Journal of Recent Advances in Medicine

JRAM
Journal of Recent Advances in Medicine
مجلة التطورات الحديثة في الطب
Print ISSN 2636-252X - Online ISSN 2636-2538

Original Article

Spinal accessory nerve entrapment as a cause of myofascial pain syndrome (integrated nerve conduction and neuromuscular ultrasound study)

Rheumatology

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ABSTRACT

Background: Cervical myofascial pain syndrome (MPS) is a common clinical complaint in the daily practice of musculoskeletal physicians. Its prevalence of 21% in the general population. MPS is the major reason of chronic regional pain, such as pain of shoulder, back and facial pain

Objective: To identify neuropathy of the spinal accessory nerve in MPS patients clinically and by integrated nerve conduction and neuromuscular ultrasound studies.

Methodology: This cross sectional study enrolled 60 cases with unilateral chronic MPS, all cases were investigated for history, underwent clinical checkup (general and local), assessment of the pain intensity by numerical rating scale (NRS), Nerve Conduction Study (NCS) and ultrasonographic measurement of the cross sectional area (CSA) of the Spinal Accessory Nerve (SAN) in both symptomatic and asymptomatic healthy side for comparison.

Results: NCS revealed presence of SAN neuropathy in 23.3% of MPS side. All of them (100%) showed demyelinating lesion, while 4 patients (28.5%) showed mixed type of neuropathy. There was highly considerable higher mean of distal latency on the affected side which was 3.46±1.27 ms compared to the healthy side which was 2.77±0.99 ms, ($p<0.001$). Also, a highly significant lower mean of motor amplitude on the affected side which was 6.34±2.14 mv, compared to the healthy side which was 7.31±2.38 mv, ($p<0.001$). As for ultrasonographic assessment, the mean of CSA of the SAN on the affected side was 7.30±1.51 mm² compared to the healthy side which was 4.67±0.96 mm², with highly statistically significant difference, ($p<0.001$).

Conclusion: Spinal accessory neuropathy is significantly increased in MPS patients, NCS and neuromuscular ultrasonography could lead to more reliable diagnosis.

JRAM 2024; 5 (1): 76-82

Keywords: Cross sectional area (CSA); Myofascial pain syndrome (MPS); Spinal accessory nerve (SAN).

Submission Date: 4 June 2024 **Acceptance Date:** 20 July 2024

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Please cite this article as: Hussien NA, Mohamed MS, Elazeb SA, Abed El-Rhiem MMA. Spinal accessory nerve entrapment as a cause of myofascial pain syndrome (integrated nerve conduction and neuromuscular ultrasound study). JRAM 2024; 5 (1): 76-82. DOI: 10.21608/jram.2024.293913.1251

INTRODUCTION

Chronic regional musculoskeletal pain, accompanied by sensory, motor, and autonomic abnormalities, is frequently caused by myofascial pain syndrome (MPS). Myofascial trigger points (MTrPs), which are palpable, hyperirritable bands or nodules, are what define it. Myofascial pain in a skeletal muscle linked to muscular spasm is caused by the contractile activity of myofascial trigger points and nociceptor stimulation in response to pathogenic processes in the muscle fascial layer [1]. It usually affects the muscles in the neck and shoulder girdle. Repetitive microtrauma and overuse injuries may be the cause [2]. The trapezius muscle helps move the neck and is crucial for keeping an upright posture. It plays a significant role in maintaining the scapular stabilizer and scapulothoracic rhythm [3]. As a result, this muscle is always engaged in prolonged contraction, which may aid in the development of trapezius MPS [4]. The eleventh cranial nerve is the spinal accessory nerve (SAN), that provides deep sensory innervation for proprioceptive sensation to the sternocleidomastoid and trapezius muscles in addition to motor nerve supply. This is due to the cervical plexus's contribution [5]. The symptoms of spinal accessory neuropathy include winging of the scapula, sternocleidomastoid and trapezius muscles atrophy, and dull excruciating pain [6]. Electrophysiologic test assesses the peripheral electrophysiological alterations in the peripheral nerves [7]. Neuromuscular ultrasound has recently become attractive approach to electrodiagnostic study in the evaluation of peripheral nervous system disorders [8]. The aim of the work was to assess neuropathy of the spinal accessory nerve in MPS patients by integrated nerve conduction and neuromuscular ultrasound studies.

PATIENTS AND METHODS

- **Study design:**

The design is cross sectional study.

- **Subjects:**

This study included sixty patients presented with unilateral chronic MPS. They were recruited from Rheumatology and Rehabilitation Department at Al Zahraa University hospital, Al Azhar University. They were 8 (13.33%) males and 52 (86.66%) females, their ages ranged between 16 and 58 years, with disease duration ranged from 1 to 10 years with a mean of 2.43±1.79 years.

- **Ethical considerations**

A written consent was provided by all participants after explaining the work procedures. A prior approval from the Medical Ethics committee of Al-Azhar University was also obtained.

- **Inclusion criteria**

MPS diagnosis was based on Travell and Simons, 2011 criteria [9]. Five major and one minor requirements had to be fulfilled. A perceptible taut band, focal tenderness at a single site or nodule within the taut band, presence of a degree of restricted range of motion, presence of a regional pain complaint, and pain pattern that matches a recognized distribution of muscular referred pain are the main criteria. A local muscle twitch response is elicited by snapping palpation of the taut band at the major trigger points (MTrP), which is one of the minor criteria. Pain can be reduced or eliminated by muscle treatment, such as stretching or injecting the MTrP, or by physiotherapy.

- **Exclusion criteria**

Patients with previous cervical spine fracture or neck surgery, pregnant females, malignancies, renal failure, hepatic failure, neck myelopathy or radiculopathy, cognitive impairment, psychological illness, smoking or alcohol consumption and those on medications (contraceptive pills, drugs causing polyneuropathy or causing edema as steroids) or any other cause of polyneuropathy.

- **Methods**

All participants were subjected to; history taking, involving disease duration and the predisposing determinants for MPS. Clinical checkup was done including neurological and musculoskeletal checkup. Pain severity was assessed by Numeric Rating Scale (NRS); it is a segmented numeric version of visual analogue scale (VAS) [10]. Subjects were asked to choose an integer number representing their level of discomfort, ranging from 0 (no pain) to 10 (the worst). The myofascial trigger points (MTrPs) were determined by pain presence when firm pressure was applied over the trigger points perpendicular to the trapezius muscle harder than normal [11]. If local sensitivity accompanied spontaneous pain, it was deemed to be active MTrP. If there was only localized soreness and no spontaneous pain, latent MTrP was taken into consideration [12]. Ultrasonographic measurement of CSA and motor conduction study of SAN on the affected side and normal side for comparison. Ultrasonographic examination of all patients using **(**Xario 200, Toshiba ultrasound machine Japan) and ultrasonographic apparatus adjusted at 7-11 MHz. While electrophysiological study was conducted on Neuro - EMG Micro electroneuromygraphy (EMG) apparatus, Japan at fixed room temperature of 25°C during the examination

Statistical analysis

When comparing between related sample we used Paired sample t-test of significance. When comparison between two periods for non-parametric data we used Wilcoxon Signed-Rank Sum test. If one or both of the variables were skewed, Spearman's rank correlation coefficient (r) has been utilized for evaluating the degree of association between them. The value of "rs" varies between-1 and1; 0 = no linear correlation, 1= perfect positive correlation, -1 = perfect negative correlation. Positive correlation means when the independent variable rises, so does the dependent variable. Negative correlation means when the dependent variable decreases as the independent variable increases. Scatter plot is a graph where in two variables ‘values are plotted on two axes, with the pattern of the obtained points referring a correlation. The accepted marginal error was set to 5%. So, the p-value was considered significant at: P-value <0.05; significant

RESULTS

Regarding Clinical examination of MPS cases it revealed the following: there were 12 patients had left side MPS and 48 patients had right side MPS., all patients (100%) had regional pain,12 patients (20%) had referred dorsal back pain, 20 patients (33.3%) had referred neck pain, 16 patients (26.7%) had referred shoulder pain and 6 patients (20%) had referred upper arm pain. Also all patients (100%) had positive palpable taut bands and trigger points. Regarding the type of trigger points, 24 patients (40%) had active and 36 patients (60%) had latent trigger points. Regarding the minor criteria, there was positive snapping palpation at myofascial trigger points (MTrP) that produce twitch response in 22 patients (36.7%) and 38 patients (63.3%) had pain that decreased with treatment or physiotherapy. The mean of pain severity was 9.50±0.86 and ranged from 8 to 10.

Regarding the nerve conduction study (NCS) results of the SAN, a total of 14 patients 23.3% revealed SAN neuropathy. There were 12 patients (20%) had left side MPS, 4 of them had demyelination type of neuropathy, 2 patients had mixed type and 6 patients were normal, while 48 patients (80%) had Rt side MPS, 6 of them had demyelination type, 2 patients had a mixed type neuropathy and 40 patients showed normal NCS results. There was highly considerable higher mean value of distal latency on the affected side which was 3.46±1.27 ms compared to the healthy side which was 2.77±0.99 ms, (p<0.001). Also, a highly significant lower mean of motor amplitude on the affected side which was 6.34±2.14 mv, compared to the healthy side which was 7.31±2.38 mv, (p<0.001), table (1) and figure (1).

As for ultrasound CSA, there was an increase of CSA of the SAN on the affected side in all patients (100%) with significant increased mean value of CSA on the affected side which was 7.30±1.51 mm² compared to the healthy side which was 4.67±0.96 mm², (p<0.001), table (2) and figure2(a, b).

There was potential positive relation between disease duration and distal latency (ms) of the SAN, (p<0.05); figure (3). while there was insignificant relation with amplitude and ultrasound CSA, (p>0.05), A significant positive correlation was found between NRS and distal latency of the SAN, figure (4). Also a potential positive association between NRS and CSA of the SAN was found (p<0.05), figure (5).

Table (1): Comparison between the spinal accessory nerve on the affected side and healthy side regarding nerve conduction study parameters

Nerve conduction study parameters of spinal accessory nerve	Affected side n = 60	Healthy side n = 60	Paired sample t-test		
			MD±SD	t-test	p-value
Distal latency (ms)					
Range	2.1-6.3	1.2-4	0.69±0.17	3.967	<0.001*
Mean ±S	3.46±1.27	2.77±0.99			
Amplitude "mv"					
Range	2.6-11	2.5-12	-0.97±0.19	-5.067	<0.001*
Mean ±SD	6.34±2.14	7.31±2.38			

SD: Standard deviation, *: Significant p-value (<0.005).

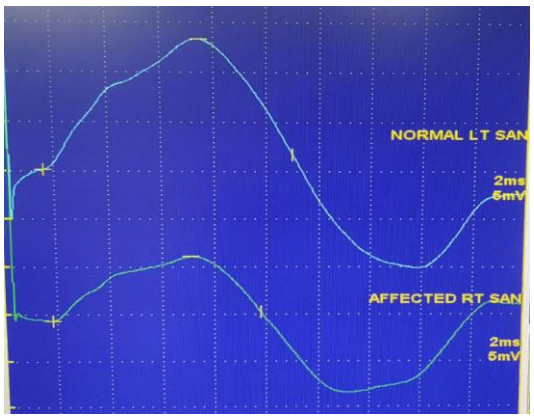
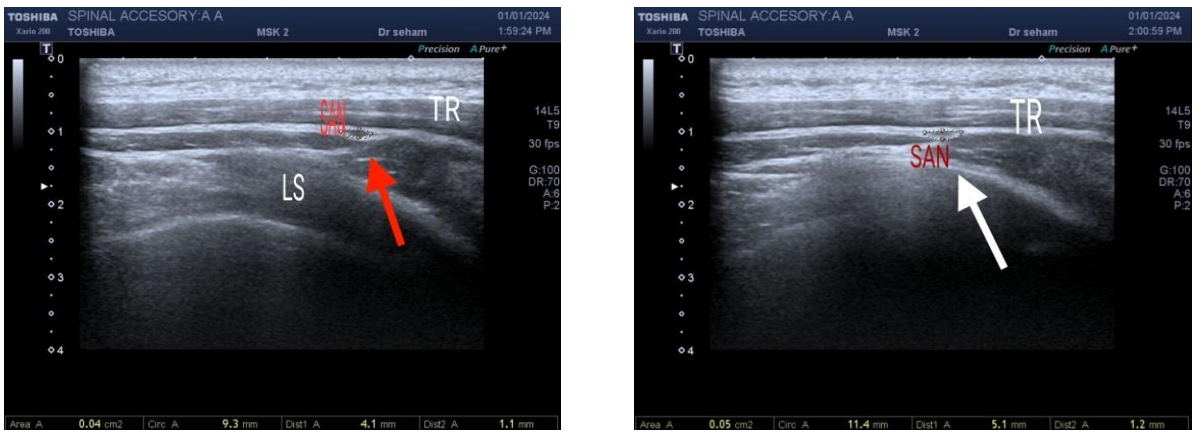


Figure (1): Nerve conduction study of the normal and affected spinal accessory nerve

Table (2): Comparison between ultrasound cross-sectional area of the spinal accessory nerve on the affected and healthy sides

Cross-sectional area of spinal accessory nerve " mm²"	CSA of the affected side n = 60	CSA of the healthy side n = 60	Paired Sample t-test		
			Mean ±SD	t-test	p-value
Range	4-10	2-6	2.63±0.18	14.432	<0.001*
Mean ±SD	7.30±1.51	4.67±0.96			

CSA: Cross-sectional area, SD: Standard deviation, *: Significant p-value (<0.005).



(a). **(b).**

Figure (2): a) Ultrasound image of the trapizus muscle (TR), levator scapulae (LS) muscle (red arrow), and spinal accessory nerve (SAN) on the healthy side. (b) Ultrasound image showing spinal accessory nerve (SAN) (white arrow) on the affected side of the same patient.

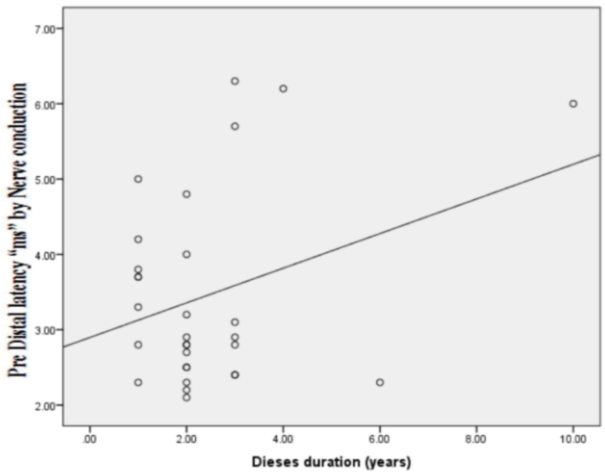


Figure (3): Scatter plot between disease duration (years) and distal latency (ms) of the SAN on the affected side r =0.424. r: Pearson's correlation coefficient, SAN: Spinal accessory nerve.

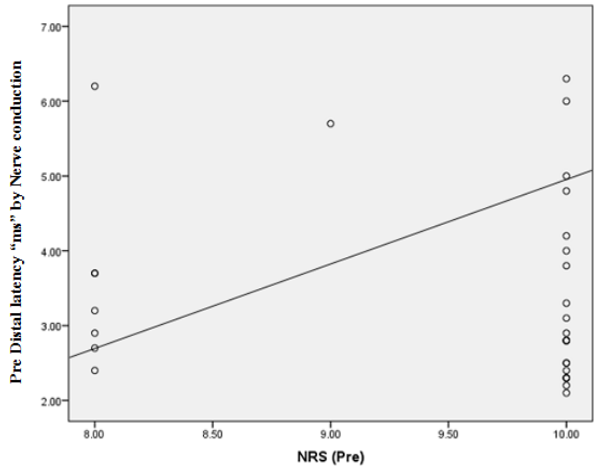


Figure 4: Scatter plot between NRS and distal latency (ms) of the SAN on the affected side. rs =0380.
rs: Spearman's rank correlation coefficient, SAN: Spinal accessory nerve.

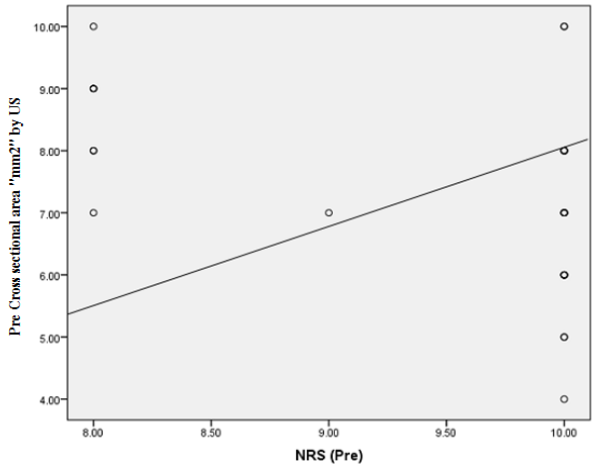


Figure (5): Scatter plot between NRS and ultrasound CSA (mm^2) of the SAN on the affected side. rs =0480.
rs: Spearman's rank correlation coefficient, NRS: Numerical rating scale, CSA: Cross-sectional area.

DISCUSSION

Many visits to pain clinics are caused by MPS with severe conditions. MPS can result to restricted movement, tightness, soreness, stiffness, and local or referred pain [13]. In this study we aimed to assess the SAN neuropathy in MPS patients by integrated neuromuscular ultrasound study and nerve conduction study.

This research displayed that, the site of most taut bands was located at the upper portion of the Trapizus muscle. Also, El Sharnoby et al. [14] and Köse et al. [15] reported the same findings as most of the taut bands presented at the upper segment, and this portion is in charge of posture and definite positions of the shoulder and neck, which may elevate the pressure surrounding the SAN

especially when neck spasm occurs. In the current study patients didn't show manifestations of muscle wasting or weakness, unlike El Sharnoby et al. [14] who found one subject (4%) exhibited modest weakening of the trapezius muscle and slight atrophy.

In the current patients, there was no clinical manifestation of shoulder winging. This comes in agreement with Köse et al. [15] as their axonal degeneration patients exhibited slight weakness and a subtle waste of muscle without shoulder winging, which were minute clinical symptoms of a lower motor neuron damage. This might be the result of axonal degeneration occurring in a localized or little portion of the nerve. Hefny et al. [16] concluded that, more severe pain was experienced by those with spinal accessory neuropathy than by those without it. Spinal accessory neuropathy may exacerbate the level of pain associated with MPS, therefore exacerbating its severity. Neuropathic pain as a result of nerve entrapment is distinct as burning pain or dull aching. According to Preston and Shapiro [7] there was no accurate values of nerve conduction study parameters (distal latency and amplitude) of the SAN. They stated that, in patients with symptoms limited to one side, the distal latency and compound muscle action potential from upper Trapizus can be compared with contralateral asymptomatic side. In this study, as regard motor nerve conduction study (NCS) parameters of the SAN on the affected side, SAN in cases with persistent trapezius MPS was found in 14 patients (23.3%). There were 12 patients (20%) with left side MPS, 4 of them had demyelination type of neuropathy, 2 patients had mixed type and 6 patients were normal. While 48 patients (80%) had right side MPS, 6 patients had demyelination type, 2 patients had mixed type and 40 patients showed normal NCS. These results agree with El Sharnoby et al., [14] who studied spinal accessory neuropathy in MPS by electrodiagnostic studies and they found that, seven patients (28%) were diagnosed as having spinal accessory neuropathy in the form of demyelination type. Electrophysiologically, there was a substantial delay in the SAN motor latency on the symptomatic side when compared to the contralateral asymptomatic side. Additionally, one patient (4%) experienced axonal degeneration that was indicated as a reduction in the SAN's CAMP amplitude. However, Chang et al. [4] reported that, two-thirds of the patients in their sample with trapezius MPS had spinal accessory neuropathy. They stated that, in addition to aberrant needle EMG of the trapezius muscle, diminished SAN CMAP amplitude is an axonopathic lesion that corresponds to spinal accessory neuropathy. This may be due to longer duration and increased disease severity in their study population. Neuromuscular ultrasound has recently emerged as a potential adjunct assessment tool for imaging small cervical and peripheral nerves Walker et al. [17]. Walter et al., [18] and Tubbs et al., [19] confirmed that, in the normal individuals, a non-significant difference was found in SAN nerve measurement of the CSA within the trapezius muscle between the right and left sides and between men and women. In the current study, there was increased CSA of the SAN on the affected side in all patients (100%) with significant increased mean value of CSA on the affected side compared to the healthy side. In our study, when comparing between NCS and ultrasound findings on the affected side, we found that, NCS of SAN revealed 14 (23.3%) patients with neuropathy, 10 of them had demyelination type and 4 patients had both axonal and demyelination. While ultrasonographic assessment of the CSA of the SAN revealed that, all patients (100%) had increased CSA of the SAN on the affected side compared with the healthy asymptomatic side. There was marked positive association between disease duration and distal latency of the SAN on the affected side. These results agree with Ravichandran et al. [20] who stated that, Patients with chronic trapezius MPS may be at risk for SAN due to their prolonged disease duration and more severe pain. So early diagnosis of MPS could prevent the development of SAN neuropathy to be clinically evident.

The limitation in our study was that, sample size included only 60 patients with the need to conduct more studies with larger number of patients.

CONCLUSIONS

Electrodiagnostic and neuromuscular ultrasound are good options for identifying subclinical spinal accessory neuropathy in patients with chronic trapezius MPS. More cases should be enrolled in future studies so as to get better electrophysiological and ultrasonographic results for detection of spinal accessory neuropathy among myofascial pain syndrome patients.

Financial support: This work was not funded by any governmental or non-governmental agencies.

Conflict of interest: The authors declared that there is no direct or indirect conflict of interest.

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الملخص العربي

إنحباس العصب الشوكي الإضافي كسبب لمتلازمة الألم الليفي العضلي (دراسة عصبيه - عضليه تكاملية بالموجات فوق الصوتية)

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ملخص البحث

الخلفية: متلازمة الألم الليفي العضلي العنقي هي شكوى سريرية شائعة في الممارسة اليومية لأطباء العضلات والعظام. نسبة انتشاره ٢١% بين عامة السكان. ويعتبر هو السبب الرئيسي للألم المزمن فى مكان معين، مثل آلام الكتف والظهر والوجه.

الهدف: تحديد الاعتلال العصبي الإضافي في العمود الفقري لدى مرضى متلازمة الألم الليفي العضلي عن طريق التوصيل العصبي المتكامل ودراسات الموجات فوق الصوتية العصبية والعضلية.

الطرق: سجلت هذه الدراسة المقطعية٦٠ حالة مصابة بمتلازمة آلالم الليفي العضلي المزمن من جانب واحد، وتم دراسة تاريخ جميع الحالات، وخضعت لفحص سريري عام ، وتقييم شدة الألم عن طريق مقياس التقييم العددي ، ودراسة التوصيل العصبي ، وقياس الموجات فوق الصوتية من منطقة المقطع العرضي للعصب الشوكي الإضافي في كل من الجانب الصحي العرضي وغير العرضي للمقارنة.

النتائج: كشفت دراسة التوصيل العصبي عن وجود اعتلال عصبي في ٢٣% من جانب متلازمة الألم الليفي العضلي، وجميعهم أظهروا آفة مزيلة للميالين، بينما أظهر ٤مرضى (٢٨%) نوعًا مختلطًا من الاعتلال العصبي. كان هناك متوسط أعلى بكثير من الكمون البعيد على الجانب المصاب والذي كان (٢٧,١) مللي ثانية مقارنة بالجانب الصحي الذي كان (٩٩,٠) مللي ثانية (ع <٠٠١,٠). أيضًا، كان هناك انخفاض كبير جدًا في متوسط السعة الحركية على الجانب المصاب والذي كان٣٤,٦ ملي فولت، مقارنة بالجانب الصحي الذي كان٣١,٧ ملي فولت، (ب<٠٠١,٠). أما بالنسبة للتقييم بالموجات فوق الصوتية، فقد كان متوسطالمقطع العرضي على الجانب المصاب ٥, ٧مم² مقارنة بالجانب الصحي الذي كان ٧٦,٤ مم²، مع وجود فرق ذو دلالة إحصائية عالية (ب<٠٠١,).

الإستنتاجات: يزداد الاعتلال العصبي الإضافي بشكل كبير لدى مرضى متلازمة آلالم الليفي العضلي ويمكن أن يؤدي دراسه التوصيل العصبي والتصوير بالموجات فوق الصوتية العصبية والعضلية إلى تشخيص أكثر موثوقية.

الكلمات المفتاحية: منطقة المقطع العرضي ، متلازمة الألم الليفي العضلي، العصب الشوكي الإضافي.

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