

# Iatrogenic Radial Nerve Palsy in the Management of Midshaft Humerus Fracture with Dynamic Compression Plate on Anterolateral versus Anteromedial Surface through Henry Approach

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## ABSTRACT

**Objective:** To compare the frequency of iatrogenic radial nerve palsy after the management of midshaft humerus fractures with dynamic compression plate on the anterolateral versus anteromedial surface through Henry approach.

**Methodology:** It was a cross-sectional comparative study conducted at the Orthopedic Department, Allied Hospital, Faisalabad after taking approval from the Institutional Ethical Review Committee. The study was conducted from January to June 2018. Eighty patients were included in this study by non-probability consecutive sampling technique. Informed consent was taken from each participant of the study. Patients of both genders aged 18 to 70 years with isolated fracture shaft of humerus or non-union after conservative management, were included in this study. Patients with polytrauma, history of previous surgery on the same humerus, and preoperative radial nerve injury were excluded. Patients with non-union of the humerus after conservative management were enrolled through the outpatient department. Patients presented in the emergency department with a history of trauma and fracture shaft of the humerus were also included in this study. Patients were divided into two groups A and B, each group included 40 patients. Group A was treated with a dynamic compression plate applied through Henry approach on the anterolateral surface and in group B, the plate was applied on the anteromedial surface through the Henry approach.

**Results:** Mean age was  $34.79 \pm 9.73$  years in group A and  $32.76 \pm 8.01$  years in group B. In group A, 8(20%) patients had radial nerve injury and 32(80%) patients did not have nerve injury. In group B, 1(2.50%) had radial nerve injury and 39(97.50%) had no findings of nerve injury. A statistically significant difference was found when postoperative radial nerve injury was compared in both groups ( $p$ -value=0.02). At 2<sup>nd</sup> follow-up after three months of surgery, radial nerve injury in eight patients (100%) of group A and one (100%) of group B was settled.

**Conclusion:** Iatrogenic radial nerve palsy is significantly lower in patients treated with dynamic compression plate on the anteromedial surface as compared to the anterolateral surface through Henry approach in midshaft humerus fracture.

**Keywords:** Humeral fracture. Radial nerve injury. Henry Approach.

## INTRODUCTION

The fracture of the humeral shaft is a common presentation in Orthopedic Surgery and accounts for approximately 1-5% of all fractures. These fractures occur more commonly in young age. The most common cause of humeral shaft fracture is road traffic accident (RTA), however, falls also account for a significant number of patients. In addition to RTA and falls, metabolic bone disorders like Paget's disease and osteoporosis can also cause fracture of the humeral shaft.<sup>1</sup>

The shaft of the humerus serves as an attachment site of major muscles which results in the major displacement of the fracture fragments. The main deforming forces are pectoralis major, deltoid, and rotator cuff. Fractures of the humeral shaft can be classified according to anatomical location and deforming forces. The

deforming forces can be bending, twisting, or axial compression. The fracture pattern resulting from these deforming forces can be simple transverse, oblique, spiral, or segmental.<sup>2</sup>

The fracture of the humeral shaft can be treated both conservatively and by operative techniques. Conservatively, these fractures are treated by braces and plaster splints. Surgically, these fractures can be treated using plates, intramedullary nails, and external fixators.<sup>3</sup>

The gold standard in the operative management of these fractures is the use of plates. The union rate with the use of plate is higher than other available operative modalities. Anterolateral and anteromedial approaches are mostly carried out to apply plate in the shaft of humerus fracture.<sup>4</sup>

Several studies have shown a higher success rate with the use of plates but the risk of radial nerve injury is relatively higher and remains a point of concern.<sup>5,6</sup>

Gouse et al. reported a higher incidence of radial nerve injury by anterolateral approach. According to the study carried out in 2016, the documented incidence approached approximately 16%. All of the reported nerve injuries were mostly physiological neuropraxia which recovered spontaneously within 6 months duration.<sup>2,7</sup> In another study carried out by Senthil et al.,

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the anteromedial approach for humerus shaft fracture was considered safe and no radial nerve injury was reported.<sup>8</sup>

The rationale of this study was to compare the outcomes of these approaches to formulate better recommendations for operative management of midshaft humerus fracture.

### METHODOLOGY

It was a cross-sectional comparative study conducted at the Orthopedic Department, Allied Hospital, Faisalabad after taking approval from Institutional Ethical Review Committee (Letter No: 823/2017, 18-08-2017). The study was conducted from January to June 2018. Eighty patients were included by non-probability consecutive sampling technique. Patients of both genders aged 18 to 70 years, with isolated fracture shaft of humerus or non-union after conservative management, were included in this study. Patients with polytrauma, history of previous surgery on the same humerus, and preoperative radial nerve injury were excluded.

Patients with non-union of the humerus after conservative management were enrolled through the outpatient department. Patients presented in the emergency department with a history of trauma and fracture shaft of the humerus were also included in this study. Patients were divided into two groups A and B, each group included 40 patients. Group A was treated with a dynamic compression plate applied through Henry approach on the anterolateral surface and in group B, the plate was applied on the anteromedial surface through the Henry approach.

Surgically, Henry approach starts from the deltopectoral groove and reaches up to the cubital fossa with a slight curvilinear pattern around the bicep brachii muscle. The approach utilizes an internervous plane between the musculocutaneous and radial nerve. The radial nerve crosses the lateral intermuscular septum in the mid-arm is at close proximity to the humerus shaft. This nerve is at risk particularly as it passes the radial groove on the humerus bone during mid and distal third shaft fractures.<sup>9</sup>

Information regarding gender, age, contact number, address, and injury to the radial nerve as determined by clinical examination on the 1<sup>st</sup> postoperative day & after 3 months was entered in proforma. Patients in both groups were operated on by the same orthopedic surgeon and team. The iatrogenic radial nerve injury during application of plate on humerus shaft either on the anterolateral or anteromedial surface was assessed clinically on the first postoperative day. The patients in which radial nerve was affected, were unable to extend

the fingers due to the effect on nerve supply of extensor digitorum muscle. Nerve conduction studies and electromyographic studies were only required if the injury persisted beyond 3 months.

### STATISTICAL ANALYSIS

The data was analyzed by using Statistical Package for the Social Sciences (SPSS) version 25. Mean & standard deviation was calculated for age. Frequency and percentage were calculated for all qualitative variables like gender and radial nerve injury. Chi-square test was applied to compare radial nerve injury in both groups, between two age groups, and in males & females. A p-value of  $\leq 0.05$  was considered as significant.

### RESULTS

Mean age was  $34.79 \pm 9.73$  years in group A and  $32.76 \pm 8.01$  years in group B. In group A, 31(77.5%) and 34(85%) in group B were between 18-44 years of age whereas 9(22.5%) in group A and 6(15%) in group B were between 45-70 years of age. Thirty (75%) patients in group A and 26(65%) in group B were males and 10(25%) in group A and 14(35%) in group B were females.

In group A, 8(20%) patients had radial nerve injury and 32(80%) patients did not have nerve injury. In group B, only 1(2.5%) had radial nerve injury and 39(97.5%) had no findings of the nerve injury (Figure 1).

A statistically significant difference was found when postoperative iatrogenic radial nerve injury was compared in both groups (p-value=0.02). At 2<sup>nd</sup> follow-up after three months of surgery, radial nerve injury in eight patients (100%) of group A and one (100%) of group B was settled.

Table 1 shows the stratification of radial nerve injury according to age & gender. No statistically significant difference was found when radial nerve injury in males & females and between two age groups were compared.

### DISCUSSION

Humeral shaft fractures account for 3-5% of orthopedic surgeries. The gold standard for operative management is plate osteosynthesis. The most commonly used approach was described by Henry. Using Henry approach, anterolateral or anteromedial dissection is carried out. The radial nerve is the extension of the posterior cord of the brachial plexus. The nerve traverses the spiral groove and processes lateral intermuscular septum to enter in the anterior compartment. This nerve is susceptible to injury at this level.<sup>9</sup> In this study, iatrogenic radial nerve injury after the operative management of midshaft humerus

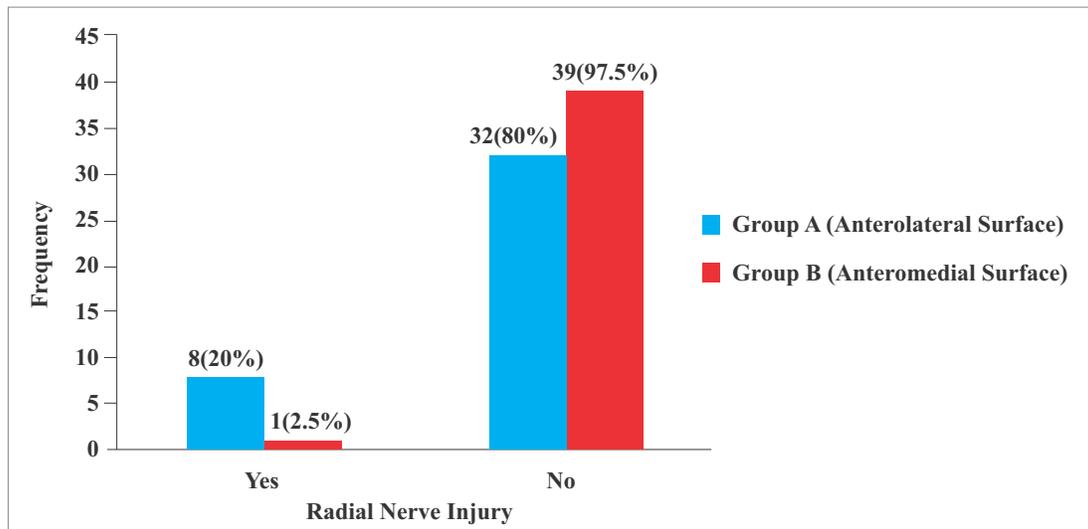


Figure 1: Comparison of Radial Nerve Injury in Group A & B

Table 1: Stratification for Radial Nerve Injury in Study Groups according to Age and Gender

Variables		Group	Radial Nerve Injury		p-value
			Yes	No	
Age (Years)	18-44	A	7	24	0.006*
		B	0	34	
	45-70	A	1	8	0.71
		B	1	5	
Gender	Male	A	6	24	0.11
		B	1	25	
	Female	A	2	8	0.08
		B	0	14	

\* Significant p-value

fracture with dynamic compression plate applied on anterolateral or the anteromedial surface of the humerus was compared.

The results of our study showed that out of 40 cases in each group, 31(77.50%) in group A and 34(85.00%) in group B were between 18-44 years of age whereas 9(22.50%) in group A and 6(15.00%) in group B were between 45-70 years of age. Mean age was  $34.79 \pm 9.73$  years in group A and  $32.76 \pm 8.01$  years in group B. Regarding gender, 30(75.00%) in group A and 26(65.00%) in group B were males and 10(25.00%) in group A and 14(35.00) in group B were females. On comparison of radial nerve injury in management of midshaft humerus fracture with dynamic compression plate on anterolateral with the anteromedial surface

through Henry approach, 8(20.00%) in group A and 1(2.50%) in group B had radial nerve injury (p-value was 0.02), which was settled within 3 months.

Another study conducted in Pakistan showed that radial nerve injury is lower in patients treated with anteromedial plating as compared to anterolateral plating through the Henry approach.<sup>10</sup> A study conducted in India showed that 10.6% of patients treated with anterolateral approach had radial nerve palsy, whereas, radial nerve palsy was not seen in any patient treated with an anteromedial approach.<sup>11</sup>

A study was carried out on 150 patients with fractures of the humerus shaft. One hundred and thirty patients were males with a mean age of  $38 \pm 5.6$  years. These findings are consistent with our study which showed

that the mean age was 34.79±9.73 years in group A and 32.76±8.01 years in group B. The fracture of the humerus shaft was more common in males, which is also consistent with our results. There was no documented radial nerve palsy in any of the patients after surgery using anteromedial plating. This finding is also consistent with our results, which showed a lesser degree of radial nerve injury with anteromedial plating. They concluded that anteromedial plating is easier and quicker fixation is achieved as compared to anterolateral plating. This study also concluded that the risk of radial nerve palsy is relatively less than anterolateral plating as it does not require radial nerve exposure.<sup>12</sup>

A study conducted in 2016 by Kumar et al., showed that there was no significant risk of iatrogenic radial nerve palsy using anteromedial plating. The mean age group of the patients included in this study was also similar to our results. This was a prospective study and 54 patients with a fracture of the shaft of the humerus were operated on by using anteromedial plating. This study showed a lesser duration of surgery, no incidence of iatrogenic radial nerve palsy, and good functional outcome 60.5% of the patients by using anteromedial plating.<sup>13</sup>

In another study conducted at the Department of Orthopedics, Beijing Chaoyang Hospital, China in 2016, a comparison was done between the mechanical properties of anteromedial and anterolateral plating. They concluded that anteromedial plating was superior to anterolateral plating in all mechanical aspects and suggested that anteromedial plating is a clinically safe and effective way for humerus shaft fracture.<sup>14</sup>

A recent study conducted by Chu et al., concluded that the advantage of anteromedial plating includes the absence of soft tissue injury, less blood loss, shorter operation time, and a lower rate of complication including radial nerve palsy. The study focused on the geometrical analysis of the humerus and showed that torsional deformities can be reduced with proper angle adjustment by the use of medial plating.<sup>15</sup>

In a study by Lotzien et al., the mean age of the patients presented with midshaft humerus fracture was slightly higher than the results shown in our study. They also reported that only 3.75% incidence of radial nerve palsy using anteromedial plating which is similar to our study (2.5%).<sup>9</sup>

### CONCLUSION

Iatrogenic radial nerve palsy is significantly lower in patients treated with dynamic compression plate on the anteromedial surface as compared to plating on the anterolateral surface through Henry approach in midshaft humerus fracture.

### LIMITATIONS & RECOMMENDATIONS

The major limitations of this study was the small sample size and single study settings. In this study other surgical complications were not observed. Furthermore, randomized control trial or multi-centered study should be conducted to strengthen the results of our study.

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