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Ultrasono graphic Evaluation of Tarsal Tunnel Syndrome in Patients with Rheumatoid Arthritis

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Abstract

Background: Rheumatoid arthritis (RA) is a chronic systemic inflammatory disease of unknown cause that primarily affects the peripheral joints in a symmetrical pattern. Rheumatoidneuropathy could result from entrapment as by adjacent tenosynovitis, nerve ischemia due to vasculitis or drugs used to treat these conditions. Tarsal tunnel syndrome is a condition that is caused by compression of the tibial nerve or its associated branchesas the nerve passes underneath the flexor retinaculum at the level of the ankle ordistally.Musculoskeletalultrasoundhaslong been established asa valuable tool inthe diagnosis of synovitis and tenosynovitis in addition to effusions in RA patientsand also proofed valuable for diagnosis of TTS.

Objective: The aim of the current study was to diagnose and evaluate tarsal tunnelsyndromein patients withrheumatoid arthritis by meansof ultrasonography and nerve conduction studies.

Patients and methods: This study included fifty patients with age ranged from (20 to 68) years.All patients were classified as having RA according to ACR/EULAR 2010criteria for RA classification, and suspected clinically to have TTS by complaining of burning pain or paresthesia onthe plantar aspect of their feet and toes.

Results: Of 50 patients (50 feet), 47 patients (94.0%) had abnormal Electrophysiologicalfindings; 28 patients (59.6%) had prolonged distal latency in the motor Lateral planternerve (any variable). 12 patients (25.5%) had prolonged distal latency in the motor medial planter nerve (any variable). 35 patients (74.5%) had prolonged distal latency in the sensory Lateral planter nerve (any variable). Musculoskeletal Ultrasonographyshowed 86.0 % of patients had abnormal findings including ankle effusion (34.8%), Doppler (synovitis) (32.6%),tenosynovitis (tendon girth) (28.3%) and plantar faciatis (4.3%)

Conclusion: Musculoskeletal ultrasound and nerve conduction study should be used concomitantly to confirm the diagnosis of tarsal tunnel syndrome in patients with rheumatoid arthritis.

Keywords: Tarsal tunnel syndrome, rheumatoid arthritis, musculoskeletal ultrasonography, nerve conduction study.

Key points:

1. This prospective study showed that MSK ultrasound provides greaterdiagnostic confidence for the tarsal tunnel syndrome.
2. MSK ultrasoundconfirm the diagnosis of tarsal tunnel syndrome in patientswithrheumatoid arthritis.
3. The management and treatment of the tarsal tunnel syndrome in patients withrheumatoid arthritis becomes more appropriate and confidence.

Introduction:

Rheumatoid arthritis (RA) is a chronic systemic inflammatory disease ofunknowncausethatprimarilyaffectstheperipheraljointsinasymmetrical pattern. Rheumatoid arthritis (RA) is a common disease thataffectsapproximately1%ofthepopulation.Onsetusuallyoccursbetween 30 and 50 years of age. It is 2-3 times more common in femalesthan in males**[1]**. Rheumatoid neuropathy could result from entrapmentas by adjacent tenosynovitis, nerve ischemia due to vasculitis or drugsused to treat these conditions. The commonest entrapment neuropathiesinclude carpal tunnel syndrome, tarsal tunnel syndrome, ulnar neuropathyat the elbow or wrist, posterior interosseous nerve syndrome, femoralneuropathy and peroneal neuropathy **[1]**.

Tarsal tunnel syndrome is a condition that is caused by compression ofthe tibial nerve or its associated branches as the nerve passes underneaththe flexor retinaculum at the level of the ankle or distally **[2]**.

Common symptom of TTS include paresthesia along the distribution ofthe posterior tibial, lateral plantar and/or medial plantar nerves manifestedin the medial portion of the ankle and or plantar aspect of the foot

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byburning,numbnessortinglingandassociatedsometimeswithlocaltenderness behind the medial malleolus **[3]**. Musculoskeletal ultrasoundhas long been established as a valuable tool in the diagnosis of synovitisand tenosynovitis in addition to effusions in RA patients and also proofedvaluable for diagnosis of TTS **[4, 5]**.

Although TTS is not uncommon in RA and may affect the daily activitiesof patients **[6]**, the condition is still underestimated in such debilitatingdisease.

The aim of the current study was to diagnose and evaluate tarsal tunnelsyndromeinpatientswithrheumatoidarthritisbymeansofultrasonography and nerve conduction studies.

Patients and Methods:

This study included fifty patients with age ranged from (20 to 68) years.All patients were classified as having RA according to ACR/EULAR 2010criteria for RA classification **Aletaha et al. [7]**, and suspectedclinically to have TTS by complaining of burning pain or paresthesia onthe plantar aspect of their feet and toes.

Patients with peripheral neuropathy, diabetes mellitus, S1 radiculopathy, space occupying lesions at the tarsal tunnel, post traumatic foot, deformity, varicose veins, deep venous thrombosis, lower limb edema orhypothyroidism were excluded from the study.

Allpatientsweresubjectedtocompletehistorytaking,full generallocomotorandneurologicalexaminationwithspecialattentionto thesymptoms and signs of tibial nerve entrapment under the tarsal tunnel.

Plain x ray on both feet was performed.

Musculoskeletal Ultrasonography:

Allpatientsandcontrolsubjectsweresubjectedtorealtimeultrasonographic examination ofthemedial compartmentof the anklejoint, using (Toshiba Xario200, Tokyo, Japan), with a linear 12 MHzprobe by a radiologist and rheumatologist, well trained in musculoskeletalultrasound and blinded to clinical and neurophysiological data. Contactgel was applied to the skin to provide an acoustic interface. With thepatient laying supine, his knee flexed and his foot in neutral position onthe examination bed, the probe was positioned parallel (short axis) andperpendicular (long axis) to the malleolar-calcanel axis **[8]**, for detectionofthepresenceofjointeffusion,synovialhypertrophyorganglion,tendenosis or tenosynovitis of flexor hallucis, flexor digitorumlongus ortibialis posterior tendons. Power Doppler signal was applied for detectionofneovascularization indicating active inflammation. Then the patientwas asked to lay prone with the foot hanged on the bed's edge forexamination of the plantar fascia.US Tinel test was done by tapping over the nerve, as a positive US Tinelsign is suggestive of a positive diagnosis of the tarsal tunnel syndrome. Incase of pathological findings, the nerve should be further studied in thelongitudinal plane to confirm previous findings.

Neurophysiological studies:

Using Nihon Kohden CorporationEMG apparatus(Model: MEB2003k, Serial no 00051, Japan 2012), the following electrophysiological studieswere performed to all patients and control:

1. Sensory conduction study (SCS) of the sural, medial and lateralplantarnerves.
2. Motor conduction study (MCS) both medial and lateral planternerves.
3. F response and H reflex of posterior tibial nerve.
4. These studies were done by a neurophysiologist blinded to the clinicaland ultrasonographic data.

Statistical analysis:

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test ($\chi 2$) to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean ± SD (Standard deviation).Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P value < 0.05 was considered significant.

Results:

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This study was carried out on the mostly affected foot of fifty RA patients(35female,15male) with mean age 46.4±16.6, the highest percentage of 50.0%at the age of 30 - 60 years. Disease duration ranged from 2 – 15years (12.9±7.6) (table 1).

Neurological examinationshowed thatall patientshadpainandparesthesia on the plantar aspect, 34% of patients with ankle inversion, 26.0% of patients with ankle eversion and dorseflection. 52.0% ofpatients had positive Valleix sign and 46.0 % of patients had positiveTinel's sign.

The most common ankle X-ray findingswerejointspace narrowing(90.0%)followed by osteopenia (14.0%), bone cyst (12.0%) and erosions(8.0%).Table 1 reveals the demographic and clinical findings of patients. MusculoskeletalUltrasonographyshowedthat86.0%ofpatients hadabnormal findings including ankle effusion (34.8%), Doppler (synovitis) (32.6%)tenosynovitis (28.3%), and planter faciitis (4.3%) (table 2).

Electrophysiological findingsshowedthat 94.0%ofpatientshadabnormal electrophysiological findings out of them 59.6% had prolongeddistal latency in the motor lateral plantar nerve, 25.5% had prolongeddistal latency in the motor medial planter nerve, 74.5% had prolongeddistal latency in sensory lateral plantar nerve, 13% had prolonged distallatencyinsensorymedialplanternerve,20%hadslowconductionvelocity insensory lateralplantarnerve and19% hadslow conductionvelocityinmedialplantarnerve(table3).

Therewasastatisticallysignificantassociationbetweentheclinicalandtheoverallelectrophysiological diagnosis of TTS (p value < 0.005) (Table 4). Thedifferent electrophysiological findings are summarized in (table 5).

Table (1): Demographic and clinical data.

Variable	No.	%
Age Mean±SD (range)	46.4±16.6 (20-68)	
Sex Male Female	 15 35	 30% 70%
Duration of disease Mean±SD (range)	12.9±7.6 (3-25)	
Pain &paresthesia	50	100.0
Tinel's sign	23	46.0
Valleix sign	26	52.0
Ankle inversion	17	34.0
Ankle eversion &dorseflection	13	26.0
Ankle x-ray findings		
Narrowing	45	90.0
Erosion	4	8.0
Osteopenia	7	14.0
Cyst	6	12.0
Deformity	0	0.0

Table (2): Ultrasound findings in the abnormal group.

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Ultrasound findings	No. (46) 4 neuropathy without compression.	%
Ankle effusion	16	34.8
Doppler synovitis	15	32.6
Tenosynovitis	13	28.3
Plantar fasciitis	2	4.3

Table (3): Electrophysiological findings (number and % of cases).

	Sensory (cut off value)		Motor
	D.L (>4.7ms)	CV (≤ 34.7)	DL (>3.4ms)
Lateral planter nerve	35	10	28
%	74.5	21.3	59.6
P value	0.000*	0.063	0.000*
Medial plantar nerve	6	9	12
%	12.8	19.1	25.5
P value	0.076	0.067	0.04*

*P value ≤ 0.05 significant

Table (4): Correlation between electrophysiological diagnosis, ultrasound findings and clinical diagnosis.

		N (50)	%	P Value
Clinical		(50)	100.0	P1= 0.241ns
Electrophysiological	Abnormal	47	94.0	P2<0.001**
	Normal	3	6.0	

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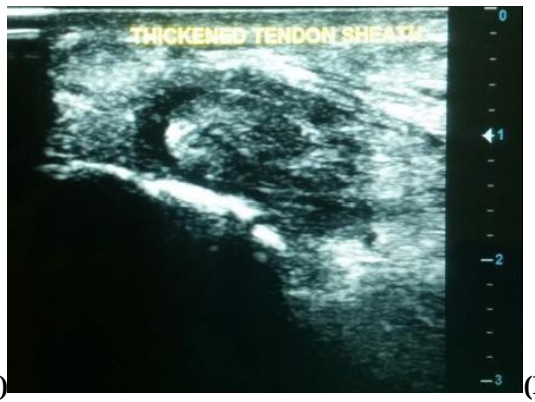
Ultrasound	Abnormal	26	52%	P3=0.841^{ns}
	Normal	24	48%	

Chi-square test used
P1: Comparison between clinical and electrophysiological abnormal
P2: Comparison between normal electrophysiological and abnormal
P3: Comparison between normal ultrasonographic and abnormal
Ns: No significant difference (p>0.05)
** Significant difference (p<0.01)

Table (5): Findingsof different electrophysiological parameters.

	Min – Max	**Mean ± SD**
Medial planter nerve motor (m/s)	2.1 - 9.8	5.8 ± 1.5
Medial planter nerve sensory (m/s)	2.1 - 9.8	5.1 ± 1.9
Lateral planter nerve motor (m/s)	4.2 - 9.2	6.6 ± 1.5
Lateral planter nerve sensory (m/s)	3.2 - 9.9	5.8 ± 1.8
Medial planter conduction velocity sensory (m/s)	21.3 - 56.7	46.1 ± 9.2
Lateral planter conduction velocity sensory (m/s)	22.3 - 78.8	47.9 ± 9

(A) 

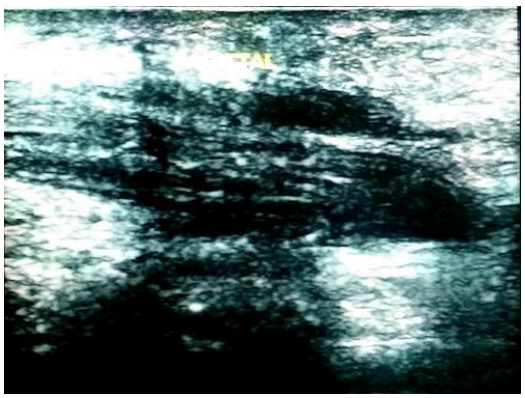
(B) 

Figure (1): A, axial and B, longitudinal ultrasound scan shows diffuse swelling with increase caliber and surrounded fluid distending the tendon sheath.

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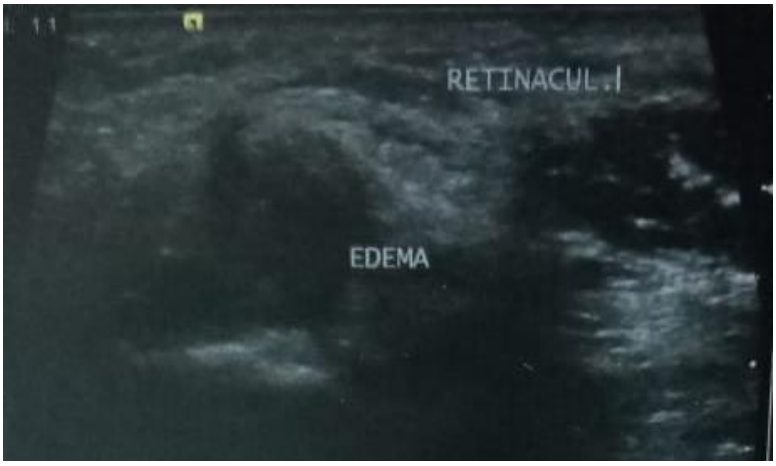

Figure (2): Axial scat of the tarsal tunnels shows edematous changes with convex appearance of the retinaculum denoting increase tunnel pressure.

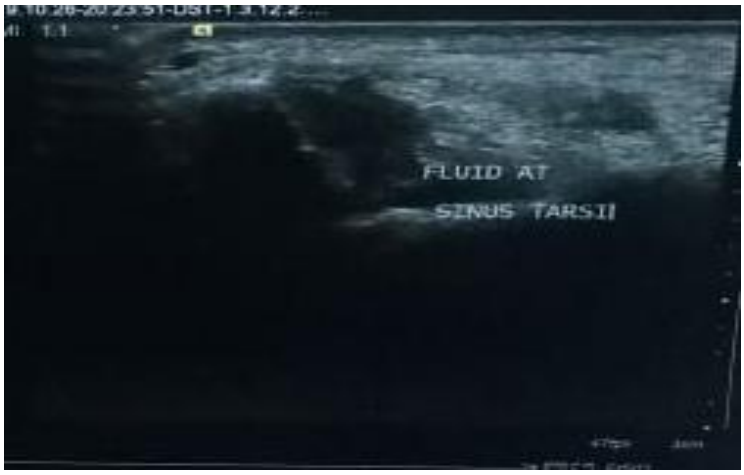

Figure (3): Axial ultrasound view of the tarsal tunnel shows fluid texture localized adjacent to the medial malleolus with edematous changes of the contents.

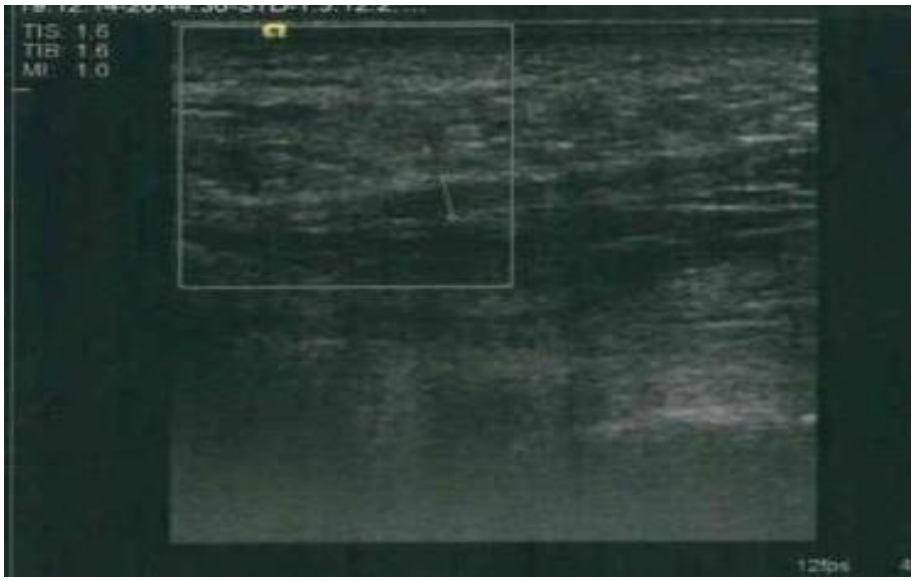

Figure (4): Axial ultrasound view of the planter surface shows mild thickening of the plantar faciaind.of plantar faciitis.

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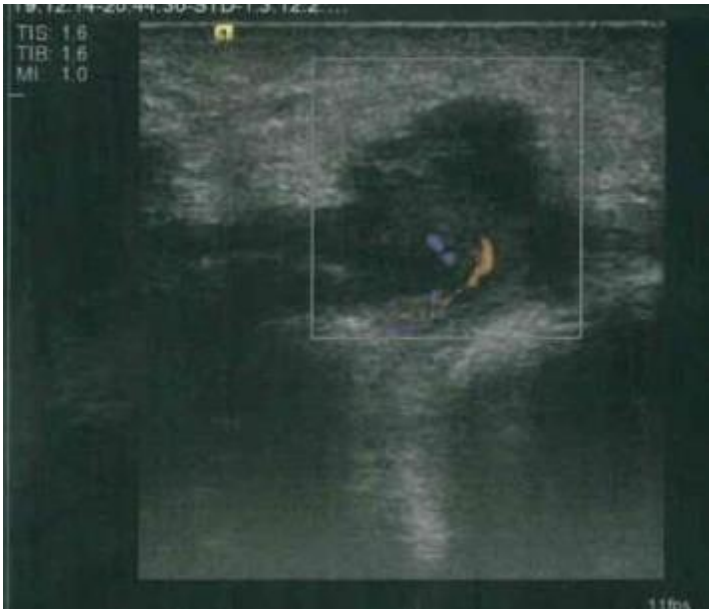

Figure (5): Axial ultrasound view of the medial ankle shows synovial proliferation with increase vascularity.

Discussion:

In this study, we examined by ultrasonography and electrophysiologically Fifty feet of rheumatoid arthritis patients who had pain and burning sensation in their feet and hence suspected to have criteria of TTS. Similar inclusion criteria were adopted in a study done by **Mondelli and his colleagues [9]** and another study by **Ibrahim et al.[10]**who suggested inclusion of cases based on clinical history andsymptomssuggestingTTS.**Lanzillo and his collages [11]**consideredthatpainandparaesthesiainrheumatoidarthritispatientscould be due to other causes such as referred pain of arthritis or tendinitisor even plantar fasciitis and be misinterpreted by patients who complainas being related to a neurological problem. This can lead clinicians toover- or underestimate the incidence of clinical sensory symptoms.

In our study, eliciting Tinel's sign was considered as an objectiveclinicalmethod for possible tibial nerve entrapment at the tarsal tunnel.

Positive Tinel's sign was observed in 23 (46%) of the cases. In previousstudies, it was present in 90% of cases **Samarawickrama et al. [12].**While, inthestudy done by **Ibrahimandhis collages[10].**

PositiveTinel'ssignwasobservedin12(40%) of cases.However, Tinel's sign is not pathognomonic of nerve entrapment syndromes, andcan also be elicited in the normal population and in patients withpolyneuropathy **Preston and Shapiro [13].**

In our study, the Valleix sign was positive in 26 (52%) cases. It isbased on the possible presence of a damaged local area of the nerve at thetarsal tunnel resulting from nerve compression. Consequently, percussion ofthatdamagedarea could lead to the reproduction of paresthesia andpain proximally as well as distally along the course of the nerve from thatdamaged area. **Ibrahim et al. [10],** reported positive Valleixsign in 17 (56.6%) cases.

In this study, the ankle inversion test was positive in 17(34%) casesand by ankle eversion and dorsiflexion, symptoms were reproduced inonly 13 (26.0%) cases. In the study by **Ibrahim et al. [10],** thesetests were positive in 9 (30%) and 8 (26.6%) cases respectively.

The above 2 clinical findings depend on the fact that, unlike thecarpaltunnel,thetarsaltunnelisafullyenclosedspacewith criticalvolume and pressure. Any decrease in the volume or increase in pressureby space occupyinglesions,edema, orswollentendonscouldcompromise the neural bundle passage through the tunnel leading to theentrapment, **Wallach et al. [14].**

TheaimofUSexam.,istoidentifythecauseoftarsaltunnelsyndromeandconfirm clinicaldiagnosis. Inourstudy USoutcomeisrarelynormalinthesepatients,andinthevastmajorityofcases,acompression element is detected.

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We used Musculoskeletal US in order to identify the possible inflammatory causes affecting the medial ankle including joint effusion (fig. 2 & 3), detection of active inflammation by Doppler study (fig. 5),altered echogenicity of tendons and tendon girth swelling **[15]**.

The most frequently finding in this study was joint effusion, detectedin 16 patients (34.8%) followed by Doppler synovitis then tenosynovitis (fig. 1), while the plantar faciitis (fig. 4) is rarely seen by ultrasound.

Joint effusion increased with the patient in the standing position.WefoundsignificantstatisticalassociationbetweenelectrophysiologicdiagnosisofTTSandtheultrasonographicinflammatory relevant abnormalities.The same association was reportedby **[10, 16]**.

We aimed also to exclude by electrophysiologic examination theassociated peripheral polyneuropathy and S1 radiculopathy. Specific electrodiagnostictests for TTS were performed measuring the motordistal latency of both medial and lateral plantar nerves as well as theirsensory latency and conduction velocity.

Wedidnotuseneedleelectromyography(EMG)aspartoftheelectrophysiological study for the diagnosis of TTS. This agrees with thereview of **Patel et al. [17],** where none of the 317 articles reviewedmentioned the use of needle EMG in diagnosis of TTS.

Another reasonfor not using needle EMG is the difficulty of interpretation.In this study, 28 patients 59.6% had prolonged distal latency in themotor Lateral plantar nerve Min –Max (4.2 - 9.2) and Mean ± SD (6.6±1.5) any variable. 12 patients 25.5% had prolonged distal latency inthe motor medial plantar nerve Min –Max (2.1-9.8) andMean± SD (1.5±5.8) anyvariable).35patients (74.5%)hadprolongeddistallatency in sensory lateral planter nerve Min –Max (3.2 - 9.9)andMean±SD (5.8 ± 1.8) (any variable). and 6 patients (12.5%) had prolongeddistal latency in sensory medial planter nerve Min –Max (2.1 - 9.8) andMean ± SD (5.1 ± 1.9) (any variable).10 patients had slow conductionvelocityin sensory lateral plantar nerve Min –Max (21.3 - 56.7) andMean±SD(46.1±9.2)(anyvariable).And 9 patients had slowconduction velocity medial plantar nerve Min –Max (22.3 - 78.8) andMean ± SD (47.9 ± 9) (any variable).

In agreement with study done by **Ibrahim et al.[10]** whereassensory lateral planter nerve prolonged latency in 23 patient 76.6% Min– Max(2.1 - 9.8) and Mean ± SD (4.570 ± 1.6174) (any variable).While, its sensory conduction velocity in 8 patient 26.6% Min –Max (19.0–66.0)and Mean ± SD (39.800 ±9.78193) (any variable). Whereas detection ofabnormalitiesinmedialplanternervesensoryprolongedlatencywasfound in 18 patient60% of casesMin –Max(2.0–9.6)and Mean ±SD (1.5654±3.817) any variableand sensory conduction velocity in 6patients 20% Min –Max(21.9–66.0) and Mean ± SD (42.730± 10.6993)any variable.8 patients (26.6%)have prolonged distal latency in medialplanter motor nerve Min –Max(3.4–5.8) and Mean ± SD (4.4± 0.5954)anyvariable)and18patient(60%)haveprolongeddistallatencyin lateralplantermotorMin–Max(3.9–7.4) andMean±SD(5.057±0.8054) any variable.

Finally, US imaging considered a reliable study of the tarsal tunnel, andinourstudy,USrevealedcompressionelementsin46of cases (86%).The US technique has many advantages: high spatial resolution,faster examination, and the possibility to study patients during limbloading.

Conclusion:

The combination of electrophysiology and ultrasonography performedin the same session (or in collaboration with an ultrasound examiner) may be useful for diagnosis of TTS.

Abbreviations:

RA rheumatoid arthritis

TTS tarsal tunnel syndrome

MHz megahertz

SCS sensory conduction study

MCS motor conduction study

References:

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1. **Loveday DT, Jackson GE, Geary NP (2012):** The rheumatoid foot and ankle: current evidence. Foot and Ankle Surgery, 18: 94- 102.
2. **Satish VK, Rakhil SY, Bhagyadhan AP (2017):**VasculiticNeuropathy. In: Electromyography and Neuromuscular Disorders. 2nd edition, Pp. 337-350.
3. **Therimadasamy AK, Seet RC, Kagda YH, Wilder-Smith EP (2011)**:Combination of ultrasound and nerve conduction studies in the diagnosis of tarsal tunnel syndrome. Neurology India, 59 (2): 296-297.
4. **Park JW, Lee SJ, Choo HJ, Kim SK,Gwak HC, Lee SM. (2017):** Ultrasonography of the ankle joint. Ultrasonography, 2017; 36:321-335.
5. **Chari B, McNally E. (2018):**Nerve Entrapment in Ankle and Foot: Ultrasound Imaging. SeminMusculoskeletRadiol.,22:354–363.
6. **Gorson GC (2007):** Vasculitic neuropathies:an update. Neurologist; 13:12–9.
7. **Aletaha D, Neogi T, Silman AJ, Funovits J, Felson DT, BinghamCO III. (2010):** Rheumatoid arthritis classification criteria: an American Collegeof Rheumatology/EuropeanLeagueAgainst Rheumatism collaborative initiative. Arthritis Rheum., 62:2569–2581.
8. **Nagaoka M, Matsuzaki H (2005):** Ultrasonography in tarsal tunnelsyndrome. J Ultrasound Med.,24(8): 1035–40.
9. **Mondelli M, Morana P, Padua L (2004):** An electrophysiological severity scale in tarsal tunnel syndrome. ActaNeurol Scand., 109: 284–9.
10. **Ibrahim I, Medani S, El-Hameed M, Imam M, Shaaban M (2013):** Tarsal tunnel syndrome in patients with rheumatoid arthritis, electrophysiological and ultrasound study. Alexandria J Med., 49: 95- 104.
11. **Lanzillo B, Pappone N, Crisci C, et al. (1999):** Sub clinicalperipheralnerve involvementin patient with rheumatoidarthritis. Arthritis Rheum,42:1304–5.
12. **Samarawickrama D, Aravinda K, Therimadasmy, Cheun Chan Y, Vijayan J (2016):**Nerve ultrasound in electro physiologically verified tarsal tunnel syndrome. Muscle Nerve, 53: 906-912.
13. **Preston D, Shapiro B (2013):** Tarsal tunnel syndrome. In: Electromyography and neuromuscular disorders Philadelphia, 3rd Edition, Pp. 365 -372.
14. **Wallach DM, Katchis SD. (1999):**Tarsal tunnel syndrome. In: Ranawat RG,Positano RG,editors Disorders of the heel, rear foot, and ankle.Churchill:Livingston. Pp.125–34.
15. **Nagaoka M, Matsuzaki H.(2005):** Ultrasonography in tarsal tunnel syndrome. J Ultrasound Med., 24:1035-1040.
16. **Al-Dahan MA,Al-Tamimy HM,Fahmy AM,Risha MI. (2018):**NeuromuscularUltrasoundVersuslectrophysiological Studies in Assessment of Posterior Tibial Nerve Neuropathy in Rheumatoid Arthritis Patient 2018. The Egyptian Journalof Hospital Medicine, 72 (4): 4362-4367.
17. **Patel AT, Gaines K, Malamut R, Park TA, Del Toro DR, Holland N, American Association of Neuromuscular and Electrodiagnostic Medicine(2005):** Usefulnessof electrodiagnostic techniques in the evaluation of suspected tarsaltunnel 3syndrome: an evidence based review. Muscle Nerve,32:236–40.