

Research Article

Radial Nerve Injury in Patient Presenting with Closed Fracture of the Shaft of Humerus

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Abstract

Background: Radial nerve injury may be the result of neuropraxia, nerve laceration, or entrapment of the nerve between the fracture fragments. This study will also provide us with local statistics regarding radial nerve injury humeral shaft fracture as no local studies were found on this topic.

Objective: The study aims to determine the frequency of radial nerve injury in closed humeral shaft fractures.

Methodology: A total of 89 patients with the age between 20-60 years, irrespective of gender having closed humeral shafts fractures were recruited. Standard ward protocols for the management of patients were followed including stabilization of fracture and analgesia administration. All patients were assessed under the supervision of an expert orthopedic surgeon for radial nerve injury based on wrist drop with the inability to extend wrist fingers and thumb.

Results: The range of age of patients in this study was from 20 to 60 years having a mean of 38.89 ± 7.89 years. Most of the patients 47 (52.81%) were between the ages of 20 to 40. Out of the 89 patients, 53 (59.55%) were male and 36 (40.45%) were females. The ratio between males and females was 1.5:1. The percentage of injury to the radial nerve in patients with a closed humeral shaft fracture was 25.84%, affecting 23 patients, while those without injury to the radial nerve numbered 66 (74.15%).

Conclusion: This study concluded that the frequency of injury to the radial nerve in patients having closed humeral shaft fracture is 25.84%.

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Introduction

Around 80% of all proximal humerus fractures are either minimally displaced or not displaced at all, and are therefore, mostly managed non-operatively.¹ Distal humeral fractures are linked with fractures of the ipsilateral proximal forearm. Nerve or vascular injuries are uncommonly connected with humerus fractures. Humerus fractures have the following mechanism of occurrence, direct trauma to the arm, direct trauma to the shoulder, or axial loading transmitted by the elbow.²

Stress fractures of the humerus develop as a result of overhead throwing and, on rare occasions, severe

muscular spasms. Baseball players are prone to these sorts of fractures. The major causes, like with other stress fractures, are increased activity or stress on immature or unconditioned bone.³ Due to its closed contact in the spiral groove across the back of the mid-shaft of the humerus, its spiral course, and a fixed position in the distal arm where it penetrates the lateral intramuscular septum anteriorly, the radial nerve is most frequently injured in fracture of the humeral shaft. Radial nerve palsy can either be primary i.e., occurring at the time of injury (primary) or (secondary) i.e., occurring during reduction.⁴ Concerning the type and size of humeral

shaft fracture we have many opinions about treatment of radial nerve injury.³ Radial nerve injury may be the result of neuropraxia, nerve laceration, or entrapment of the nerve between the fracture fragments. The closed fracture of the shaft of the humerus with wrist drop is mainly treated non-operatively with closed reduction under an image, applying a U-slab cast and dynamic wrist drop splint for radial nerve palsy, has a good overall outcome.⁴

There are different statistics related to the incidence of primary radial nerve injury in the literature. The incidence of injury to the radial nerve is 12%, in closed mid-shaft humeral fracture.⁵ Another study reported an incidence of radial nerve injury as 17.9% in humeral shaft fractures.⁶ While the fracture of the spiral groove, also known as sulcus nervi radialis (SNR) has an incidence of radial nerve injury, as high as 37.5%.⁷ In another study performed the number of radial nerve injury in patients having shaft spiral fracture of the humerus, also called Holtein-Lewis type fracture, was 22%.⁸

This paper aims to investigate the connection between radial nerve injury and closed humeral shaft fractures, common orthopedic injuries encountered in clinical practice. Radial nerve damage in the context of humeral shaft fractures can lead to significant functional impairment. Therefore, prompt diagnosis and appropriate management are crucial to optimize patient outcomes. By examining the prevalence, risk factors, and clinical implications of radial nerve injury in this patient population, the study will better understand the complex relationship between the radial nerve and humeral shaft fractures, ultimately guiding healthcare.

Methodology

This descriptive cross-sectional study was conducted at the Departments of Orthopedic Pak International Medical College, Hayatabad, Peshawar, and Khyber Teaching Hospital, Peshawar from 31st May 2021 to 30th November 2022. The inclusion criteria were either gender of patients between the age 20-60 presenting to ER or OPD with closed fracture of humerus while the exclusion criteria were open fractures of humerus, polytrauma patient with multiple fractures involving the same limb, pathological fracture of humeral shaft, and a history of having neurological deficit in the same limb. Consent forms from patients/guardians and ethical approval were also obtained from the hospital before conducting the study (RefNo. 01/DMR/PIMC).

All patients were assessed with detailed clinical exami-

nation and history. Standard ward protocols for the management of patients were followed including stabilization of fracture and analgesia administration. All patients were assessed under the supervision of an expert orthopedic surgeon for radial nerve injury based on wrist drop with the inability to extend wrist fingers and thumb. To control confounders and bias in the study outcomes, the aforementioned data, including name, gender, and age, were recorded in a pre-designed proforma and the exclusion criteria were rigorously adhered to.

All data were initially entered in Microsoft Excel 2016 and then further analyzed through Statistical Package for Social Sciences version 22 (SPSS 22). Descriptive analysis was applied and frequency along with percentage were shown in tables and figures. P-values less than 0.05 were considered statistically significant.

Results

In a total frequency of 89, the distribution of patients according to the type of trauma as follows: traffic road accident 50 patients (56.18%), fall-related injuries account for 25 patients (28.09%), and violence-related injuries account for 14 patients (15.73%). The distribution concerning the type of fracture is as follows: 21 patients (23.60%) have spiral fractures, 19 patients (21.35%) have comminuted fractures, 32 patients (35.96%) have segmental fractures, and 17 patients (19.10%) have transverse fractures. Regarding the site of the fracture, the distribution is as follows: 12 patients (13.48%) have proximal fractures, 59 patients (66.29%) have middle fractures, and 18 patients

Table 1: Distribution of Patients with closed fracture of the shaft of Humerus (n=89) with respect to the type of trauma, type of fracture and site of fractures

Distribution with respect to type of trauma		
Parameters	Frequency	Percentage (%)
Road traffic accident	50	56.18
Fall	25	28.09
Violence	14	15.73
Distribution with respect to type of fracture		
Parameters	Frequency	Percentage (%)
Spiral	21	23.60
Comminuted	19	21.35
Segmental	32	35.96
Transverse	17	19.10
Distribution with respect to the site of fracture		
Parameters	Frequency	Percentage (%)
Proximal	12	13.48
Middle	59	66.29
Distal	18	20.22

(20.22%) have distal fractures as shown in Table 1.

Frequency of patient with and without radial nerve

Table 2: Frequency of injury to the radial nerve in patients with and without radial nerve injury.

Total Frequency	Patient with Radial nerve injury	Patient without Radial nerve injury
89	23 (25.84%)	66(74.15%)

injury in closed humeral fracture is shown in Table 2.

The range of age of patients in this study was from 20 to 60 years with a mean age of 38.89 ± 7.89 years with most of the patients 47 (52.81%) between 20 to 40 years of age. Out of the 89 patients, 53 (59.55%) were male and 36 (40.45%) were females. The ratio between male to female was 1.5:1. Stratification of radial nerve injury for age groups, gender, and type of trauma, type of

Table 3: Frequency of injury to radial nerve in patients having closed humeral shaft fracture (n=89).

Stratification of injury to radial nerve with respect to age groups.			Total
Age	Radial nerve injury present	Radial nerve injury absent	
20-40	16 (69.6%)	31 (47%)	47 (52.8 %)
41-60	07 (30.4%)	35 (53%)	42 (47.2%)
Stratification of radial nerve injury with respect to gender			Total
Gender	Radial nerve injury present	Radial nerve injury absent	
Male	14 (60.8%)	39 (59.1%)	53 (59.5%)
Female	09 (39.2%)	27 (40.9%)	36 (40.5%)
Stratification of radial nerve injury with respect to type of trauma			Total
Type of trauma	Radial nerve injury present	Radial nerve injury absent	
Road traffic accident	19 (82.6%)	31 (46.9%)	50 (56.1%)
History of fall	02 (8.6%)	23 (34.8%)	25 (28.1%)
Violence	02 (8.6%)	12 (18.7%)	14 (15.8%)
Stratification of radial nerve injury with respect to type of fracture			Total
Site of fracture	Radial nerve injury present	Radial nerve injury absent	
Spiral	03 (3.3%)	18 (27.2%)	21(23.59%)
Comminuted	09 (10.1%)	10 (15.15%)	19(21.34%)
Segmental	04 (4.5%)	28 (42.42%)	32 (35.9%)
Transverse	07 (7.9%)	10 (15.15%)	17 (19.1%)
Stratification of radial nerve injury with respect to site of fracture			Total
Site of fracture	Radial nerve injury present	Radial nerve injury absent	
Proximal	04 (17.39%)	08 (12.12%)	12 (13.4%)
Middle	11 (47.8%)	48 (72.72%)	59 (66.2%)
Distal	08 (34.7%)	10 (15.15%)	18(20.22%)

fracture, and site of fracture (Table 3).

Discussion

Fractures of the shaft of the humerus are very common with reported cases of more than 237,000 each year. Humeral shaft fractures have a bimodal distribution mostly occurring in males under 25 years of age and in women above 50 years of age.⁹

Primary, secondary, and delayed radial nerve palsies can be either partial or total. Occurring during the treatment of fractures, secondary radial nerve palsies cause more than 20% of all nerve palsies.⁹ 87.3% of patients with primary radial nerve palsies resolve spontaneously, though a more aggressive treatment involving early exploration has been suggested to improve time to functional recovery.⁹

In our study, the frequency of injury to radial nerve in patients having closed humeral shaft fracture was found in 23 (25.84%) patients and those without injury to the radial nerve is 66(74.15%). Another study reported the incidence of injury of radial nerve as 12%, in the closed mid-shaft and distal-mid shaft fractures.¹⁰ with nerve injury more common in spiral and transverse fractures compared to comminuted and oblique fractures.¹¹ Another study reported an incidence of radial nerve injury as 17.9% in humeral shaft fractures.⁶ Another study reported the fracture of the spiral groove, also known as sulcus nervi radialis (SNR) has an incidence of radial nerve injury, as high as 37.5%.¹² In another study performed by Ekholm et al., the frequency of injury to radial nerve in patients having spiral humeral shaft fracture, also called Holtein-Lewis type fracture, was 22%.⁸

Various studies report an incidence of radial nerve palsy ranging from 1.8%¹³ to 35.3%^{12,13} and a good recovery rate of 31 % (Sim et al.,)¹⁴ to a poor recovery rate of 0% (Pollock et al.,)¹⁵ Our study reported an incidence of primary radial nerve palsy of 25.84% which is high compared to other literature which can be since our hospital is a tertiary care health center and thus receives more complex cases.

In our study, out of the 89 patients, we had 53 (59.55%) males and 36 (40.45%) females. The ratio between males and female was 1.5:1. Studies indicate that men are more likely to injure their upper extremities, especially the radial nerves due to issues like driving accidents, occupation, and insignificant safety issues more than women.¹⁶

Level of fracture also played a significant role in injury to the radial nerve i.e. 32% in the lower one-third of the

humeral shaft, 64% in the middle one-third, and 4% in the upper one third which is comparable to Bostman et al.,¹⁷ Most of fractures involving the middle third of the humerus caused radial nerve palsy because radial nerve lies in close contact with humerus in the spiral groove level making it more prone to injury.¹⁸

Fracture pattern was comminuted in 39% (n=9/23) of cases, spiral in 13.0% (n=3/23), transverse in 30.4% (n=7/23), and oblique in 40% of cases which is again comparable to Bostman et al.,¹⁷ In Comminuted fractures, the limb segment absorbs high energy at the site of injury resulting in direct radial nerve damage while transverse fracture is mostly angulated laterally causing indirect damage to the radial nerve by either stretching across the fracture site or impingement of fracture fragments. 36% population showed associated injuries mainly occurring in population involved in road traffic accidents.¹⁹ Nerve continuity was intact in all cases requiring no surgical repair. One patient recovered within 5 weeks showing a pattern of neurapraxia while others recovered between 16 -50 weeks showing a pattern of axonotmesis. The average time of complete recovery was 22 weeks in our study while the literature showed recovery time of 15 weeks. This can be because most cases in our study had axonotmesis-type injury patterns.⁶

There are two groups of radial nerve injury based on time of injury i.e., primary and secondary. In primary injury function is lost at the time of injury, and occurs mainly in closed fractures. In the secondary injury, function is lost due to conservative management or entrapment of the nerve in the fracture segment, as well as following surgery.^{19,20} Published literature indicates that in patients undergoing surgery for fracture stabilization, secondary damage occurs in 4% to 32%.²¹

There is substantial data indicating conservative management of radial nerve palsies due to humeral shaft fractures because of the high rate of spontaneous recovery.²² However, high-velocity gunshot wounds, open fractures, vascular injuries, or extensive soft tissue injury should be managed with early surgical exploration of the nerve.^{9,23}

Conclusion

This study found that patients with closed humeral shaft fractures had a 25.84% prevalence of radial nerve damage. Therefore, it is recommended that proper evaluation of patients with fractures of the shaft of the humerus should be done for radial nerve injury to take timely management for reducing the morbidity of these

particular patients.

Author Contributions

The following authors have made significant contributions to the manuscript as under:

Farhan Qazi: Conception, Study Design, Data Acquisition, And Final Approval

Anwar Imran: Manuscript Drafting, Data Analysis, And Final Approval

Mudir Khan: Conception, Study Design, Manuscript Revising, And Final Approval

Sajid Akhtar: Data Collection, Interpretations Of Results, And Final Approval

Muhammad Abubakr: Data Collection, Revising Manuscript, And Final Approval

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