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TWO DISTINCT MECHANISMS, ONE OUTCOME: ELECTROPHYSIOLOGICAL TRACES OF PERIPHERAL NERVES IN DIABETES MELLITUS AND RHEUMATOID ARTHRITIS

İKİ FARKLI MEKANIZMA, TEK SONUÇ: DİYABETES MELLİTUS VE ROMATOİD ARTRİTTE PERİFERİK SİNİRLERİN ELEKTROFIZYOLOJİK İZLERİ

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ABSTRACT

Introduction: Diabetes mellitus (DM) and rheumatoid arthritis (RA) affect the peripheral nervous system through distinct mechanisms, leading to polyneuropathy (PNP). This study compared nerve conduction studies in DM and RA patients, evaluating subgroups by PNP status.

Methods: Electrophysiological examinations performed between 2015 and 2025 were retrospectively reviewed, including 208 DM and 96 RA patients. Motor and sensory conduction parameters of the median, ulnar, sural, and fibular nerves were assessed. Patients were classified as PNP+ or PNP–. Group differences were analyzed, risk factors identified with logistic regression, and significant parameters tested with ROC analysis.

Results: In DM, conduction velocities were reduced, distal latencies prolonged, and amplitudes decreased ($p<0.05$). In RA, parameters were relatively preserved, with higher amplitudes than DM. Among PNP+ patients, DM showed more severe involvement; sural nerve velocity <34.5 m/s was discriminatory for DM (AUC=0.771; specificity 85.1%) from RA. In RA, PNP was mainly sensory and strongly associated with female sex (OR=7.51, 95% CI: 3.36–16.80). In PNP– patients, no major differences were found, though RA showed entrapment/demyelinating features and DM subclinical small fiber involvement.

Conclusion: DM is characterized by widespread axonal degeneration, whereas RA presents heterogeneous and milder neuropathic patterns. These differences may aid differential diagnosis and prognostic evaluation. Sural nerve conduction velocity appears particularly promising as a biomarker.

Keywords: Diabetes Mellitus, Rheumatoid Arthritis, Nerve Conduction Study, Polyneuropathy, Ulnar Sensory Conduction

ÖZET

Amaç: Diyabetes mellitus (DM) ve romatoid artrit (RA), periferik sinir sistemini farklı patofizyolojik mekanizmalarla etkileyerek polinöropatiye (PNP) yol açabilmektedir. Bu çalışmada, DM ve RA hastalarında sinir iletim çalışmalarının karşılaştırılması ve PNP varlığına göre alt grupların değerlendirilmesi amaçlanmıştır.

Yöntem: 2015–2025 yılları arasında yapılan retrospektif elektrofizyolojik incelemeler taranarak, 208 DM ve 96 RA hastası dahil edilmiştir. Median, ulnar, sural ve fibular sinirlerde motor ve duysal iletim parametreleri değerlendirilmiştir. Hastalar PNP saptananlar (PNP+) ve saptanmayanlar (PNP–) olarak ikiye ayrılarak analiz edilmiştir. Gruplar arası farklılıklar karşılaştırılmış, risk faktörleri lojistik regresyonla belirlenmiş ve anlamlı parametreler için ROC analizi uygulanmıştır.

Bulgular: DM grubunda iletim hızları belirgin şekilde düşük, distal latanslar uzun, amplitüdler azalmıştı ($p<0,05$). RA grubunda parametreler görece korunmuştu, özellikle amplitüd değerleri DM'ye kıyasla daha yüksekti. PNP+ alt grupta DM hastaları daha ağır etkilenmiş, sural sinir iletim hızının <34,5 m/sn olması DM için RA'dan ayırt edici bulunmuştur (AUC=0,771; spesifite %85,1). RA'da ise PNP daha çok duyusal tipte olup kadın cinsiyetle ilişkiliydi (OR=7,51, %95 GA: 3,36–16,80). PNP– alt grupta gruplar arasında belirgin fark izlenmezken, RA'da entrapment/demyelinizan özellikli değişiklikler, DM'de ise subklinik küçük lif tutulumuna işaret eden bulgular dikkat çekmiştir.

Sonuç: DM'de yaygın aksonal dejenerasyon, RA'da ise heterojen ve görece hafif nöropati paternleri ön plandadır. Bu farklılıkların ayırıcı tanı ve prognoz öngörüsünde klinik olarak yol gösterici olabileceği, özellikle sural sinir iletim hızının biyobelirteç potansiyeli taşıdığı düşünülmektedir.

Anahtar Kelimeler: Diyabetes Mellitus, Romatoid Artrit, Sinir iletim çalışması, Polinöropati, Ulnar duysal iletim

INTRODUCTION

The peripheral nervous system is one of the structures most frequently affected by metabolic and immunological diseases. Diabetes mellitus (DM) and rheumatoid arthritis (RA) are two of the most extensively studied systemic conditions in this regard, and the development of polyneuropathy (PNP) not only impairs patients' quality of life but also constitutes one of the major causes of long-term morbidity.

Diabetic neuropathy is among the most common complications of DM, with a prevalence reaching 30–50% (1). Metabolic disturbances secondary to chronic hyperglycemia, oxidative stress, and microvascular injury predominate in its pathophysiology, and the clinical presentation most often manifests as distal symmetric polyneuropathy (2,3).

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Peripheral nervous system involvement in RA may arise through vasculitic neuropathy, immune-mediated mechanisms, drug-related toxicity, or compressive neuropathies (4). The reported prevalence of polyneuropathy in RA ranges from 20% to 60% (5), and electrophysiological studies have described alterations in both motor and sensory fibers (6,7).

In the literature, DM and RA have typically been compared with control groups separately. While pronounced abnormalities in nerve conduction studies have consistently been reported in DM, findings in RA have been more heterogeneous (8–11). However, no study to date has directly compared DM and RA. Such a comparison is clinically relevant for differential diagnosis as well as for predicting disease course.

In this study, nerve conduction studies obtained during the initial electromyography (EMG) evaluation following diagnosis in patients with type 2 DM and RA were compared. The novelty of the study lies in moving beyond the frequently encountered DM–control or RA–control comparisons and directly juxtaposing the nerve conduction parameters of patients with DM and RA. Furthermore, analyses were performed not only on the overall patient groups but also on subgroups with (PNP+) and without (PNP–) electrophysiologically confirmed polyneuropathy. This approach aimed to provide more detailed and comparative insights into the patterns of peripheral nerve involvement across different clinical subgroups in both diseases.

METHODS

Study Design and Patient Selection

This study employed a retrospective, observational design. Electrophysiological evaluations performed between 2015 and 2025 in the Clinical Electrophysiology Laboratory of the Department of Neurology, Manisa Celal Bayar University Faculty of Medicine, were reviewed. Prior to initiation, approval was obtained from the local ethics committee (approval number 20.478.486/3420, dated 24.09.2025).

Inclusion Criteria

- Adult patients aged ≥18 years
- Diagnosis of type 2 DM or RA
- RA diagnosis fulfilling the 2010 American College of Rheumatology (ACR)/EULAR classification criteria (12)
- DM diagnosis based on the American Diabetes Association criteria (13)
- Electrophysiological assessment performed within the first 6 months after diagnosis
- Complete EMG recordings with at least the median, ulnar, sural, and fibular nerves evaluated

Exclusion Criteria

- Prior diagnosis of peripheral neuropathy
- History of chronic alcohol use
- Chronic kidney disease, liver cirrhosis, or other severe systemic illnesses
- Vitamin B12 or folate deficiency
- Thyroid dysfunction (hypothyroidism or hyperthyroidism)
- History of malignancy or prior chemotherapy
- Use of neurotoxic medications (e.g., amiodarone, isoniazid, certain chemotherapeutic agents)
- Previous peripheral nerve injury or surgery
- Presence of significant orthopedic deformities that could interfere with electrophysiological testing
- EMG findings limited solely to carpal tunnel syndrome (CTS) or isolated entrapment neuropathies

Figure 1. Study flow diagram.

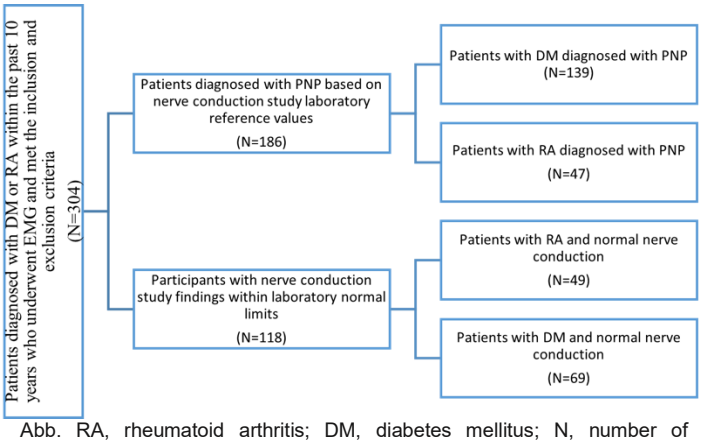

Abb. RA, rheumatoid arthritis; DM, diabetes mellitus; N, number of participants; PNP, polyneuropathy.

Electrophysiological Assessments

All patients underwent standardized nerve conduction studies using the same device (Natus Medical Inc., USA) in accordance with international guidelines (14). All examinations were performed by the same operator. In the absence of pathology on the right side, nerve conduction data for the polyneuropathy (PNP) protocol were consistently obtained from the right upper and lower extremities. During testing, laboratory room temperature was maintained between 24–26°C. Surface electrodes were used for both motor and sensory conduction studies. For each nerve, at least two recordings were obtained, and mean values were included in the analysis.

Standard nerve conduction studies were performed in all included cases. For motor nerves, distal latency, compound muscle action potential (CMAP) amplitude measured from negative to positive peak, and conduction velocity were assessed. For sensory nerves, sensory nerve action potential (SNAP) amplitude measured from baseline to negative peak, distal latency, and conduction velocity were evaluated. Latency and amplitude values were automatically calculated by the device, and conduction velocities were determined using the distance/distal latency formula.

The normative values used in our laboratory were as follows:

Figure 2. Sensitivity and specificity values of nerve conduction parameters distinguishing DM from RA in the polyneuropathy group.

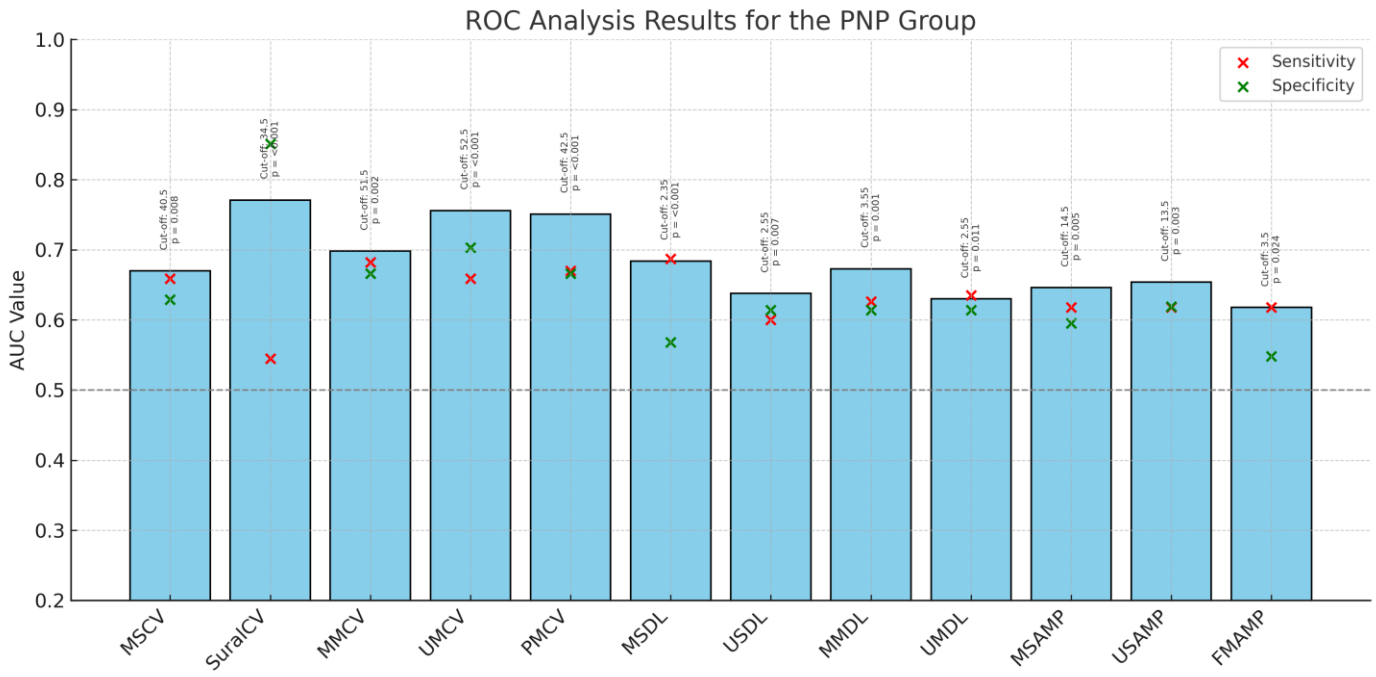

Abb. MS, median sensory; US, ulnar sensory; MM, median motor; UM, ulnar motor; FM, fibular motor; CV, conduction velocity; DL, distal latency; Amp, amplitude; PNP, polyneuropathy; ROC, receiver operating characteristic; AUC, area under the curve.

- **Median and ulnar sensory nerves:** conduction velocity >40 m/s, SNAP amplitude >20 µV, distal latency <3.0 ms
- **Sural nerve:** conduction velocity >40 m/s, SNAP amplitude >5 µV, distal latency <3.0 ms
- **Median motor nerve:** conduction velocity >50 m/s, CMAP amplitude >5 mV, distal latency <3.9 ms
- **Ulnar motor nerve:** conduction velocity >50 m/s, CMAP amplitude >6 mV, distal latency <3.0 ms
- **Fibular (peroneal) motor nerve:** conduction velocity >40.5 m/s, CMAP amplitude >3 mV, distal latency <5.3 ms *(If extensor digitorum brevis [EDB] atrophy was suspected, the contralateral EDB was evaluated when within normal limits; otherwise, the patient was excluded.)*

Values outside the age- and height-adjusted normal ranges were considered pathological. Additionally, for the purposes of this study, the presence of any abnormality (in conduction velocity, distal latency, or amplitude) in the motor or sensory parameters of the median, ulnar, sural, or fibular nerves was categorized as “pathology present”; thus, each nerve was classified into “pathology present/absent” categories for statistical analysis.

Definition of Polyneuropathy

Based on electrophysiological criteria, patients were stratified into three groups:

1. **Normal EMG:** All nerve parameters within reference limits
2. **Sensory polyneuropathy (S-PNP):** Pathological findings in at least two sensory nerves with normal motor parameters
3. **Sensorimotor polyneuropathy (SM-PNP):** Abnormalities in both motor and sensory nerves based on laboratory reference values

Figure 3. Cut-off values, areas under the curve, sensitivity, and specificity of significant nerve conduction parameters distinguishing DM from RA in patients with normal EMG findings.

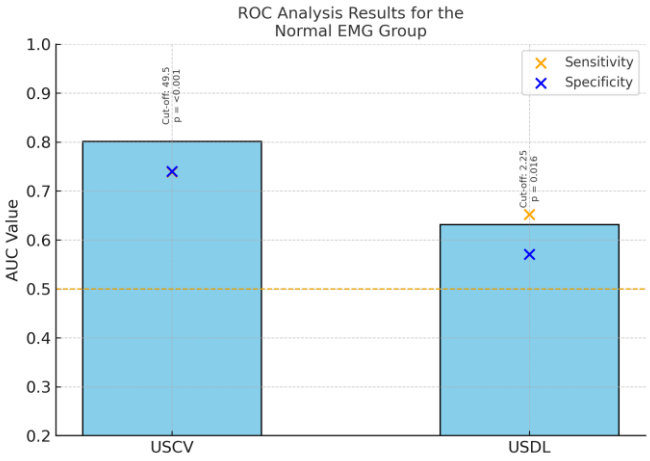

Abb. US, ulnar sensory; CV, conduction velocity; DL, distal latency; ROC, receiver operating characteristic; AUC, area under the curve.

Statistical Analysis

Statistical analyses were performed using SPSS software (version 25.0; IBM Corp., Armonk, NY). Distribution of variables was assessed with the Kolmogorov–Smirnov test. Continuous variables were expressed as mean ± standard deviation for normally distributed data, and as median (minimum–maximum) for non-normally distributed data.

Table 1. Demographic and Nerve Conduction Study Characteristics of DM and RA Patients With and Without Polyneuropathy

Variable	RA		DM		p
	N	Mean (sd)	N	Mean (sd)	
Age	96	54.08 (11.10)	208	53.59 (15.50)	1.000
Sex (F/M)	96	80/16	208	108/100	**<0.001**
MS CV	93	44.73 (5.54)	193	40.57 (10.23)	**<0.001**
MS DL	93	2.16 (0.36)	193	2.27 (0.62)	**0.005**
MS SNAP	93	25,30 (11.50)	193	20,15 (14.16)	**<0.001**
US CV	93	47.96 (5.59)	195	45.39 (9.06)	**0.034**
US DL	93	2.42 (0.37)	195	2.46 (0.53)	0.295
US SNAP	93	24.04 (10.94)	195	19.11 (12.63)	**<0.001**
Sural CV	77	40.57 (3.78)	162	34.55 (13.60)	**0.002**
Sural DL	77	2.59 (0.40)	162	2.49 (1.02)	0.101.
Sural SNAP	77	8.93 (3.79)	162	7.65 (4.39)	0.248
MM CV	95	53.47 (4.04)	207	50.00 (5.69)	**<0.001**
MM DL	95	3.29 (0.51)	207	3,74 (1.03)	**<0.001**
MM CMAP	95	10.45 (2.87)	207	10.52 (3.67)	0.169
UM CV	95	54.65 (4.33)	198	50.81 (6.05)	**<0.001**
UM DL	95	2.5 (0.40)	198	2.59 (0.46)	0.176
UM CMAP	95	12.23 (3.11)	198	11.36 (3.42)	**0.031**
FM CV	93	46.34 (4.62)	197	41.59 (7.54)	**<0.001**
FM DL	93	4.39 (0.74)	197	4.64 (1.00)	0.228
FM CMAP	93	4.50 (1.84)	197	3.92 (2.52)	**0.011**

Abb. RA, rheumatoid arthritis; DM, diabetes mellitus; SD, standard deviation; F, female; M, male; MS, median sensory; US, ulnar sensory; MM, median motor; UM, ulnar motor; FM, fibular motor; DL, distal latency; CV: conduction velocity, SNAP: sensory nerve action potential, CMAP: compound motor action potential

Group comparisons were conducted using the independent samples t-test or Mann–Whitney U test, as appropriate. Categorical variables were analyzed using the chi-square test.

Logistic regression analyses were performed to identify risk factors for polyneuropathy, and odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. For parameters showing statistically significant differences, receiver operating characteristic (ROC) curve analyses were conducted to determine cut-off values along with sensitivity and specificity. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 304 patients met the inclusion and exclusion criteria. Among them, 186 patients were diagnosed with PNP, whereas 118 patients had no PNP based on the predefined EMG criteria. Of the patients with PNP, 139 had DM and 47 had RA. In the PNP-negative group, 49 patients had DM and 69 had RA. The study flow diagram is summarized in Figure 1.

1. Comparison of All Patients (DM vs RA)

Of the 304 included patients, 208 (68.4%) had type 2 DM and 96 (31.6%) had RA. The mean age was 54.1±11.1 years in the RA group and 53.6±15.5 years in the DM group, with no significant difference between groups (p=1.000).

Table 2. Comparison of Nerve Conduction Study Parameters and Categorical Variables in All Patients

Presence of abnormality	RA		DM		p
	N	%	N	%	
MS absent/present	62/34	64.6/35.4	83/125	39.9/60.1	**<0.001**
US absent/present	66/30	68.8/31.3	89/119	42.8/57.2	**<0.001**
Sural absent/present	51/45	53.1/46.9	70/138	33.7/66.3	**0.001**
MM absent/present	90/6	93.8/6.2	128/80	61.5/38.5	**<0.001**
UM absent/present	89/5	89.4/10.6	129/72	64.2/35.8	**<0.001**
FM absent/present	88/7	92.6/7.4	121/86	58.5/41.5	**<0.001**
Normal/S-PNP/SM-PNP	49/38/9	51/39.6/9.4	69/50/89	33.2/24/42.8	**<0.001**

Abb. RA, rheumatoid arthritis; DM, diabetes mellitus; N, number; MS, median sensory; US, ulnar sensory; MM, median motor; UM, ulnar motor; FM, fibular motor; S-PNP, sensory polyneuropathy; SM-PNP, sensorimotor polyneuropathy.

Regarding sex distribution, women constituted 83.3% of the RA group and 52.0% of the DM group; this difference was statistically significant (p<0.001). Demographic and electrophysiological parameters are summarized in Table 1. In nerve conduction studies, median motor conduction velocity was significantly higher in the RA group (44.7±5.5 m/s) than in the DM group (40.6±10.2 m/s) (p<0,001). Similarly, median and ulnar CMAP amplitudes were higher in RA patients (p<0.001). Conversely, distal latency values were longer in the DM group (p=0.005). A similar pattern was observed in the lower extremities: sural nerve conduction velocity averaged 40.6±3.8 m/s in RA and 34.5±13.6 m/s in DM (p=0.002). Fibular motor conduction velocities were also higher in RA (46.3±4.6 m/s vs 41.6±7.5 m/s, p<0.001) (Table 1).

Table 3. Risk Analysis of Demographic and Nerve Conduction Study Parameters for Differentiating Between Diseases

	ORR	Lower CI	Upper CI
Factors Increasing the Risk of RA			
Sex: Female	4.630	2.536	8.450
Factors Increasing the Risk of DM			
MS abnormality	2.746	1.662	4.537
US abnormality	2.942	1.764	4.906
Sural abnormality	2.234	1.364	3.659
MM abnormality	9.375	3.919	22.429
UM abnormality	8.279	3.449	19.871
FM abnormality	8.935	3.944	20.243

Abb. RA, rheumatoid arthritis; DM, diabetes mellitus; MS, median sensory; US, ulnar sensory; MM, median motor; UM, ulnar motor; FM, fibular motor; OR, odds ratio; CI, confidence interval.

When electrophysiological findings were categorized as pathological versus non-pathological, all parameters differed significantly between groups (p<0.05). Chi-square analyses for categorical variables are summarized in Table 2. Additionally, univariate analyses evaluating the predictive value of nerve conduction abnormalities showed that being female increased the likelihood of RA by 4.63-fold (OR=4.63, 95% CI: 2.53–8.45), whereas the presence of abnormalities—more prominently in motor than sensory

Table 4. Comparison of Demographic and Electrophysiological Parameters Between Diagnostic Subgroups in Patients With Polyneuropathy Detected on Nerve Conduction Studies

Variable	RA		DM		p
	N	Mean (sd)	N	Mean (sd)	
Age	47	59.31 (9.70)	139	58.14(13.03)	0.943
Sex (F/M)	47	37/10	139	62/77	**<0.001**
MS CV	44	42.75 (6.19)	124	36.53 (10.06)	**<0.001**
MS DL	44	2.30 (0.41)	124	2.44 (0.69)	**0.002**
MS SNAP	44	17,88 (9.27)	124	12.56 (8.22)	**<0.001**
US CV	44	46.11 (6.13)	126	41.99 (9.11)	**0.001**
US DL	44	2.52 (0.41)	126	2.60 (0.57)	**0.015**
US SNAP	44	18.09 (10.36)	126	12.50 (7.55)	**<0.001**
Sural CV	28	36.46 (2.11)	93	27.82 (14.35)	**<0.001**
Sural DL	28	2.8 (0.38)	93	2.40 (1.30)	0.822
Sural SNAP	28	7.35 (2.94)	93	5.72 (3.89)	0.068
MM CV	46	51.84(4.43)	138	47.89 (5.32)	**<0.001**
MM DL	46	3.48 (0.55)	138	4.09 (1.07)	**<0.001**
MM CMAP	46	9.89(2.77)	138	9.66 (3.33)	0.569
UM CV	47	53.44 (4.74)	136	48.42 (5.57)	**<0.001**
UM DL	47	2.58 (0.43)	136	2.74 (0.44)	**0.011**
UM CMAP	47	11.04 (3.34)	136	10.52 (3.31)	0.187
FM CV	44	44.52 (3.73)	129	38.46 (7.14)	**<0.001**
FM DL	44	5.46 (5.83)	128	4.93 (1.03)	0.069
FM CMAP	44	3.93 (1.52)	129	3.32 (2.56)	**0.002**

Abb. RA, rheumatoid arthritis; DM, diabetes mellitus; SD, standard deviation; F, female; M, male; MS, median sensory; US, ulnar sensory; MM, median motor; UM, ulnar motor; FM, fibular motor; DL, distal latency; CV: conduction velocity, SNAP: sensory nerve action potential, CMAP: compound motor action potential

conduction—significantly increased the likelihood of DM (p<0.05, Table 3).

2. Comparison of Patients with PNP

Among patients with confirmed polyneuropathy, 47 (49%) were in the RA group and 139 (66.8%) in the DM group. Sex distribution again differed, with females predominating in RA (79%), whereas males were more common in DM (55.4%, p<0.001).

Median motor conduction velocity was 42.8±6.2 m/s in RA and 36.5±10.1 m/s in DM (p<0.001). Sural conduction velocity averaged 36.5±2.1 m/s in RA and was markedly lower in DM (27.8±14.3 m/s, p<0.001). RA patients also exhibited higher amplitude values compared with DM (Table 4).

Categorizing each nerve as pathological or non-pathological yielded chi-square and risk analysis results consistent with those obtained in the overall cohort. When PNP subtypes were evaluated, patients with sensory PNP (a milder pattern) had a 7.51-fold higher likelihood of having RA relative to DM (OR=7.516, 95% CI: 3.360–16.809, p<0.001). Findings are detailed in Tables 5 and 6.

Table 5. Differences in Categorical Variables Between Polyneuropathy Subgroups Identified on Nerve Conduction Studies

Presence of abnormality	RA		DM		p
	N	%	N	%	
MS absent/present	14/33	29.8/70.2	14/125	10.1/89.9	**0.002**
US absent/present	17/30	36.2/63.8	20/119	14.4/85.6	**0.002**
Sural absent/present	2/45	4.3/95.7	1/138	0.7/99.3	0.158
Sural response absent/present	26/19	57.8/42.2	73/65	52.9/47.1	0.346
MM absent/present	41/6	87.2/12.8	59/80	42.4/57.6	**<0.001**
UM absent/present	42/5	89.4/10.6	64/72	47.1/52.9	**<0.001**
FM absent/present	39/7	84.8/15.2	52/86	37.7/62.3	**<0.001**
S-PNP/SM-PNP	38/9	80.9/19.1	50/89	36/64	**<0.001**

Abb. RA, rheumatoid arthritis; DM, diabetes mellitus; N, number; MS, median sensory; US, ulnar sensory; MM, median motor; UM, ulnar motor; FM, fibular motor; S-PNP, sensory polyneuropathy; SM-PNP, sensorimotor polyneuropathy.

ROC analyses identified cut-off values for parameters with significant discriminatory ability. For instance, the cut-off value for sural conduction velocity was 34.5 m/s, with values below this threshold indicating a higher likelihood of DM (AUC=0.771; sensitivity 54.5%; specificity 85.1%). Sensitivity and specificity values of significant nerve conduction parameters in the PNP group are summarized in Figure 2.

Table 6. Demographic and Electrophysiological Predictive Risk Factors for RA and DM in Patients With Polyneuropathy Identified on Nerve Conduction Studies

	ORR	Lower CI	Upper CI
Factors Increasing the Risk of RA			
Sex: Female	4.595	2.118	9.969
PNP type: Sensory	7.516	3.360	16.809
DM riskini arttıran faktörler			
MS abnormality	3.788	1.645	8.724
US abnormality	3.372	1.576	7.213
MM abnormality	9.266	3.691	23.258
UM abnormality	9.450	3.524	25.343
FM abnormality	9.214	3.841	22.106

Abb. RA, rheumatoid arthritis; DM, diabetes mellitus; MS, median sensory; US, ulnar sensory; MM, median motor; UM, ulnar motor; FM, fibular motor; OR, odds ratio; CI, confidence interval.

3. Comparison of Patients with Normal EMG

Among patients with normal EMG, 49 (51%) were in the RA group and 69 (33.2%) in the DM group. The mean ages were similar (RA: 49.1±10.1 years; DM: 44.4±16.1 years; p=0.145). Women constituted 87.8% of the RA group and 66.7% of the DM group (p=0.007).

In this subgroup, no significant differences were observed in most nerve conduction parameters. However, ulnar sensory conduction velocity was higher in the DM group (51.6±4.6 m/s) than in the RA group (49.6±4.5 m/s)

(p=0.029). No other parameters showed statistically significant differences (p>0.05, Table 7). ROC analyses for ulnar sensory SNAP conduction velocity and distal latency are presented in Figure 3.

Table 7. Comparison of Demographic and Electrophysiological Parameters in DM and RA Patients With Normal Nerve Conduction Studies

Variable	RA		DM		p
	N	Mean (sd)	N	Mean (sd)	
Age	49	49.06 (10.05)	69	44.42(16.09)	0.145
Sex (F/M)	49	43/6	69	46/23	**0.007**
MS CV	49	46.51 (4.21)	69	47.84 (5.38)	0.323
MS DL	49	2.03 (0.24)	68	1.96 (0.29)	0.182
MS SNAP	49	32.12 (8.87)	69	33.78 (12.27)	0.959
US CV	49	49.63 (4.52)	69	51.60 (4.57)	**0.029**
US DL	49	2.34 (0.30)	69	2.20 (0.33)	**0.015**
US SNAP	49	29.38 (8.46)	69	31.18 (11.03)	0.674
Sural CV	49	42.91 (2.16)	69	43.62 (3.72)	0.635
Sural DL	49	2.4 (0.36)	69	2.61 (0.42)	0.066
Sural SNAP	49	9.83 (3.94)	69	10.26 (3.64)	0.375
MM CV	49	55.0(2.94)	69	54.81 (2.94)	0.680
MM DL	49	3.11 (0.41)	69	3.04 (0.42)	0.450
MM CMAP	49	11.0(2.89)	69	12.26 (3.74)	0.051
UM CV	48	55.83 (3.56)	62	56.06 (2.95)	0.964
UM DL	48	2.41 (0.34)	62	2.26 (0.31)	0.051
UM CMAP	48	13.39 (2.39)	62	13.20 (2.92)	0.512
FM CV	49	47.97 (4.76)	69	47.44 (3.92)	0.769
FM DL	49	4.24 (0.71)	69	4.10 (0.69)	0.360
FM CMAP	49	5.01 (1.95)	69	5.05 (2.02)	0.931

Abb. RA, rheumatoid arthritis; DM, diabetes mellitus; SD, standard deviation; F, female; M, male; MS, median sensory; US, ulnar sensory; MM, median motor; UM, ulnar motor; FM, fibular motor; DL, distal latency; CV: conduction velocity, SNAP: sensory nerve action potential, CMAP: compound motor action potential

DISCUSSION

In this study, the initial nerve conduction studies performed after diagnosis in patients with type 2 DM and RA were compared. Our findings indicate that peripheral neuropathy is more severe in DM, whereas RA exhibits a milder and more heterogeneous electrophysiological profile. Although numerous studies have compared DM and RA separately with healthy controls, no prior work has directly compared these two diseases. In this respect, our study provides an original contribution. The results may also help predict the etiology of polyneuropathy in patients with coexisting DM and RA, thereby informing clinical decisions and therapeutic strategies.

In the DM group, conduction velocities in the median, ulnar, sural, and fibular nerves were significantly lower, distal latencies were prolonged, and amplitudes were reduced. These findings are consistent with the typical features of diabetic neuropathy. Recent reviews have emphasized that the prevalence of diabetic neuropathy ranges between 30–50% and that its clinical course is predominantly characterized by axonal degeneration (8,9). Several recent studies have investigated the diagnostic sensitivity and specificity of nerve conduction studies in diabetes, reporting ROC analyses for the sural nerve, dorsal sural nerve (15), medial plantar responses (16), and the sural/radial amplitude ratio (17). However, studies evaluating the ability of NCS parameters to distinguish between different etiologies have mainly compared CIDP and DM, showing that no single parameter provides perfect differentiation, although F-wave latency and median motor conduction velocity may offer greater diagnostic utility (18). To date, no data have addressed the discriminatory role of nerve conduction studies in differentiating neuropathy caused by DM and RA. Such data are particularly relevant in older patients with multiple PNP risk factors. In our cohort, the prevalence of diabetic PNP was higher than in many published studies, and significant differences in nerve conduction parameters were observed between DM and RA regardless of PNP status.

Small fiber neuropathy may appear early in diabetes and may not always be detected by standard NCS (19). Therefore, we also compared nerve conduction findings in DM and RA patients whose EMG results were normal. Although all values were within the laboratory reference ranges, ulnar sensory conduction velocity and distal latency were worse in RA than in DM. Other nerve conduction parameters were similar between the PNP(–) RA and PNP(–) DM groups.

Although nerve conduction parameters were relatively preserved in RA compared with DM, female sex was identified as a significant risk factor for neuropathy. Peripheral nerve involvement in RA may be related to vasculitic neuropathy, drug-induced toxicity (e.g., methotrexate or biologic agents), and compressive neuropathies (10). Current evidence indicates that peripheral neuropathy develops in 20–60% of RA patients (11). With the widespread use of biologic agents, immune-mediated mechanisms have gained importance, and atypical patterns of nervous system involvement have been reported in some cases (20). The higher amplitudes observed in RA compared with DM in our study suggest that neuropathy mechanisms in RA may be more heterogeneous and potentially reversible.

Among patients with polyneuropathy, the DM group was more severely affected than the RA group. The cut-off values derived from sural conduction velocity, which showed strong discriminatory power for DM, suggest its potential applicability in clinical practice. Similarly, Pop-Busui et al. (8) proposed sural conduction velocity as a sensitive diagnostic parameter for diabetic neuropathy. In RA, polyneuropathy appeared predominantly sensory and was more common in women. This further supports the notion that length-dependent axonal injury in DM differs not only from healthy individuals but also from other disease etiologies.

In patients with normal EMG findings, no major differences were observed between groups. However, RA patients without PNP showed reduced ulnar sensory conduction velocity and prolonged distal latency, whereas DM patients with PNP exhibited marked abnormalities in the ulnar nerve. This pattern reinforces the concept that the mechanisms of peripheral nerve involvement differ between DM and RA.

In diabetes, the subclinical phase may begin with small fiber neuropathy, during which standard EMG parameters have limited sensitivity (21). In RA, subclinical nerve involvement

is often related to immune-mediated processes, underscoring the increasing relevance of biomarker studies (22). Additionally, synovitis, tenosynovitis, and joint deformities in RA predispose to ulnar nerve compression at the cubital tunnel or Guyon's canal. This can produce a demyelinating pattern characterized by slowed conduction velocity and prolonged distal latency with relatively preserved amplitude, potentially detectable at a subclinical level without meeting PNP criteria (23,24). Peripheral neuropathy in RA may be detected by nerve conduction studies even in the absence of clinical symptoms, particularly through reduced ulnar sensory conduction velocity and prolonged latency in the upper extremities (25). In contrast, diabetic polyneuropathy is predominantly axonal, characterized by reduced SNAP amplitudes and more severe impairments in conduction parameters (26). Vasculitic neuropathy in RA, although rare, typically presents with asymmetric and axonal features (27). Our findings support that PNP-negative RA patients exhibit patterns consistent with local entrapment or demyelination, whereas PNP-positive DM patients display a more generalized axonal polyneuropathy.

The major strength of this study is that it represents the first direct comparison of DM and RA in terms of nerve conduction abnormalities. Additionally, subgroup analyses based on PNP status provide more nuanced clinical insights. However, the retrospective design is a limitation, and parameters such as glycemic control (HbA1c) and disease duration in DM were not evaluated. Nonetheless, we included the first nerve conduction study performed after diagnosis. Larger, prospective studies with long-term follow-up are needed.

CONCLUSION

In conclusion, nerve conduction studies reveal distinct patterns in DM and RA. Axonal degeneration and sensorimotor involvement predominate in DM, whereas RA demonstrates milder and more heterogeneous abnormalities. These differences may be useful for differential diagnosis and prognostic assessment. Parameters such as sural conduction velocity may also serve as practical biomarkers in clinical settings.

Ethics Committee Approval: Prior to the initiation of the study, approval was obtained from the local ethics committee (No. 20.478.486/3420, dated September 24, 2025).

Informed Consent: Informed consent was not obtained from the patients owing to the retrospective design of the study.

Authorship Contributions: Concept – YIG.; Design – YIG.; Supervision – YIG HM.; Data collection &/or processing – YIG BCA AŞS.; Analysis &/or interpretation – YIG HM AŞS Literature search – YIG HM Writing – YIG HM; Critical review – HM.

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