

Original Article

## A comparison of visual analog scale and shear-wave ultrasound elastography data in fibromyalgia patients and the normal population

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**Abstract.** [Purpose] The aim of this study was to compare Visual Analog Scale (VAS) values with the Shear Wave Elastography (SWE) values of rhomboid major muscles in fibromyalgia (FM) patients with those of a normal healthy population. [Participants and Methods] Evaluation was made of 53 female patients diagnosed with FM according to the American Collage of Rheumatology criteria, and a control group of 47 healthy volunteers with a VAS score of 0. All the patients were applied with ultrasonography. The severity of pain was measured using a VAS. [Results] Mean age was calculated as 39 years (range, 23–60 years) in the patient group and 37 years (range, 21–58 years) in the control group. The mean SWE value of the rhomboid major muscle of the patients was 4.74 m/sn and 70.21 kPa on the right side and 4.46 m/sn and 58.78 kPa on the left side. In the control group, these values were 4.18m/sn and 55.03 kPa on the right side and 3.78 m/sn and 44.21 kPa on the left side. The mean VAS score of the patients was 7.3. [Conclusion] The use of SWE values could be more objective than the subjective parameter of the VAS score in the evaluation of the severity of pain in fibromyalgia.

**Key words:** Fibromialgia, Shear wave elastography, Rhomboid muscle

(This article was submitted Aug. 4, 2020, and was accepted Oct. 11, 2020)

### INTRODUCTION

Fibromyalgia (FM) is a complex chronic pain syndrome, for which the etiology is not fully known. It mostly affects females and the prevalence in the young female population has been reported as 2.4–6.8%<sup>1)</sup>. Somatic symptoms such as pain, fatigue and numbness, cognitive disorders, sleep disorders and psychiatric comorbidities such as psychological stress and mood disorders are seen at high rates in FM patients<sup>2–4)</sup>. Pain in FM is often characterised as chronic, widespread musculoskeletal system pain, showing symmetric distribution with painful sensitive points<sup>5)</sup>.

The Visual Analog Scale (VAS) was developed to transform values which cannot be measured numerically to a numerical form. The patient is instructed to mark the severity of pain on a line marked at one end as 0=no pain to 10=intolerable pain, thereby providing the level of pain in a numerical form<sup>6)</sup>.

Ultrasonography (US) is a simple, cost-effective examination method, which does not contain radiation and can be rapidly applied<sup>7, 8)</sup>. US provides a rapid and reliable diagnosis of several musculoskeletal system lesions. As US and shear-wave elastography (SWE) examination can be applied easily and rapidly, does not contain radiation, and is low cost, it has become the preferred method for musculoskeletal lesions<sup>9)</sup>. Muscles are one of the structures examined with this method. In the SWE method, low-frequency shear-wave waves are received from tissues, by sending ultrasound-focussed mechanical vibrations to the tissues. These waves are received at different speeds within the tissues which have different elasticity. SWE examination is based on measuring these speeds to reveal the differences in elasticity of the tissues.

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The aim of this study was to compare VAS values with the SWE values of rhomboid major muscles in FM patients with those of a normal healthy population. Thus it was aimed to examine whether or not there was an association between the objectivity of VAS values and elasticity. It was also examined whether or not there was any change in the elasticity of muscles other than the trigger points in the periscapular area, as the area of chronic back pain most described in FM patients.

## PARTICIPANTS AND METHODS

The study included 53 female patients who presented at the Physical Therapy and Rehabilitation Polyclinic of our hospital and were diagnosed with fibromyalgia and 47 healthy female volunteers for control group. Patients were excluded from the study if they had diabetes, cancer, a major psychological disorder, were obese, pregnant, smoked or drank alcohol. Approval for the study was granted by the Local Ethics Committee (no: 74059997-050.04.04-E.2441). Informed consent was obtained from all the patients.

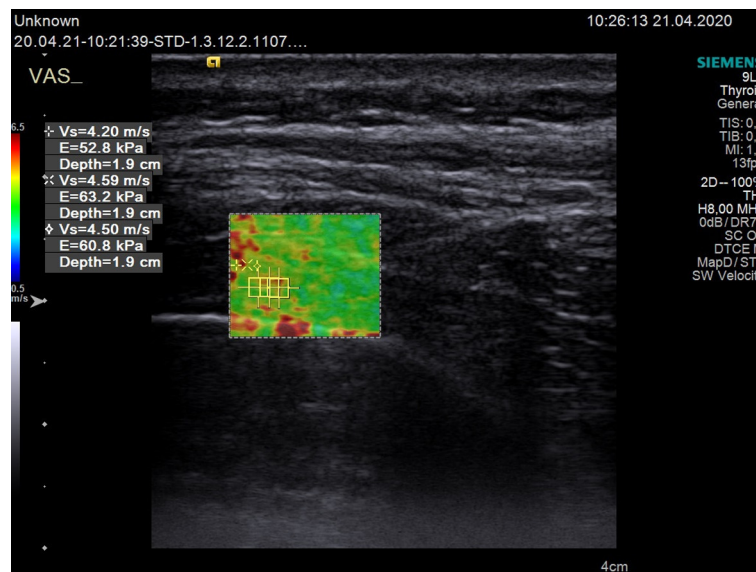
All the patients diagnosed with FMS according to the ACR criteria<sup>10</sup>) were applied with ultrasonography using an ACUSON S3000 Ultrasound System device (Siemens Medical Solution, Mountain View, CA, USA). With the patient lying prone, after visualisation of both rhomboid major muscles in the longitudinal position, the elastography examination was made with the Virtual Touch IQ method (Sieman Medical Solutions) using a 9L4 probe with shear-wave elastography properties. The SWE examinations were made by a single radiologist with 10 years of experience in the field. In the elastography examination, the speed measurements were taken using 3 square 1.5 mm regions of interest (ROI) placed next to each other on the best visualised area of the muscle (Figs. 1, 2). The average of these 3 speed measurements was calculated and used in the statistical analysis.

The severity of pain was measured using a Visual Analog Scale (VAS). Each patient was instructed to mark the severity of pain felt in the last week on a 10 cm ruler. The VAS value was calculated as the measurement from 0–10 and used to evaluate the level of pain. The patients were separated into 2 groups according to the VAS score, as 1–5 and 6–10. The mean SWE speed measurement values were compared with the VAS scores as a whole group of 1–10, and as the two subgroups.

Data obtained in the study were analysed statistically using IBM SPSS vn. 20.0 software (SPSS Inc., Chicago, IL, USA). Conformity of the data to normal distribution was assessed with the Shapiro Wilk W-test when sample size was <50, and with the Kolmogorov-Smirnov test when sample size was ≥50. In the comparisons between two independent groups, the Independent Samples t-test was used if normal distribution conditions were met, otherwise, the Mann Whitney U-test was applied. In the comparison of two continuous variables, Pearson correlation was used when normal distribution was met, otherwise, the Spearman Correlation test was applied. A value of  $p < 0.05$  was accepted as statistically significant.

## RESULTS

Evaluation was made of 53 female patients diagnosed with FM according to the ACR criteria, and a control group of 47 healthy volunteers with a VAS score of 0. The sociodemographic characteristics of the patient and control groups were similar. Mean age was calculated as 39 years (range, 23–60 years) in the patient group and 37 years (range, 21–58 years) in the control group.



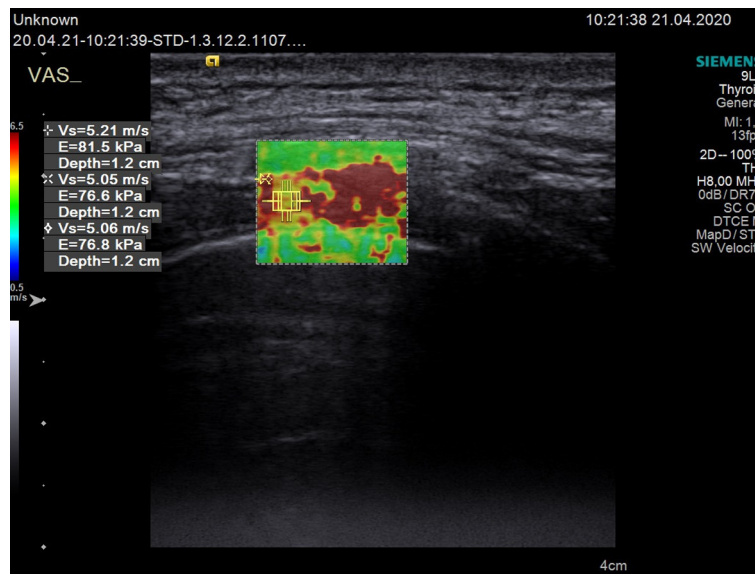
**Fig. 1.** Shear wave elastography image of the rhomboid major muscle of the control group. Areas with less tissue stiffness appear green.

The mean SWE value of the rhomboid major muscle of the patients was 4.74 m/sn (min 2.92 max 7.57) and 70.21 kPa (min 14.70 max 77.77) on the right side and 4.46 m/sn (min 2.20 max 4.41) and 58.78 kPa (min 14.67 max 58.50) on the left side. In the control group, these values were 4.18m/sn (min 2.62 max 6.30) and 55.03 kPa (min 20.53 max 118.97) on the right side and 3.78 m/sn (min 2.77 max 6.01), and 44.21 kPa (min 14.67 max 58.50) on the left side. The differences between the patients and the control group in respect of the right and left side rhomboid muscle mean values were determined to be statistically significant ( $p<0.05$ ) (Table 1).

The mean VAS score of the patients was 7.3 (min: 3, max: 10). All the control group subjects had a VAS score of 0. In the comparison of the SWE values and VAS scores of the patients, no statistical significance was determined.

## DISCUSSION

In the quantitative evaluation of pain in fibromyalgia, which is a chronic myofascial pain syndrome, the VAS score is a widely used method<sup>6</sup>). However, as this method is only based on personal statement, and the pain threshold may vary from person to person, it is not an objective criterion. In this study, no significant relationship was determined between the VAS scores and the SWE values. In addition to not being an objective parameter, VAS can also be considered to be affected by secondary benefits such as the interest and love shown to the individuals by society and those in their immediate environment. There are studies in literature, similar to the current study, which have not determined a relationship between SWE speed measurements and VAS, functional status and quality of life scores<sup>11</sup>).



**Fig. 2.** Shear wave elastography image of the rhomboid major muscle belonging to the patient group. Areas with high tissue stiffness appear to be red.

**Table 1.** Comparison of mean elastography values of the patient and control groups

		Group statistics			
	Group	N	Mean	Standard Deviation	Standard Error Mean
RrhomortV	Patient	53	4.7494	0.84159	0.11560
	Control	46	4.1881	0.89482	0.13193
RrhomortE	Patient	53	70.2157	24.95830	3.42829
	Control	46	55.0370	23.95982	3.53268
LrhomortV	Patient	53	4.6645	2.68531	0.36886
	Control	46	3.7818	0.65054	0.09592
LrhomortE	Patient	53	58.7818	22.07642	3.03243
	Control	46	44.2188	16.61295	2.44945

RrhomortV: Right Rhomboid major muscle average speed in meters / second; RrhomortE: Right Rhomboid major muscle mean velocity in kilopascals; LrhomortV: Left Rhombod major muscle average speed in meters / second; LrhomortE: Leftt Rhomboid major muscle mean velocity in kilopascals.

Elasticity is the ability of tissue to reform and return to previous dimensions when it has been deformed by force and that force is removed. Due to their superficial localisation, skeletal muscles are extremely suitable structures for SWE, which measures the hardness of tissues in a quantitative and reliable way. From a scan of literature, no study could be found in which evaluation of the rhomboid muscles has been made with SWE in FM patients. Muscles are frequently affected structures in FM, which is a chronic pain syndrome, and the higher measurements of SWE speeds obtained in the current study patient group compared to the control group were thought to be related to spasticity in the muscles.

With the quantitative and reliable direct measurement of the tissue stiffness of this spasticity in the muscles provided by SWE, the tissues can be compared with each other and with adjacent organs, and changes over time in the tissues can be observed<sup>12, 13</sup>. The hardness of the tissues is proportional to the speed values measured on SWE, and the hardness of the tissue can be seen as the speed of the sound in the tissue, which is recorded as kilopascal or m/sn. As the hardness of muscles increases, so the speed values increase<sup>14</sup>. Previous studies have reported that SWE speed measurements have both inter and intra-observer reliability<sup>15, 16</sup>.

Although there are studies in literature that have been conducted with SWE directed at trigger points in FM, there is no study that has applied SWE to the rhomboid major muscle in FM. In a study by Ballyns et al., the tissue elasticity of trigger points and normal tissue was compared with the SWE method, and the SWE speed values in the trigger points were found to be higher than those of normal tissue<sup>17</sup>. Muro et al. investigated the morphology of trigger points in FM patients, blood flow and tissue hardness using B-mode ultrasonography, Doppler ultrasonography and elastography and compared these values with a healthy control group. In contrast to the previous study, no statistically significant difference was determined between the data obtained with these techniques in the trigger points and the control group. While the previous study reported that the elastography method with B-mode could be used in the diagnosis of trigger points, it was concluded that these methods remain insufficient for the differentiation of sensitive points<sup>18</sup>.

In a study by Guo et al., the SWE speed values were measured as  $3.70 \pm 1.53$  m/sn in a patient group with myofascial pain syndrome and  $1.60 \pm 0.72$  m/sn in the healthy control group. Following treatment, the speed values in the patient group were measured as  $2.40 \pm 0.87$ . Based on these results, Guo et al. suggested that SWE could be used in the evaluation of treatment efficacy<sup>19</sup>. In an initial study by Maher et al., a decrease was determined in the SWE speed of tissue which can be palpated following dry needling applied to myofascial trigger points, and it was suggested that SWE could be a sensitive method following treatment<sup>20</sup>.

The limitation of our study was that the number of patients was relatively low.

In conclusion, it can be considered that the use of SWE values could be more objective than the subjective parameter of the VAS score in the evaluation of the severity of pain in fibromyalgia. Furthermore, with the determination of cut-off values for SWE examination of the rhomboid major muscle in studies with larger populations, this method could be used in diagnosis.

### *Funding*

The authors received no financial support for the research and/or authorship of this article.

### *Conflict of interest*

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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