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Original Research Article

Comparison of Nerve Conduction Parameters in Ulnar and Common Peroneal Nerves between Rheumatoid Arthritis Patients and Healthy Controls: A Cross-Sectional Study in Northern India

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Abstract

Background: Rheumatoid Arthritis (RA) is a chronic autoimmune disorder characterized by synovial inflammation, joint destruction, and systemic manifestations, including peripheral neuropathy. Despite the high prevalence of RA in India, data on its neurological impact, especially from northern regions like Agra, remain limited.

Objective: To assess and compare motor and sensory nerve conduction velocities (NCV) in the ulnar and common peroneal nerves of RA patients versus healthy adults, to identify early evidence of peripheral neuropathy.

Methods: A cross-sectional observational study was conducted on 30 diagnosed RA patients and 30 age-and sex-matched healthy controls at Sarojini Naidu Medical College, Agra. Motor and sensory NCV studies were performed bilaterally on ulnar and common peroneal nerves using standardized surface electrode techniques. Mean NCV values (±SD) were compared using independent t-tests, and significance was set at $p < 0.05$.

Results: RA patients showed significantly reduced motor and sensory nerve conduction velocities compared to controls. The most pronounced reductions were observed in the right common peroneal nerves. ($p < 0.05$ for all comparisons).

Conclusion: RA patients in the Agra region demonstrated significantly impaired nerve conduction velocities in both upper and lower limb peripheral nerves. These findings suggest a high prevalence of both clinical and subclinical peripheral neuropathy in RA, underscoring the importance of routine electrophysiological screening for early neurological involvement and improved disease management.

Keywords: Rheumatoid Arthritis, Peripheral neuropathy, Nerve Conduction Studies, Ulnar Nerve, Common Peroneal Nerve, Subclinical Neuropathy.

Introduction

Rheumatoid arthritis (RA) is a chronic systemic autoimmune disease characterized by persistent synovitis, systemic inflammation, and progressive joint destruction, typically involving small joints in a symmetrical pattern. Extra-articular manifestations are frequent, particularly in the lungs, cardiovascular system, and peripheral nervous system [1].

The pathogenesis of RA involves activation of T and B lymphocytes and the release of pro-inflammatory cytokines such as TNF-α, IL-6, and IL-1, which contribute to both joint and systemic damage [2]. Globally, RA affects approximately 0.3%–1% of the population, with prevalence highest in North America and Europe and relatively lower in Asia and Africa [3,4]. The disease contributes substantially to morbidity, work disability, and escalating healthcare costs. In India, prevalence ranges from 0.4% to 1.3%, with delayed diagnosis and limited access to specialized care often leading to advanced disease and irreversible joint damage [5–7].

Peripheral neuropathy is a common but under-recognized extra-articular manifestation of RA. It may present as distal sensory neuropathy, mononeuritis multiplex, or entrapment neuropathies such as carpal tunnel syndrome and ulnar nerve involvement [8]. Reported prevalence varies widely (20–50%), with longer disease duration and RF/ACPA positivity identified as risk factors [9]. Nerve conduction studies (NCS) provide a sensitive and reliable tool for detecting subclinical

neuropathies in RA patients. Abnormalities commonly include prolonged latencies, reduced conduction velocities, and decreased amplitudes in both motor and sensory nerves [10,11]. However, existing literature from India, particularly from northern regions, remains limited and shows inconsistent findings—some reporting significant NCS alterations while others finding no major differences compared with controls [12].

This study aimed to evaluate motor and sensory nerve conduction parameters of the ulnar and common peroneal nerves in RA patients in northern India and to compare these with healthy individuals. The objective was to assess the prevalence and characteristics of peripheral neuropathy in this population to aid in early diagnosis and improved management of neurological complications in RA.

Materials and Methods

This observational cross-sectional study was conducted over one year in the Department of Physiology, in collaboration with the Departments of Orthopaedics and Medicine, Sarojini Naidu Medical College, Agra.

Participants: After obtaining Institutional Ethics Committee approval, 30 RA patients attending Orthopaedics and Medicine OPDs were recruited using simple random sampling.

Thirty age- and sex-matched healthy individuals from hospital staff and local residents were included as controls. Written informed consent was obtained from all participants.

Inclusion Criteria:

- Age 20–60 years, both sexes
- Diagnosis of RA per 1987 ACR and 2010 ACR/EULAR classification criteria (score ≥6)
- Positive rheumatoid factor (RF), raised ESR, and elevated CRP

Exclusion Criteria:

- Chronic alcohol or smoking history
- Exposure to heavy metals
- Neurological, vascular, metabolic, or psychiatric disorders
- Vitamin B6/B12 deficiency, fibromyalgia
- Use of neurotoxic drugs
- History of leprosy

Pre-Assessment Preparation: Participants were instructed to avoid caffeine, sedatives, and strenuous activity for 24 hours before the test. A light breakfast was permitted. All recordings were conducted in a quiet laboratory at 25°C, with subjects in a supine, relaxed state.

Clinical and Neurological Examination: Each subject underwent a detailed orthopedic and neurological assessment to exclude confounding conditions.

Nerve Conduction Studies (NCS): NCS were performed using the Neurostim NS-2 system (Medicaid Instruments, India). Standardized surface electrode techniques were applied. Motor and sensory NCV were recorded bilaterally from the ulnar (upper limb) and common peroneal nerves (lower limb).

Ulnar Motor NCV: Recording from abductor digiti minimi; stimulation at wrist (distal) and medial epicondyle (proximal). (Fig.1)

Figure 1: Electrode Placement for Right side Ulnar Motor Nerve

Ulnar Sensory NCV: Recording with ring electrode at 5th MCP joint; stimulation 3 cm distal to wrist crease along ulnar border (antidromic). (Fig.2)

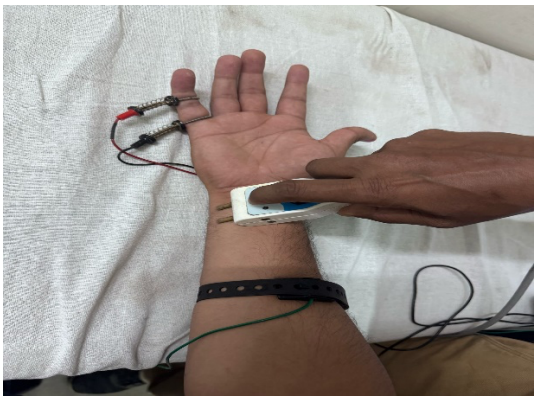

Figure 2: Electrode Placement for Right side Ulnar Sensory Nerve

Common Peroneal Motor NCV: Recording from extensor digitorum brevis; stimulation at ankle (distal) and 2 cm below fibular neck (proximal). (Fig.3)

Figure 3: Electrode placement for Right side CPN Motor nerve

Superficial Peroneal Sensory NCV: Recording above junction of lateral third of line connecting malleoli; stimulation 10–15 cm proximal to lateral malleolus (antidromic). (Fig.4)

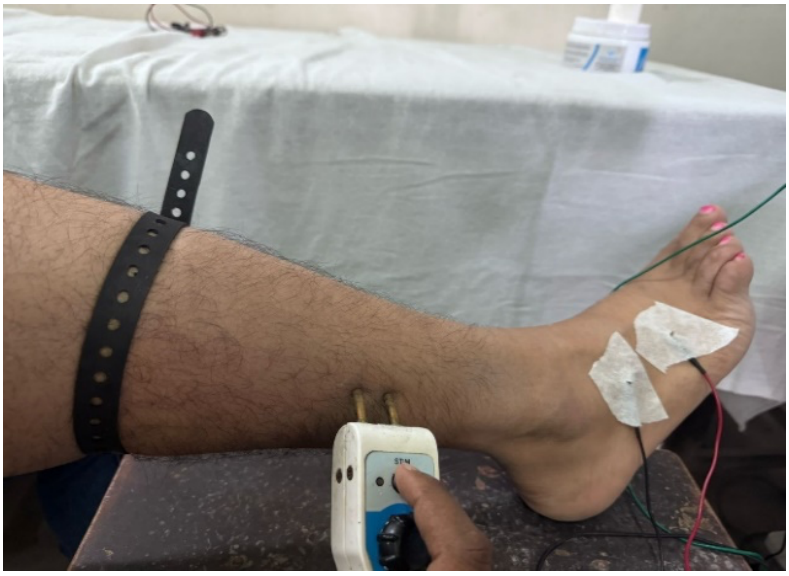

Figure 4: Electrode placement for Right side Superficial Peroneal Sensory nerve.

Latency, amplitude, and conduction velocity values were recorded and analyzed.

Statistical Analysis: Data were analyzed using SPSS version 20.0. Results were expressed as mean ± SD. Group comparisons were performed using unpaired t-tests. Pearson's correlation was used to assess relationships between variables. A p-value <0.05 was considered statistically significant.

Results

The study included 30 RA patients and 30 age- and sex-matched healthy controls.

Demographics: The gender distribution was balanced: RA group (16 males, 14 females), controls (14 males, 16 females). (Fig 5)

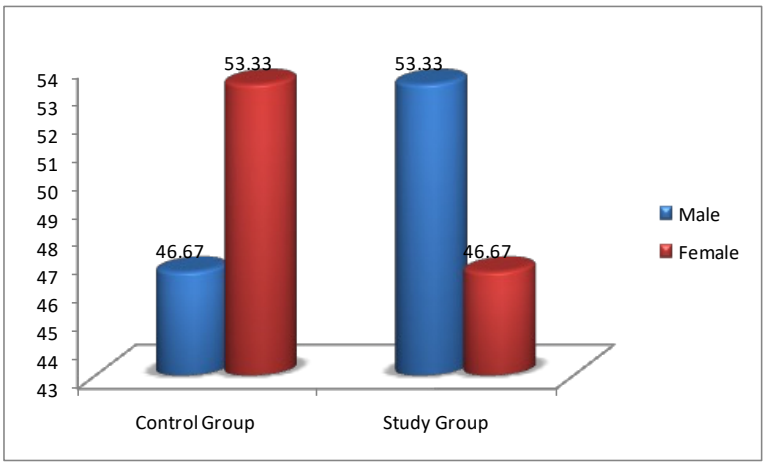

Figure 5: Graphical Representation of Gender wise Distribution of both groups

By applying chi-square test, the difference in distribution of gender in both groups was found to be statistically non-significant**.** (P>0.05)

General Parameters: The comparison of mean age and BMI between the study and control groups using the unpaired t-test showed a p-value >0.05, indicating that the difference in age and BMI between the two groups was statistically not-significant. (Table 1)**.**

Table 1: Shows the comparison of general parameters between study group and control group. (n= 30)

Parameter	Study Group	Control group	P
Age (Years)	40.33 ±10.97	40.03 ±11.61	>0.05
BMI (Kg/m^2)	24.95 ± 2.66	25.29 ± 5.25	>0.05

BMI: Body Mass Index; P >0.05 = Not Significant

NCV Parameters:

Motor Nerve Conduction: MNCV was consistently lower in RA patients. (Table 2).

Table 2: Comparison of Motor Nerve Conduction Velocity (MNCV) Between Study and Control Groups (n=30)

Nerve	Study Group	Control group	P
MNCV Left Ulnar	49.17 ± 4.73	58.53 ± 5.43	0.001*
MNCV Right Ulnar	51.33 ± 4.92	59.66 ± 5.32	0.016*
MNCV Left CPN	40.39 ± 3.75	47.40 ± 4.80	0.021*
MNCV Right CPN	38.85 ± 4.43	46.54 ± 4.28	0.0001***

All data expressed as Mean + S.D. *p < 0.05 = significant, **p < 0.01 = strongly significant, ***p < 0.001 = highly significant.

Sensory Nerve Conduction: Significant reductions in SNCV were observed in RA patients compared with controls across all nerves tested. (Table 3)

Table 3: Comparison of Sensory Nerve Conduction Velocity (SNCV) between Study and Control Groups. (n=30)

Nerve	Study Group	Control group	P
SNCV Left Ulnar	46.25 ± 6.75 m/s	54.92 ± 5.86 m/s	0.032*
SNCV Right Ulnar	46.43 ± 5.26 m/s	54.63 ± 4.30 m/s	0.012*
SNCV Left SPN	39.74 ± 7.93 m/s	48.49 ± 3.24 m/s	0.002**
SNCV Right SPN	40.69 ± 3.35 m/s	48.70 ± 3.35 m/s	0.0001***

All data expressed as Mean + S.D. *p < 0.05 = significant, **p < 0.01 = strongly significant, ***p < 0.001 = highly significant.

Discussion

RA is an autoimmune disorder with systemic manifestations beyond joint inflammation. Peripheral neuropathy is one of the most frequent extra-articular complications, often underdiagnosed due to overlapping musculoskeletal symptoms. Our findings revealed significant reductions in both sensory and motor NCV in RA patients compared with controls, consistent with studies by Bekkelund

et al. and Sulaiman et al. (2011), who reported demyelinating features and conduction delays. [12] Sensory involvement was particularly notable, aligning with reports by Biswas et al. and Dash & Thakur (2019), who documented a higher prevalence of sensory neuropathy in RA. [9,13]

A significant reduction in motor conduction velocity of the ulnar and common peroneal nerves was observed among RA patients when compared to controls. For the ulnar nerve, the mean MNCV of the left limb was 49.17 ± 4.73 m/s in the study group versus 58.53 ± 5.43 m/s in the control group ($p < 0.001$), and for the right limb, it was 51.33 ± 4.92 m/s versus 59.66 ± 5.32 m/s ($p < 0.001$). This indicated a significant bilateral impairment of motor nerve conduction in the upper limbs of RA patients.(Table 2)

In the lower limbs, similar reductions were noted. The MNCV of the left common peroneal nerve (CPN) was 40.39 ± 3.75 m/s in RA patients compared to 47.40 ± 4.80 m/s in controls, and the right CPN showed values of 38.85 ± 4.43 m/s versus 46.54 ± 4.28 m/s ($p < 0.001$). These findings suggested that motor neuropathy in RA is not limited to localized joint areas but extends systemically to multiple peripheral nerves. We also observed significant reductions in sensory nerve conduction velocities in RA patients. The left ulnar SNCV was 46.25 ± 6.75 m/s in the study group versus 54.92 ± 5.86 m/s in the control group ($p < 0.001$), and the right ulnar SNCV was 46.43 ± 5.26 m/s versus 54.63 ± 4.30 m/s ($p < 0.001$). (Table3) These findings clearly demonstrated bilateral sensory nerve involvement of the upper limbs.

For the lower limbs, superficial peroneal nerve (SPN) conduction was similarly affected. The left SPN SNCV was 39.74 ± 7.93 m/s in RA patients compared to 48.49 ± 3.24 m/s in controls, and the right SPN SNCV was 40.69 ± 3.35 m/s compared to 48.70 ± 3.35 m/s ($p < 0.001$). These results indicated diffuse sensory nerve involvement, which is critical in explaining symptoms such as numbness, tingling, and paresthesia's in RA patients—often mistaken for non-neurological joint discomfort.

Neuropathy in RA may result from chronic systemic inflammation, vasculitis, immune-mediated demyelination, or compressive neuropathies at entrapment-prone sites (e.g., elbow, fibular head). These mechanisms collectively contribute to axonal degeneration and impaired conduction.

Limitations: The sample size was modest (n=60), limiting generalizability. Only ulnar and common peroneal nerves were studied; other clinically relevant nerves (e.g., median, sural) were not assessed. Cross-sectional design precludes establishing causal relationships between RA duration/severity and neuropathy. Medication history and disease activity scores (DAS28) were not systematically analyzed, which may influence neuropathy prevalence.

Future Scope: Future studies should include larger multicenter cohorts with longitudinal follow-up to determine progression of neuropathy over disease duration. Incorporating quantitative sensory testing, autonomic function assessment, and high-resolution ultrasonography may further improve early detection. Evaluating the impact of disease-modifying antirheumatic drugs (DMARDs) and biologics on nerve function would also provide clinically valuable insights.

Conclusion

This study demonstrated significant reductions in both sensory and motor nerve conduction velocities of ulnar and common peroneal nerves in RA patients compared to healthy controls, indicating both clinical and subclinical peripheral neuropathy. Early electrophysiological evaluation can aid in timely diagnosis and management of neurological complications, potentially improving quality of life and functional outcomes in RA.

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