Nerve conduction and electromyography in rheumatoid arthritis patients: a case - control study

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ABSTRACT

Objectives: This study aims to assess peripheral nerve conduction and electromyographic function abnormalities in patients with rheumatoid arthritis.

Subjects and methods: One hundred normal subjects and rheumatoid arthritis patients for each were included in this study, the normal subjects were matched regarding the age and sex with rheumatoid arthritis patients, rheumatoid arthritis patients were diagnosed according to American revised criteria (ARC) 1987; at the Department of Rheumatology in Ibn-Sina Teaching Hospital in Mosul city during the period of 15th of November 2009 - 15th of May 2010. Nerve conduction study for median, ulnar, radial (motor and sensory), posterior tibial and common peroneal nerves were done for all normal subjects and rheumatoid arthritis patients by using system 98-MyoQuik (micromed) EMG. Electromyography for tibialis anterior, gastrocnemius and quadriceps muscles were done for normal subjects and rheumatoid arthritis patients by using Dantec- Neuromatic 2000M-EMG.

Results: In this study, peripheral neuropathy was detected in 54 patients (54%); mononeuritis simplex was the commonest lesion and detected in 36 patients (66.6%) out of the 54 patients. The entrapment neuropathy was found in 25 patients (46.74%), affecting the median (24.07%), posterior tibial (14.81%) and ulnar (7.40%) nerves. Mononeuritis multiplex was detected in 11 patients (20.37%), and symmetrical polyneuropathy found in 7 patients (12.90%).

In the present study, the axonopathy (due to vasculitis mainly), and local demylination (due to entrapment mainly), were the common types of nerve injury seen in rheumatoid arthritis patients. Muscle involvement could be detected by electromyography in rheumatoid arthritis patients in this study.

Conclusion: Neurogenic lesions were present, while no myogenic lesion was detected in patients with rheumatoid arthritis.

Keywords: Electromyography, nerve conduction study, rheumatoid arthritis, nerve.

الخلاصة

الهدف: دراسة توصيل الأعصاب وتخطيط العضلات عند المرضى المصابين بالروماتزم الرثوي.

طريقة البحث: شملت الدراسة (١٠٠) شخص من الحالات الطبيعية و(١٠٠) مريض من المرضى المصابين بالروماتزم الرثوي. أجريت الدراسة في قسم المفاصل وقسم الجملة العصبية في مستشفى ابن سينا التعليمي في الموصل للفترة من ١٥ تشرين الثاني ٢٠٠٩ ولغاية ١٥ أيار ٢٠١٠. تم إملاء الاستمارة الخاصة بالمعلومات للمرضى وأجري الفحص الطبي السريري والمختبري والشعاعي لجميع المرضى المصابين بالتهاب المفاصل الرثوي.

تم إجراء فحص توصيل الأعصاب الكهربائي للعصب الوسطي والزندي والكعبري (الحسي والحركي) والشظوي والعصب الضنبوبي لدراسة الكمون العصبي القاص وسعة العصب الحسي والحركي (المدى) وسرعة توصيل العصب الحسي والحركي باستخدام جهاز: EMG System 98-MyoQuick (micro med) .

تم إجراء فحص تخطيط العضلات الكهربائي للعضلة الرباعية الفخذية والعضلة الضنبوبية الأمامية وعضلة الساق لدراسة النشاط العضلي التلقائي والوحدات الحركية وخصائصها (مدى الوحدة الحركية، سعة الوحدة الحركية، وعدد الصفحات) والزيادة التدريجية في شدة انقباض العضلة باستخدام جهاز Dantec - Neuromatic 2000 EMG system.

النتائج: لقد أظهرت هذه الدراسة أن عدد المصابين باعتلال الأعصاب المحيطية هو ٥٤ مريض (٥٤%) من بين المرضى المصابين بالروماتزم الرثوي. كما بلغ عدد المرضى المصابين باعتلال الأعصاب المحيطية الأحادي ٣٦ مريض (٦٦.٦%) من مجموع المرضى المصابين باعتلال الأعصاب المحيطية. وبلغ عدد المرضى الذين يعانون من الضغط الموضعي على الأعصاب المحيطية ٢٥ مريض (٤٦.٧٢%) وقد شملت العصب الوسطي (٢٤.٠٧%) والعصب الزندي (٧.٤٠%) والعصب الضنبوبي (١٤.٨١%). كما بلغ عدد المرضى المصابين باعتلال الأعصاب المحيطية المتعدد ١١ مريضا (٢٠.٢٧%)، والمرضى المصابين باعتلال الأعصاب المحيطية البعيدة المتشابه ٧ مرضى (١٢.٩٠%).

تبين من هذه الدراسة أن من أهم أسباب اعتلال الأعصاب المحيطية هو الضغط الموضعي على الأعصاب المحيطية والتهاب الأوعية الدموية التي تغذي الأعصاب المحيطية، واللذان يؤديان إلى تحلل الغشاء الخارجي المحيط بالألياف العصبية والى اعتلال مركز الألياف العصبية.

الاستنتاجات: أظهرت هذه الدراسة وجود اعتلال الأعصاب المحيطية بشكل واسع وعدم وجود الاعتلال العضلي عند المرضى المصابين بالروماتزم الرثوي.

Rheumatoid arthritis (RA) is associated with various neurological extra-articular manifestations including nerve compression by synovial proliferation, sensory or sensorimotor neuropathies,[1] and impingent on the central nervous system (CNS) causing neurologic symptoms.[2] Carpal tunnel syndrome is the most common compressive neuropathy in RA, Less common are tarsal tunnel syndrome and ulnar nerve entrapment. [3]

Mononeuritis multiplex is a form of combined sensorimotor neuropathy caused by vasculitis of epineural and perineural arteries and can present as acute foot or wrist drop, such patients usually have severe longstanding RA with other extra-articular features.[4]

Myopathy in RA is usually due to disuse atrophy, corticosteroid therapy, or both. Clinically significant disease-related myositis is very rare.[5] Denervation atrophy from peripheral neuropathy is another cause of muscle weakness.[6]

Electromyography (EMG) and nerve conduction studies (NCS) typically comprise the electrodiagnostic evaluation of function of motor neurons, nerve roots, peripheral nerves, neuromuscular junction and the skeletal muscles.[7] EMG/NCS are considered medically necessary for diagnosing the following conditions: Unexplained peripheral neuropathy with pain of a neuropathic pattern, demonstrated sensory or motor loss on physical examination and no known etiology, Neuropathy suspected to be due to trauma, Carpal tunnel syndrome, ulnar neuropathy at the elbow or wrist, tarsal tunnel syndrome, Peroneal palsy with foot drop, cervical and lumbar radiculopathy. [8-11]

In EMG: Electrical potentials are detected by a needle electrode inserted directly into a skeletal muscle. It assists in clinical diagnosis, prognosis and clinical management decisions.[8] It is helpful in distinguishing between inflammatory and chronic, metabolic or inherited muscle diseases; also in differentiating between acute, recovering and chronic denervation.[8]

NCS provide information regarding the presence, severity and location of a peripheral neuropathy, mononeuropathy or disorders affecting the neuromuscular junctions. Also the functional modality most involved (sensory or motor) and the predominant pattern of pathology (e.g., axonal, demyelinating, or both).[8,9] In NCS surface electrodes are usually used for both stimulation and recording of the electrical responses. However; needle electrodes are sometimes needed to evaluate a deep nerve, such as the sciatic or the femoral nerve. [8,9]

The aim of the study

- To study the nerve conduction and electromyography in normal subjects.
- To evaluate the nerve and muscle involvement in rheumatoid arthritis patients through the nerve conduction study and electromyography.

- To estimate of RF, ESR, CRP and CPK in RA patients.

SUBJECTS AND METHODS

The study has been conducted at the Rheumatology and Neurophysiology Department in Ibn- Sina Teaching Hospital, in Mosul, during the period from 15th of November 2009 to 15th of May 2010. One hundred RA patients whose ages are above 20 years were included; diagnosis was made according to American revised criteria (ARC) 1987.[12]

One hundred normal subjects of healthy volunteers of similar age and sex, were compared to rheumatoid arthritis patients, and were examined for nerve conduction, and electromyography.

NCS for median, ulnar, radial (motor and sensory), posterior tibial and common peroneal nerves were done for each patient and normal subject to study the distal motor and sensory latency (DML, DSL), compound motor and sensory action potentials (CMAP, SNAP), and motor and sensory nerve conduction velocities (MNCV, SNCV) by using the system 98- MyoQuik (micromed) EMG machine.

Electromyography for gastrocnemius, tibialis anterior and quadriceps muscles for RA patients and normal subjects were done by using DANTEC Neuromatic 2000 M. to study the: insertional activity, spontaneous activity, motor unit potential and recruitments.

Collected data were analysed by (SPSS) software; unpaired t-test was used to compare between the studied parameters. P-value equal to or less than 0.05 is considered to be significant.

RESULTS

Are shown in figure 1-3 and tables 1-8.

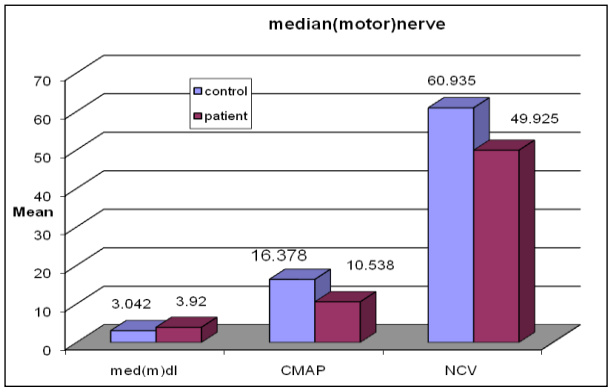
Figure 1 shows the nerve conduction study for median nerve for normal subjects and RA patients; there is increase in distal latency, decrease in compound motor action potential and decrease in nerve conduction velocity for RA patients compared to normal subjects and these differences are significant.

Figure 2 shows the nerve conduction study for for ulnar nerve for normal subjects and RA patients; there is increase in distal latency, decrease in compound motor action potential and decrease in nerve conduction velocity for RA patients compared to normal subjects and these differences are significant.

Figure 3 shows the nerve conduction study for posterior-tibial nerve for normal subjects and RA patients; there is increase in distal latency, decrease in compound motor action potential and decrease in nerve conduction velocity for RA patients compared to normal subjects and these differences are significant.

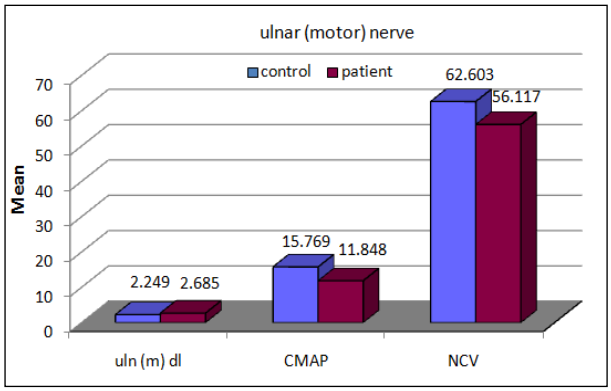
Table 1 shows prolonged distal latency for rheumatoid arthritis patients than that of normal subjects with significant difference between them (P =0.01), except for the radial nerve it is not significant.

Table 2 shows a decrease of the compound motor action potentials (CMAP) for rheumatoid arthritis patients compared to normal subjects with significant difference between them (P≤ 0.05); except for radial nerve which is not significant.



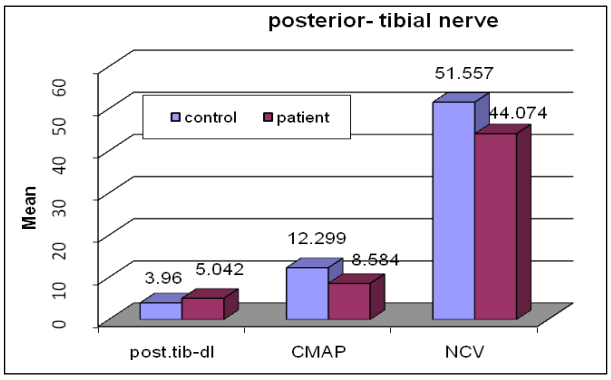
(dl: distal latency (ms), CMAP: compound action potential (mv), NCV: nerve conduction velocity (m\s)).

Figure 1. Median (motor) nerve conduction study for normal subjects and rheumatoid arthritis patients.



(dl: distal latency (ms), CMAP: compound action potential (mv), NCV: nerve conduction velocity (m\s)).

Figure 2. Ulnar (motor) nerve conduction study for normal subjects and rheumatoid arthritis patients.



(dl: distal latency (ms), CMAP: compound action potential (mv), NCV: nerve conduction velocity (m\s)).

Figure 3. Posterior tibial nerve conduction study for normal subjects and rheumatoid arthritis patients.

Table 3 shows that the motor nerve conduction velocities (MNCV) for patients were less than that of normal subjects with significant difference between them (P < 0.05), while for the radial nerve it is not significant.

Table 4 shows prolongation of sensory distal latency (SDL) for rheumatoid arthritis patients compared to normal subjects with significant difference between them (P = 0.01).

The sensory nerve action potential (SNAP) was less in rheumatoid arthritis patients than in normal subjects with significant difference between them (P < 0.01) except for radial nerve which is not significant, as shown in **Table 5**. **Table 6** shows that the sensory nerve conduction velocities (SNCV) were less for rheumatoid arthritis patients than normal subjects with significant difference between them (P < 0.05), except in radial nerve not significant.

Table 7 shows the type of peripheral neuropathy in RA patients, there are mononeuritis simplex detected in 36 patients (66.66%); mononeuritis multiplex detected in 11 patients (20.37%) and symmetrical poly neuropathy detected in seven patients (12.90%).

Table 1. Distal motor latency (DML) of median, ulnar, radial, common peroneal and posterior tibial nerve in normal subjects and rheumatoid arthritis patients.

Nerve	Normal subjects (No.=100)		Rheumatoid arthritis patients (No.=100)	P -value
Median nerve DML (ms)	Mean±SD Range	3.042 ± 0.315 2.30 - 3.60	3.920 ± 0.742 2.60 - 6.20	0.01**
Ulnar nerve DML (ms)	Mean±SD Range	2.249 ± 0.364 1.70 - 3.00	2.685 ± 0.529 2.00 - 4.70	0.01**
Radial nerve DML(ms)	Mean±SD Range	3.023 ± 0.250 1.80 - 3.500	3.281 ± 0.363 2.50 - 3.75	(NS)
Common peroneal nerve DML(ms)	Mean±SD Range	3.859 ± 0.224 3.20 - 4.50	4.534 ± 0.645 2.8 0 - 6.70	0.01**
Posterior tibial nerve DML(ms)	Mean±SD Range	3.690 ± 0.249 3.30 - 4.60	5.042 ± 0.983 3.40 - 8.00	0.01**

**Highly significant (P < 0.01), (NS) not significant.

Table 2. Compound motor action potential (CMAP) of median, ulnar, radial, common peroneal and posterior tibial nerve of normal subjects and rheumatoid arthritis patients.

Nerve	Normal subjects (No.=100)		Rheumatoid arthritis patients (No.=100)	P -value
Median nerve CMAP (mv)	Mean±SD Range	16.378 ± 2.721 8.00 - 19.90	10.530 ± 3.630 3.3 0 - 19.30	0.04 *
Ulnar nerve CMAP (mv)	Mean±SD Range	15.769 ± 3.208 8.00 - 20.00	11.840 ± 3.580 5.5 0 - 20.00	0.02 *
Radial nerve CMAP (mv)	Mean±SD Range	15.376 ± 2.621 9.00 - 19.00	12.340 ±2.855 7.00 - 19.00	(NS)
Common peroneal nerve CMAP(mv)	Mean±SD Range	11.927 ± 2.881 8.00 - 19.30	8.368 ± 2.166 3.90 - 17.00	0.05*
Posterior tibial nerve CMAP (mv)	Mean±SD Range	12.290 ± 2.360 7.00 - 19.00	8.594 ± 2.721 3.00 - 18.00	0.04 *

*Significant (P≤ 0.05), (NS) not significant.

Table 8 shows nerve entrapment, which was detected in 25 patients (46.28%) (out of 36 patients who developed mononeuritis simplex) affecting mainly the median (24.07%), ulnar (7.40%) and posterior tibial (14.81%) nerve.

The electromyography which includes the spontaneous activity (fibrillation potential and \ or positive sharp waves-FP, PSW), the motor unit potential (MUP) which include (Duration, Amplitute and number of phases) and interference (recruitment) of tibialis anterior, gasrtrocnemius and quadriceps muscles for normal subjects and rheumatoid arthritis patients shows differences between them which were not significant.

The normal subjects in this study showed neither nerve conduction study for median, ulnar and radial nerves (motor and sensory) abnormalities, nor needle muscle study for tibialis anterior, and gastrocnemius muscles abnormalities.

Table 3. Motor nerve conduction velocity (MNCV) of median, ulnar, radial, common peroneal and posterior tibial nerves of normal subjects and rheumatoid arthritis patients.

Nerve	Normal subjects (No.=100)		Rheumatoid arthritis patients (No.=100)	P- value
Median nerve NCV (m\s)	Mean±SD Range	60.93 ± 3.89 50.00 -78.00	49.92 ± 8.55 35.00 - 76.00	0.01**
Ulnar nerve NCV (m\s)	Mean±SD Range	62.60 ± 5.13 51.00 – 77.00	56.11 ± 4.84 40.00 - 70.00	0.02*
Radial nerve NCV (m\s)	Mean±SD Range	58.41 ± 3.37 50.00 - 70.00	53.78 ± 3.59 45.00 - 60.00	(NS)
Common peroneal nerve NCV(m\s)	Mean±SD Range	52.09 ± 2.70 45.00 - 59.00	46.94 ± 4.13 30.50 - 56.40	0.01 **
Posterior tibial nerve NCV (m\s)	Mean±SD Range	51.55 ± 3.37 40.00 - 55.00	44.07 ± 6.38 38.00 - 55.70	0.01**

*Significant (P< 0.05), **highly significant (P < 0.01), (NS) not significant.

Table 4. Sensory distal latency (SDL) of median, ulnar and radial nerves for normal subjects and rheumatoid arthritis patients.

Nerve	Normal Subjects (No.=100)		Rheumatoid arthritis patient (No.=100)	P -value
Median nerve SDL (ms)	Mean ± SD Range	2.367 ± 0.217 2.04 - 2.90	3.393 ± 1.044 2.50 - 5.40	0.01**
Ulnar nerve SDL (ms)	Mean±SD Range	2.070 ± 0.154 1.9 5 - 2.70	2.939 ± 0.507 1.8 0 - 4.90	0.01**
Radial nerve SDL (ms)	Mean±SD Range	2.098 ± 0.1626 1.50 - 3.00	2.981 ± 0.262 2.00 - 3.40	0.01**

** Highly significant (P < 0.01).

Table 5. Sensory nerve action potentials (SNAP) of median, ulnar and radial nerves for normal subjects and rheumatoid arthritis patients.

Nerve	Normal subject No.=100		Rheumatoid arthritis patient (No.=100)	P -value
Median nerve SNAP (mv)	Mean±SD Range	32.777 ± 7.492 14.50 - 49.00	23.220 ± 9.649 10.00 - 48.00	0.01**
Ulnar nerve SNAP (mv)	Mean±SD Range	32.515 ± 6.819 15.00 - 46.00	27.090 ± 8.132 8.50 - 45.00	0.01**
Radial nerve SNAP (mv)	Mean±SD Range	31.640 ± 6.999 13.00 - 43.96	28.627 ± 6.713 14.00 - 40.00	(NS)

**Highly Significant (P< 0.01), (NS) not significant.

Table 6. Sensory nerve conduction velocity (SNCV) of median, ulnar and radial nerves for normal subjects and rheumatoid arthritis patients.

Nerve	Normal subjects (No.=100)		Rheumatoid arthritis patients (No.=100)	P- value
Median nerve SNCV (m\s)	Mean±SD Range	60.913 ± 4.940 50.00 - 80.00	50.272 ± 7.860 38.00 - 67.00	0.01**
Ulnar nerve SNCV (m\s)	Mean±SD Range	60.572 ± 5.228 48.00 - 77.00	54.182 ± 5.561 35.00 - 65.60	0.04*
Radial nerve SNCV (m\s)	Mean±SD Range	59.537 ± 3.604 50.00 - 69.50	56.387 ± 4.137 50.00 - 65.00	(NS)

*Significant (P< 0.05), **Highly Significant (P< 0.01), (NS) not significant.

Table 7. Type of peripheral neuropathy findings in rheumatoid arthritis patients.

Type	Positive peripheral neuropathy 54 patients (54%)
Mononeuritis simplex	36 Pt. (66.66 %)
Mononeuritis multiplex	11 Pt. (20.37%)
Symmetrical polyneuropathy	7 Pt. (12.90%)

Table 8. Type, severity and site of nerve entrapment in rheumatoid arthritis patients.

Nerve	Type, severity and site	Nerve entrapment No=25pt. (46.28%)
Median nerve entrapment 13 pt. (24.07%)	Mild Moderat Severe	6 pt. (11.11%) 7 pt. (12.96%) 0.00 (0.00%)
Ulnar nerve entrapment 4 pt. (7.40%)	At Cubital -fossa At Guyon canal	2 pt. (3.70%) 2 pt. (3.70%)
Posterior tibial nerve entrapment 8 pt. (14.81%)	Medial Planter Lateral planter	5pt. (9.25%) 3 pt. (5.55%)

DISCUSSION

This study demonstrates the involvement of peripheral nerves in rheumatoid arthritis patients, which is a common feature and one of the common complications of the disease.

There were many changes in parameters of the nerves study regarding the distal latency, compound motor action potential and nerve conduction study in rheumatoid arthritis patients and normal subjects; these represent the preliminary changes of neuropathic lesions in RA patients.

The explanation for the differences in these measures was that; in rheumatoid arthritis there is nerve compression (nerve entrapment) which causes mechanical (direct) pressure that affects mainly the myeline sheath of these nerves (at the begining); so this will lead to a prolonged MDL and SDL and a decrease in MNCV and SNCV, with normal or slight decreases of CMAP and SNAP, which were detected by nerve conduction study. Later on, if this pressure persists, it will affect the axon leading to the decrease of the CMAP and SNAP. These findings may represent the preliminary picture of any peripheral neuropathy pattern. [13,14] Other causes are vasculitic lesions in rheumatoid arthritis which cause ischemic changes that affect the axon mainly and lead to axonopathy that causes the decrease of the CMAP and SNAP; and hence it was detected by nerve conduction study [15,16].

In the present study, the peripheral neuropathy findings in RA patients were detected in 54 patients (54%) and these findings are in agreement with other studies. [17,18] This may be due to geographical similarity. Another cause is vasculopathy; vascular injury is considered as a key finding in the pathogenesis of rheumatoid arthritis. It is responsible for the different patterns of non-compressive peripheral neuropathy in RA including mononeuritis multiplex and distal symmetrical sensory or sensorimotor neuropathy.[19,20]

In this study, mononeuritis simplex was detected in 36 patients (66.6%) out of 54 patients who developed peripheral neuropathy and this is in agreement with another study[21] (**Table 7**). Entrapment neuropathy was found in 25 patients (46.28%) (out of the 36 patients with mononeuritis simplex). The entrapment neuropathy affects mainly the median, ulnar and posterior tibial nerve (**Table 8**).

The carpal tunnel syndrome (CTS) of median nerve at the wrist is the most common form of median nerve entrapment and is the prototypical injury.[22] In present study CTS was detected in 13

patients (24.07%) and this was similar to other studies.[21,23] Mild carpal tunnel syndrome was detected in 6 patients (11.11%), moderate carpal tunnel in 7 patients (12.96%), and none of the patients showed severe degree of carpal tunnel syndrome in this study.

The second common type of nerve entrapment in our study was tarsal tunnel syndrome of posterior tibial nerve, which was detected in 8 patients (14.81%) and this is nearly in agreement with another study.[24] The medial planter nerve involved in 5 patients (9.25%), while the lateral planter nerve involved in 3 patients (5.55%).

The third common nerve entrapment in rheumatoid arthritis patients in this study was ulnar nerve entrapment which was detected in 4 patients (7.40%) and this was nearly similar to findings of another study;[17] the ulnar nerve entrapment at the cubital area was detected in 2 patients (3.70%) and at the Guyon canal by 2 patients (3.70%) also.

Mononeuritis multiplex was detected in 11 patients (20.37%) and this is nearly in agreement with the findings in another study. [25] Symmetrical polyneuropathy was seen in 7 patients (12.9%) and this finding was similar to the findings of another study.[17]

The needle muscle study of tibialis anterior, gastrocnemius and quadriceps muscles for normal subjects and rheumatoid arthritis patients show that there were no significant differences between them in this study. This finding was in agreement with another study, which found that there were neurogenic changes in rheumatoid arthritis patients but no myogenic changes.[26]

CONCLUSION

Neurogenic lesions were present, while no myogenic lesion was detected in patients with rheumatoid arthritis.

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