be lack of motivation, pain effect with negative feedback on motor unit recruitment, and/or peripheral neurogenic affection[17]. Peripheral abnormalities have also been observed in the neuromuscular system in FMS, such as abnormal muscle biopsy findings, maldistribution of oxygenation and reduced muscle content of high energy phosphates[18-20].

In our study, we found that TMS correlated negatively with the strength of abdominal muscles. Some studies have described decreased voluntary muscle strength[21], while no differences in muscle strength between patients with FMS and healthy subjects were found in others[22]. Simms et al did not find a difference in strength in the trapezius and anterior tibial muscles between patients with FMS and sedentary controls as well[23]. We found an impaired muscle function in the FMS patients and a generalised deconditioning, which might be due to fatigue, muscle damage, or psychological factors, rather than pain. Strenuous heavy resistance loading led to considerable acute muscle fatigue in both patients and healthy control groups, as shown by the remarkable acute decrease in maximal strength and maximal rate of rise of force development of the loaded muscles. Furthermore, this decrease in maximal strength characteristics took place gradually during the course of the loading session and to the same extent in both groups[22].

Jacobson et al found no correlation between strength and level of physical activity in patients with FMS, but a correlation was found between muscle strength and physical activity (daily activity) in our study[5]. Considerable difficulties to perform daily activities were reported by patients in FMS group[24]. Our study showed that the impact of chronic muscular pain on daily activities is substantial and that reduced muscular strength could contribute to decreased work capacity. Patients with FMS had lower measurement of chest expansion than the controls, and this was significant. Recently, it has been suggested that patients with FMS have reduced chest expansion with respect to healthy subjects and reduced chest expansion may be related with reduced maximum respiratory pressure, which may indicate decreased pulmonary muscle strength[25]. However, it is worth to follow-up these data in a wider and more controlled study with pulmonary function tests, maximal inspiratory and expiratory pressures, and other tests[26].

Norregaard et al[27] found a low degree of effort in patients with FMS. They suggested that exercise-induced pain and fatigue could partly be explained by an altered neuro-humoral reactivity. Backman et al found that the maximal voluntary contraction force of the muscle was lower and the relaxion rate was slower in FMS patients as compared to controls. They suggested that an increased sympathetic activity may result in these changes[28]. Lindh et al also suggested that the reduced voluntary maximal performance of muscle may be related to an impaired control mechanism at a supraspinal level[29]. Bennett et al similarly found that the majority of women with FMS are aerobically unfit and because of poor sleep, they reduce their level of physical activity, which in turn lead to a progressive detraining effect. This may subsequently result in pain and fatigue[30]. Although the exact mechanism of reduced pulmonary muscle strength is unknown, we can explain the reduced maximum respiratory pressure and endurance with low physical performance and reduced exercise capacity in patients with FMS. Patients with FMS are also ambulatory, but incapable of demanding physical exercise, and hence did not stress their respiratory system[31].

We found that patients with FMS have reduced maximum voluntary muscle strength and that pain inhibition on a conscious level or reflex mediated may be partly responsible for this finding[17]. The drawings from the FMS patients showed pain in many sites in both the upper and lower parts of the body. However, in our study, muscle performance in patients with FMS was not significantly correlated with VAS pain scores. Our results indicate that osteoporotic patients with FMS have impairment in strength of lumbar and abdominal muscles and in measurement of chest expansion. Further studies are needed to investigate the mechanism of reduced muscle performance and the effects of aerobic exercise in this group of patients.

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