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Patterns of Radial Neuropathy Presenting as Wrist Drop: Diagnostic Challenges and Electrophysiological Insights.

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Abstract:

Background:

Radial neuropathy is a common aetiology of wrist drop, usually arising from compression, trauma, or iatrogenic injury. The precise localisation of the lesion by electrophysiological tests is essential for diagnosis and therapy. This study seeks to assess the clinical patterns, aetiologies, and electrophysiological characteristics of radial neuropathy manifesting as wrist drop in a tertiary care setting.

Methods:

This retrospective observational study was performed in the Department of Neurology, MTI Lady Reading Hospital, Peshawar, over three years from January 2022 to December 2024. Adult patients (≥18 years) diagnosed with wrist drop attributable to radial neuropathy were included based on clinical and electrophysiological criteria. Demographic data, clinical presentations, aetiologies, imaging results, and nerve conduction investigations were gathered and analysed by descriptive and inferential statistics.

Results:

A total of 68 patients participated, comprising 48 males (70.6%) and 20 females(31.4%) females with a mean age of 42.3 ± 15.2 years. The right arm was predominantly afflicted in 39 patients (57.4%). The predominant cause was compression neuropathy in 26 patients (38.2%), with "Saturday night palsy" constituting 17 of these cases (65.4%), followed by trauma in 18 patients (26.5%) and iatrogenic injuries in 12 patients (17.6%). High radial nerve palsy was the predominant lesion location in 42 patients (61.8%), followed by posterior interosseous nerve syndrome in 20 patients (29.4%) and radial tunnel syndrome in 6 patients (8.8%). Electrophysiological investigations validated the localisation and severity of the lesion. Imaging was conducted in 32 patients, 47.1% of patients, demonstrating nerve compression or signal alterations in the majority of instances. All patients received conservative treatment; early diagnosis was substantially correlated with expedited recovery ($p < 0.05$).

Conclusions:

Radial neuropathy primarily results from external compression, particularly during sleep-related positions. Electrophysiological studies are crucial for the diagnosis and differentiation of lesion types.

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Conservative management produces positive results, especially when implemented early. Additional prospective studies are necessary to assess long-term prognosis and improve treatment strategies.

Keywords:
Radial nerve palsy, Wrist drop, Compression neuropathy, Electrophysiology, Saturday night palsy, Posterior interosseous nerve syndrome, Nerve conduction studies, Peripheral nerve injury.

Introduction:

Radial neuropathy, commonly presenting as wrist drop, arises from the impairment of the radial nerve, which innervates the extensor muscles of the wrist and fingers. The radial nerve's anatomical course, originating from the posterior cord of the brachial plexus and traversing the spiral groove of the humerus, predisposes it to injury at various levels (1) (2) (3).
It is the third most prevalent focal mononeuropathy of the upper extremity, following median and ulnar neuropathies. Muscle weakness, especially wrist drop, is the primary clinical manifestation of most instances of radial neuropathy, and a comprehension of radial nerve architecture typically facilitates lesion localization [3].
Etiologies of radial neuropathy are diverse and include external compression (e.g., prolonged pressure while sleeping—"Saturday night palsy"), trauma such as humeral shaft fractures, penetrating injuries, improper tourniquet application, and iatrogenic causes, including intramuscular injections or surgical interventions (4) (5).

Compressive neuropathies, such as "Saturday night palsy," constitute a considerable percentage of radial nerve injuries worldwide, particularly among young adults (4).In resource-limited settings, improper intramuscular injection techniques represent a significant risk factor (5). Furthermore, occupational hazards, such as prolonged leaning on elbows or improper use of crutches, have been reported as contributing causes in specific populations (6).
The clinical presentation of radial neuropathy is dependent on the location and severity of the lesion. High radial nerve palsy, resulting from compression in the spiral groove, presents with wrist and finger drop, while posterior interosseous nerve (PIN) syndrome, a branch of the radial nerve, may cause isolated motor deficits without sensory involvement. Distinguishing these subtypes is crucial for effective management (7) (8). Radial tunnel syndrome presents with pain and may lack objective motor or sensory findings (9).
Electrophysiological studies, including nerve conduction studies (NCS) and electromyography (EMG), are pivotal in localizing the lesion and assessing the severity of nerve involvement (10) (1).
High-resolution ultrasound and magnetic resonance neurography have become important adjuncts in atypical or refractory cases, offering anatomical insights into nerve entrapments and structural abnormalities (11) (12).

Despite the clinical significance of radial neuropathy, there is a paucity of regional data regarding its patterns, aetiology, and prognosis, especially from low-resource areas, and data pertaining to Pakistan is limited. Prior local studies have emphasized the prevalence and etiology of wrist drop in clinical settings; however, comprehensive evaluations that include electrophysiological data and diagnostic difficulties are limited (5).

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This study aims to assess the clinical and electrophysiological features of radial neuropathy manifesting as wrist drop in patients at a tertiary care centre. Understanding the range of aetiologies, lesion locations, and recovery trajectories can enhance diagnostic methodologies and augment patient prognoses.

Methods:

Study Design and Setting

This retrospective observational study was conducted at the Department of Neurology, MTI Lady Reading Hospital, Peshawar—a tertiary care center—over 3 years (January 2022 to December 2024).

Inclusion and Exclusion Criteria

Patients aged ≥18 years presenting with clinical wrist drop and diagnosed with radial neuropathy based on clinical examination and electrophysiological studies were included. Exclusion criteria comprised cervical radiculopathy, brachial plexopathy, central nervous system pathology, and systemic polyneuropathies.

Data Collection

Demographic details, clinical features, etiology, imaging findings, and electrophysiological data were extracted from medical records. Lesions were anatomically classified into high radial nerve palsy (spiral groove), radial tunnel syndrome, and posterior interosseous nerve (PIN) syndrome.

Nerve conduction studies (NCS) and electromyography (EMG) were performed following standard protocols. Radial motor and sensory studies were conducted, alongside median and ulnar nerve evaluations to exclude coexisting neuropathies. EMG of radial-innervated muscles was used to determine lesion site and severity.

Statistical Analysis:

Data were analyzed using SPSS 25. Descriptive statistics were applied to summarize continuous and categorical variables. Chi-square and independent t-tests were used to explore associations, with a p-value <0.05 considered statistically significant.

Results:

A total of 68 patients met the inclusion criteria, comprising 48 males (70.6%) and 20 females (29.4%), with a mean age of 42.3 ± 15.2 years. The right arm was affected in 39 patients (57.4%), and the left in 29 patients (42.6%).

The predominant cause was compression neuropathy in 26 patients (38.2%), with "Saturday night palsy" constituting 17 of these cases (65.4%), followed by trauma in 18 patients (26.5%) and iatrogenic injuries in 12 patients (17.6%).

Table 1. Baseline Characteristics and Etiology of Radial Neuropathy (n = 68).

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Variable n (%)
Gender
— Male 48 (70.6%)
— Female 20 (29.4%)
Mean Age (years) 42.3 ± 15.2
Side Affected
— Right 39 (57.4%)
— Left 29 (42.6%)
Etiology
— Compression (overall) 26 (38.2%)
—— Sleep-related (Saturday night palsy) 17 (65.4% of compression cases)
— Trauma 18 (26.5%)
— Iatrogenic Injury 12 (17.6%)
— Idiopathic 12 (17.6%)

Etiology of Radial Neuropathy (n=68).

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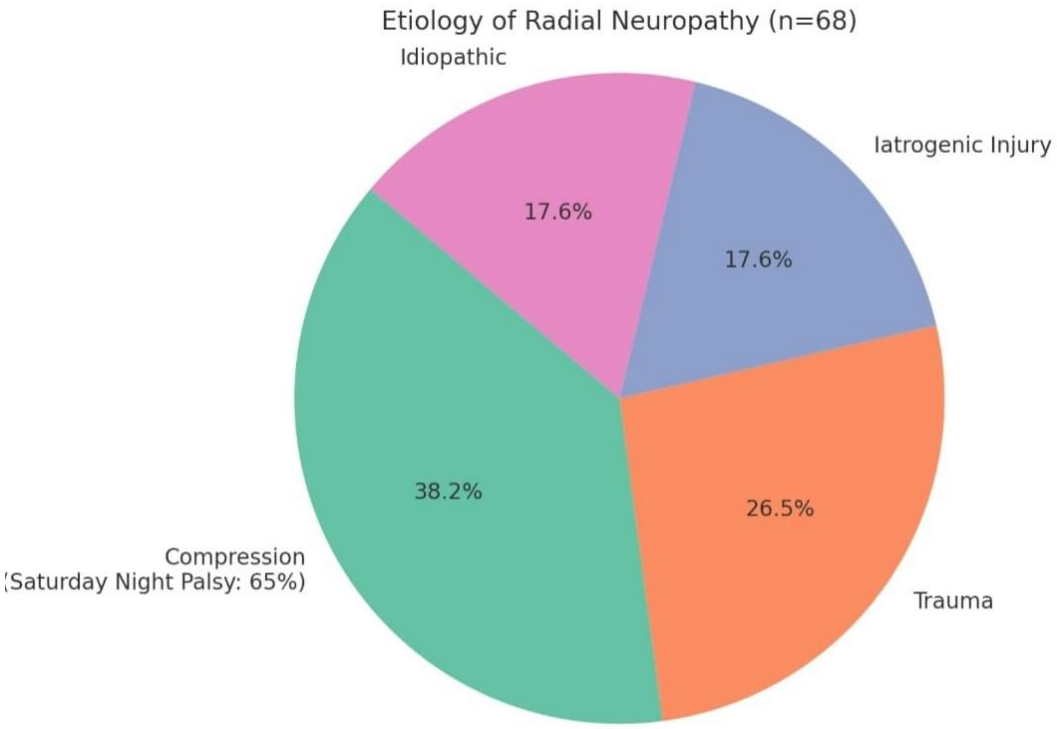

Table 2. Lesion Localization in Radial Neuropathy Patients (n = 68)

Lesion Site	Number of Patients (n)	Percentage (%)
High Radial Nerve Palsy	42	61.8%
Posterior Interosseous Nerve (PIN) Syndrome	20	29.4%
Radial Tunnel	6	8.8%

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Syndrome		

Summary Of Electrophysiological Findings by Lesion Type.

Lesion Type	CMAP	SNAP	EMG Findings	Notes
High Radial Nerve Palsy	↓ Amplitude, ↓ Conduction	↓ or normal	Denervation in radial-innervated muscles	Most common lesion
Posterior Interosseous Nerve (PIN) Syndrome	↓ Amplitude (PIN muscles	Normal	Reduced recruitment in PIN muscles	Motor deficit without sensory loss
Radial Tunnel				Requires clinical

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Syndrome	Normal	Normal	Normal	correlation

Imaging Findings in Radial Neuropathy (n = 32).

MRI and high-resolution ultrasound were utilized in 32 patients (47.1%), aiding in the diagnosis by revealing nerve compression, edema, or structural abnormalities.

Findings	n	%
Nerve compression	18	56.3
Edema/Signal abnormality	10	31.3
Structural abnormalities	4	12.5

Treatment and Outcomes

All patients were managed conservatively with physiotherapy and wrist-hand orthotic splinting. Early diagnosis and prompt initiation of therapy were significantly associated with improved recovery outcomes ($p < 0.05$). The mean recovery time was 6.2 ± 2.3 weeks in high radial nerve palsy cases and 8.5 ± 3.1 weeks in patients with posterior interosseous nerve (PIN) syndrome.

Lesion Type	Mean Recovery Time (weeks)	Standard Deviation

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High Radial Nerve Palsy	6.2	± 2.3
PIN Syndrome	8.5	± 3.1

Discussion:

This study elucidates the clinical profile, aetiologies, lesion localisation, diagnostic methods, and outcomes in individuals with radial neuropathy manifesting as wrist drop. Our findings support the established findings that radial nerve palsy is predominantly induced by compressive neuropathy, with "Saturday night palsy" serving as the quintessential example resulting from external compression of the radial nerve at the spiral groove during extended immobilisation or improper sleeping positions.

Compression neuropathy constituted 38.2% of our cases, with 68% of these instances attributed to sleep position. This discovery aligns with previous research indicating that compression is the primary cause of radial nerve injury, especially at the spiral groove, where the nerve is superficially located and susceptible to external pressure (7).

The term "Saturday night palsy" remains clinically relevant and should prompt clinicians to inquire about alcohol use, sedation, or postural habits that predispose patients to radial nerve compression (10).

Our cohort demonstrated a male predominance (70.6%), consistent with previously published studies, which may reflect occupational and behavioral risk factors such as manual labor, alcohol consumption, or recreational drug use that predispose individuals to compression neuropathy (11). The mean age of 42.3 years also aligns with the working-age group that is more vulnerable to such injuries due to lifestyle or occupational exposures.

Electrophysiological studies, including nerve conduction studies (NCS) and electromyography (EMG), were crucial for confirming the diagnosis and accurately localizing the lesion. High radial nerve palsy was the most frequent lesion site (61.8%), followed by posterior interosseous nerve (PIN) syndrome (29.4%) and radial tunnel syndrome (8.8%). These findings reflect the anatomical predisposition of the radial nerve to compression in the spiral groove and its branching patterns. High radial nerve palsy typically involves motor and sometimes sensory deficits, while PIN syndrome presents with pure motor findings and may be confused with other entities such as lateral epicondylitis or cervical radiculopathy (12) (3).

Interestingly, patients with radial tunnel syndrome had normal electrophysiological studies, highlighting the importance of clinical judgment in cases where symptoms outpace diagnostic findings. This has been

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discussed in literature emphasizing that some entrapment neuropathies, particularly dynamic compressions like radial tunnel syndrome, may yield normal studies and require imaging or surgical exploration (13) (14).

MRI and high-resolution ultrasound were utilized in 47.1% of patients in our cohort and proved beneficial in identifying nerve signal changes, edema, and structural anomalies such as ganglion cysts or fibrous bands. These imaging modalities are increasingly used as complementary tools to electrophysiology, especially in atypical or persistent cases (12).

MRI offers superior soft tissue contrast, while ultrasound provides dynamic and high-resolution assessment of the nerve and surrounding structures, aiding in both diagnosis and preoperative planning (11) (15).

All patients received conservative treatment, including physiotherapy and wrist-hand orthotic splinting. Recovery outcomes were favorable, particularly when diagnosis and treatment were initiated early. This association between early management and improved prognosis is consistent with studies emphasizing the plasticity of the peripheral nervous system and the importance of reducing denervation time to prevent permanent muscle atrophy (16).

Our data revealed that patients with high radial palsy recovered faster than those with PIN. The mean recovery time of 6.2 weeks in high radial nerve palsy versus 8.5 weeks in PIN syndrome aligns with previous observations that lesions closer to the nerve origin tend to recover faster due to better vascularity and axonal support (17).

Despite the overall positive outcomes, limitations of this study should be acknowledged. Its retrospective design may introduce selection bias, and the lack of long-term follow-up precludes assessment of chronic deficits or recurrence. Furthermore, as a single-center study, the results may not be generalizable to broader populations.

Conclusion:

Radial neuropathy is a prevalent and clinically important aetiology of wrist drop. Compression neuropathy, particularly resulting from incorrect sleep positions, is the primary cause. Precise lesion localisation using electrophysiological tests, augmented by imaging when required, enables prompt diagnosis and treatment. Conservative management produces favourable results, especially when commenced promptly. Additional prospective studies, including larger cohorts and extended follow-up, are necessary to investigate recovery determinants and enhance treatment methods.

Declarations

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Ethics approval and consent to participate:
The study was approved by the Institutional Review Board of MTI Lady Reading Hospital, Peshawar. As it was a retrospective study based on anonymized data, individual consent was waived.

Consent for publication:
Not applicable.

Availability of data and materials:
The datasets used and/or analyzed during the current study are available from the corresponding author.

Competing interests:
The authors declare that they have no competing interests.

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No external funding was received for this study.

Authors' contributions:

Dr Saad Ali, Dr.Sadiq Ali Shah	Manuscript Writing, Statistical Analysis.
Dr.Majid Khan, Dr.Usman, Dr.Zeeshan Ullah	Data Collection

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