# Study of Incidence and Treatment of Radial Nerve Palsy in Fracture Shaft of Humerus

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## ABSTRACT

**Introduction:** A radial nerve injury associated with a humeral shaft fracture is an important injury pattern among trauma patients. It is the most common peripheral nerve injury associated with this fracture. Injuries to the radial nerve can result in significant motor impairment of the arm and the wrist with the loss of wrist extension, the ability to grasp is significantly reduced leading to a serious handicap.

**Objective:** To find out the incidence of radial nerve palsy in case of fracture shaft of humerus. To analyze results of various modalities of treatment of fracture shaft of humerus associated with radial nerve injury; To establish a probable guideline for the treatment of radial nerve injuries in fracture of the shaft of humerus.

**Method:** This is a prospective study of 80 patients with closed and open diaphyseal fracture of Humerus with 20 complete primary radial nerve palsy and 5 secondary nerve palsy treated in Government Wenlock Hospital, K.M.C. and associated Hospitals, Mangalore during the period from January 2004 to September 2006.

**Result:** A total of 80 patients of fracture shaft of humerus were analyzed in this study with 20 immediate and 5 secondary radial nerve palsy. The youngest patient was 20 years and the oldest was 70 years old. Majority of the patient were in 21 – 40 years of age. Radial nerve palsy was more commonly seen in fractures involving the middle third of Humeral shaft P(0.004). The incidence of radial nerve palsy was highest in patients with oblique fracture and average time of recovery was 22 weeks. All the cases that were explored showed the nerve to be in continuity and no surgical repair of the radial nerve was required P( 0.831). Radial nerve palsy associated with upper third fracture recovers faster; though it needs to be further confirmed as the sample size was small.

**Conclusion:** The outcome of radial nerve palsy was not found to be related to age group, sex, side, mechanism of injury, intra-operative condition of nerve, method of treatment of fracture and time of exploration of radial nerve.

**Recommendation:** Our study recommends a conservative and expectant line of management for both primary as well as secondary nerve palsies. As complete recovery of the nerve can be quite delayed, patience is merited before considering tendon transfers.

**Keywords:** Radial Nerve Palsy, Fracture Shaft of Humerous

## Introduction

A radial nerve injury associated with a humeral shaft fracture is an important injury pattern among trauma patients. It is the most common peripheral nerve injury associated with this fracture. Injuries to the radial nerve can result in significant motor impairment of the arm and the wrist with the loss of wrist extension, the ability to grasp is significantly reduced leading to a serious handicap.1

The radial nerve may be injured by the force that fractures the humeral shaft directly with contusion or laceration by a spur or by traction when the bone ends are forcibly separated during closed reduction. 2The risk results from the anatomic position of the radial nerve which turns around the distal portion of the humeral shaft and separated from it by a layer of triceps fibres. When the radial nerve pierces the lateral intermuscular septum to enter the anterior compartment of the arm, it is relatively more fixed and susceptible to injury. As a rule, radial palsy regresses spontaneously, but in a few cases surgery may be required to achieve neurological recovery.3

Strong convictions for and against either line of treatment conservative or operative can be drawn from the literature. Opinion also differs regarding the time of operative intervention whether to go for early or delayed repair.4

The management of radial nerve palsy associated with fractures of the shaft of the Humerus is a controversial subject among upper-extremity surgeons and poses a challenge to treating surgeon.1

This study is attempted to find out the incidence of radial nerve palsy and to analyze results of various modalities of treatment of fracture shaft of Humerus associated with radial nerve injury to improve outcome and avoid long-term morbidity.

## Objectives

To find out the incidence of radial nerve palsy in case of fracture shaft of humerus.

To analyze results of various modalities of treatment of fracture shaft of humerus associated with radial nerve injury.

To establish a probable guideline for the treatment of radial nerve injuries in fracture of the shaft of humerus.

## Material and Method

This is a prospective study of 80 patients with closed and open diaphyseal fracture of Humerus with 20 complete primary radial nerve palsy and 5 secondary nerve palsy treated in Government Wenlock Hospital, K.M.C. and associated Hospitals, Mangalore during the period from January 2004 to September 2006.

The inclusion criteria are patients with diaphyseal fracture of the humerus radial nerve palsy developing before and after the treatment.

We excluded children with fracture, fractures of either ends of humerus and pathological fracture. As initial work up, all patients with radial nerve palsy with fracture of the humerus were evaluated for various parameters: -

A) Detailed history with emphasis on mode of injury, time since injury, primary or secondary, details of any treatment received and history of any increase in the symptoms or recovery of the palsy.

B) Local examination of the arm and fractured area to rule out any compounding and treat associated bruises and soft tissue injuries and detailed neurological examination (motor and sensory).

C) Motor power was tested using the MRC scale. The muscles tested were brachioradialis, wrist extensors, thumb extensor and abductor, extensors of metacarpophalangeal joints. Sensory examination was done with emphasis on sensory loss over the dorsal aspect of forearm and dorsal surface of the first interosseous space that forms autonomous zone for the radial nerve. The sensations were graded subjectively compared to what the patients felt on the uninvolved side.

D) X-ray of arm – Anterior-posterior view and lateral views in order to document level and type of fracture.

The fracture was managed initially by a u slab under sedation or general anesthesia. Anterio-posterior view and lateral views were taken to check the reduction. All the patients with radial nerve injury underwent open reduction and internal fixation. All the patients associated with radial nerve palsy underwent open reduction and internal fixation with exploration of radial nerve. The associated wrist drop was managed by a static cock-up splint and regular physiotherapy. A wrist dorsiflexion splint dramatically improves grip strength and function. All the patients were advice passive range of motion exercise and monitored for developing contraction. The patients were followed up at 1, 3, 6 and 12 months. At each follow up clinical sign of nerve recovery were assessed.

## Results

There were total 80 patients of fracture shaft of humerus and 25 patients met with inclusion criteria. Among them 20 had immediate and 5 had secondary radial nerve palsy. Majority of the patient were between 21 – 40 years of age (20 minimum and 70 maximum). Out of 25 patients with radial nerve palsy 16 were males and 9 were females. There was no significant side predilection. Right side was affected in 12 and left in 13 patients. The most common mode of injury was fall followed by road traffic accident. Primary nerve palsy was found to be more common in our series. Out of 25 patients, 20 presented with primary radial nerve palsy. The middle third and distal third region of Humerus shaft was involved in 96 % of patients. Oblique fracture of the humerus was found to be more commonly associated with radial nerve palsy in our series. In our series, all the cases showed the nerve to be in anatomical continuity. Regarding the relationship between recovery and age group and found it to be statistically insignificant ($p > 0.05$). Only one patient recovered within 6 weeks and he belongs to the 30 to 50 age group.

In the relationship between recovery and sex majority of the patients in either sex took more than 18 weeks for recovery and found it to be statistically not significant.

Regarding the relationship between recovery and mode of injury and found it to be statistically insignificant. Only one patient recovered within 6 weeks and he sustained injury by fall. Regarding the relationship between recovery and level of fracture and found it to be statistically significant suggesting that upper third fracture with radial nerve palsy recover faster. One patient who sustained upper third fracture showed complete recovery in 6 weeks. It was also found out that the relation between outcome and geometry of the fracture was statistically insignificant.

Regarding relationship between recovery and time of exploration of nerve with fixation, majority of cases underwent surgery after a week and found that it was statistically insignificant. All stretched nerves showed recovery after 18 weeks. In fracture shaft humerus, the dissection required for nerve exploration has made compression plating preferred method of fixation.

## Discussion

The fracture shaft of humerus with radial nerve palsy continues to be a management dilemma. The dilemma is whether the injured nerve is anatomically disrupted or continuous. The various electrodiagnostic studies are useful only after the process of wallerian degeneration has set in, which usually involves a period of 3- 6 weeks. By this time, neurapraxic lesions would presumably have recovered. Moreover, electrodiagnostic studies are not able to distinguish between a severed nerve and unrecovered intact nerve and don't detect recovery much earlier than physical examination. It is therefore noteworthy that neither clinical nor eletrodiagnostic studies offer any predictability to the type of nerve injury in fracture shaft humerus.

Several authors have recommended early surgical exploration, as soon as radial nerve palsy is recognized5,6,20,22,25,32,34,35. Others have recommended observation and exploration of the injured nerve only if it fails to recover after an interval of 6 weeks to 6 months 8,11.

The incidence of the radial nerve palsy has been reported from 1.8%20 to 35.3%24, 25 in various studies. The reported rate of poor recovery of the radial nerve function shows an amazing

variation from nil (Pollock et al28 1981) to 31 % (Sim et al33). These results imply that surgical intervention is not necessary in most patients for good functional results. Many researchers also have emphasized that, in many cases, the radial nerve palsy caused by a shaft fracture is a contusion and, therefore, exploration of the nerve is unnecessary8, 28. This study endeavors to answer the problems associated with this injury and sheds some light on its natural course in an attempt to suggest a rational treatment protocol for managing such injuries. Bearing this in mind, this study was done, and the early exploration of the radial nerve with stabilization of the fracture was the main principal line of management. The incidence of primary radial nerve palsy in our series is 25 % which is high as comparable to other literature. This can be explained as our hospital is tertiary care health centre, so it receives more of complicated cases. There are 5 cases of secondary iatrogenic palsy, 4 out of them were after plate fixation which is comparable to study done by Cognet et al9.

There was significant difference found in the radial nerve involvement with level of the fracture i.e. 4 % in upper one third, 64 % in middle one third, 32 % in lower one third of humeral shaft. This is in concordance with the study of Bostman et al8. Majority of cases of nerve palsies occurred in middle one third of the humerus shaft because radial nerve is in close contact with bone in the spiral groove at this level and at the junction of upper 2/3rd and lower 1/3rd where radial nerve pierces the lateral intermuscular septum. Hence, it is easily damaged by decreased mobility of the nerve.

Fracture pattern was oblique in 40% cases, transverse in 32 %, and spiral in 16 % and comminuted in 12 % of cases. This is in accordance with Bostman et al8. Comminution, signifying high energy absorption by the limb segment at the site of direct injury may result in direct radial nerve damage whereas the transverse fracture commonly angulated laterally may be responsible for indirectly damaging the radial nerve by either impingement by sharp fracture fragment or sudden stretching across the fracture site angulation. Associated injuries were seen in 36% of the cases. All the associated injuries occurred mainly in road traffic accidents. Ipsilateral involvement of other bones was noted. This rate is more than the rate of 21% reported by Shah and Bhatti.41 All the cases showed the nerve to be in continuity. No surgical repair of the nerve was needed in any case which is comparable to Pollock et al36. One case recovered within 5 weeks consistent with the pattern of neurapraxia while others showed recovery between 16 -50 weeks indicating axonotemesis. The average time for completion of recovery in our study is 22 weeks while the reported incidence in literature is 15 weeks. A probable explanation for this is that most of nerve injuries sustained in our series were of axonotemesis type.

It was found to be statically significant for level of fracture (chi square test, $x2 = 18.073$, p value = .001) only. This can be explained on the basis that radial nerve is protected by thick muscle layer of triceps and relatively more mobile in upper one third than middle and lower third.

Complete recovery was seen in 72 % of the cases in our series, 20% are recovering. While two cases (8%) were lost for follow up. This is comparable to comparable to overall incidence of recovery, which comes out to be 77.7 % when results of previous studies are analyzed. The rate of recovery as per literature for immediate early exploration varied for different authors from 78% for Garcia and Maeck15, to 92 % for Pollock et al28.

## Conclusion

This study found out that radial nerve palsy was more commonly seen in fractures involving the middle third of Humeral shaft. The incidence of radial nerve palsy was highest in patients with oblique fracture. All the cases that were explored showed the nerve to be in continuity and no surgical repair of the radial nerve was required. Radial nerve palsy associated with upper third fracture recovers faster; though it needs to be further confirmed as the sample size was small. The outcome of radial nerve palsy was not found to be related to age group, sex, side, mechanism of injury, geometry of fracture, intraoperative condition of nerve, method of treatment of fracture and time of exploration of radial nerve. As there was no case of neurotemesis, this conclusion needs to be verified with respect to the same.

## RECOMMENDATION

Our study recommends a conservative and expectant line of management for both primary as well as secondary nerve palsies. As complete recovery of the nerve can be quite delayed, patience is merited before considering tendon transfers.

**Conflict of Interest:** None declared. (Or mention here if any)

## References

1. Sharon I, Fishfeld CI, Duong DH. Acute nerve injury. Http://emedicine.medscape.com/article/249621-overview. Assess online 1.11.2011.
2. Samardžić M, Grujičić D, Milinković ZB. Radial nerve lesions associated with fractures of the humeral shaft . Elsevier journal of injury Volume 21, Issue 4, July 1990, Pages 220-222
3. Cognet JM, Fabre T, Durandeau A. Persistent radial palsy after humeral diaphyseal fracture: cause, treatment, and results. 30 operated cases]. Rev Chir Orthop Reparatrice Appar Mot. 2002 Nov;88(7):655-62.
4. Donat R Spahn1, Vladimir Cerny2, Timothy J Coats3, Jacques Duranteau. Management of bleeding following major trauma: a European guideline. Critical Care 2007, 11:414
5. Alnot J, Osman N, Masmejean E, Wodecki P. Lesions of the radial nerve in fractures of the humeral diaphysis. Apropos Of 62 Cases. Rev Chir Orthop Reparatrice Appar Mot. 2000 Apr; 86(2): 143-50
6. Amillo S, Barrios RH, Martinez-Peric R, Losada JI. Surgical Treatment of the radial nerve Lesions associated with fractures of the humerus. J Orthop Trauma 1993; 7 (3): 211-5.
7. Bodner G, Huber B. Schwabegger A, Lutz M, Waldenberger P. Sonographic detection of radial nerve entrapment within a humeral fracture. J Ultrasound Med, 1999; 18 (10): 703-6.
8. Bostman. 0, Bakalim. G, Vainionpaa. S, Wilppula. E, Patiala H. and Rokkanen P. Radial palsy in shaft fracture of humerus. Acta-Orthop-Scand, 1986; 57(4): 316-19.
9. Cognet JM, Fabre T, Durandeau A- Persistent radial palsy after 62 humeral diaphyseal fractures: cause, treatment, and results, 30 Operated Cases. Rev Chir Orthop Reparatrice Appar Mot. 2002; 88(7):655-62.

10. De Franco MJ, Lawton JN. Radial nerve injuries associated with humeral fractures. Journal of Hand Surg 2006 Apr; 31A:655-63.
11. Di-Filippo. P; Mancini G B.; Gillio. A. Humeral fractures with paralysis of the radial nerve. Arch-Putti-Chir-Organi-Mov 1990; 38(2): 405- 409.
12. El Ayoubi L, Karmouta A, Roussignol X, Auquit-Auckbur I, Milliez Py, Duparc F- Anterior radial nerve transposition in humerus midshaft fractures: anatomic and clinical study. Rev Chir Orthop Reparatrice Appar Mot. 2003 Oct; 89(6): 537-43.
13. Eustace stephen. M R imaging of acute Orthopaedic trauma to the extremities. Radiologic Clinics of North America 1997; 35: (3): 615 – 629.
14. Foster Robert J, Swiontkowski MF, Bach A W and Sack. J.T. Radial nerve palsy caused by open humeral shaft fractures. J Hand Surg 1993; 18A:121 -124.
15. Garcia A. Maeck Bh. Radial nerve injuries in fractures of the shaft of the humerus. Am J Surg 1960; 99: 626-627.
16. Gray's Anatomy- The Anatomical Basis of Clinical Practice, 39 th Edition, 2005.
17. Green D. P. - Radial Nerve Palsy (Green‘s operative Hand Surgery 4th edition, 1999).
18. Gregory Paul R - Rockwood and Green - Fractures in adults, Volume I, 5 Th Edition 2001.
19. Guse Thomas R, Ostrum Roert F. The surgical anatomy of the radial nerve around the humerus. Clin Orthop Relat Res 1995; 320: 149-153.
20. Holstein A, Lewis G. Fractures of the humerus With Radial Nerve Palsy. J Bone Joint Surg 1963; 48A: 1382-1388.
21. Hoppenfeld S. Surgical Exposures in Orthopaedics. New York: Lippincott Williams & Wilkins, 1994:51- 83.
22. Kwasny O, Maier R. The significance of nerve damage in upper arm fractures, Unfallchirurg, 1991; 94(9):461-7.
23. Larsen LB, Barfred T. Radial nerve palsy after simple fracture of the humerus. Scand J Plast Reconstr Surg Hand Surg 2000; 34(4):363-366.
24. Lim Ke, Yap Ck, Ong Sc, Aminuddin. Plate osteosynthesis of the humerus shaft fracture and its association with radial nerve injury - A retrospective study in melaka general hospital. Med 2001 Jun; 56 Suppl C: 8-12.
25. Lin.J. Locked nailing of spiral humeral fractures with or without radial nerve entrapment. Clin Orthop 2002 ;( 403):213-20.
26. Muller M E, Allogrower M, Schneider R and Willen Egger H. Manual of Internal Fixation, 1993.
27. Olarte Carlos M, Darovish M and Ziran Bruce H. Radial nerve transposition with humeral fracture fixation. Clin Orthop 2003; 413:170 -174.
28. Pollock. F. H, Drake. D, Bovill E. G, Day. L, Trafton P. G. Treatment of radial neuropathy associated with fracture of the humerus. J Bone Joint Surg 1981; 63A: 239-243.
29. Ring D, Chin K, Jupiter J. Radial Nerve Palsy Associated With High Energy Humeral Shaft Fracture. J Hand Surg. 2004; 29A (1):144-7.
30. Turek SL. Orthopaedic Principle and Applications (J. B. Lippincott Company).
31. Samardzic. M; Grujicic. D. and Milinkovic. Z. B. Radial nerve lesions associated with fractures of the humeral shaft. Injury 1990; 21(4): 220-2.
32. Shao YC, Harwood P, Grotz MR, Limb D, Giannoudis PV. Radial nerve palsy associated with fractures of the shaft of the humerus: A systematic review. J Bone Joint Surg 2005 Dec; 87B:1647-52

33. Sim F H, Kelly P J and Henderson E D. Radial nerve palsy complicating fractures of the humeral shaft. J Bone Joint Surg 1971; 53A: 1023- 1024.
34. Takami H, Takahashi S, Ando M. Severance of the radial nerve complicating transverse fracture of the mid- shaft of the humerus. Arch Orthop Trauma Surg, 1999; 119:109-111.
35. Vansteeenkiste.F. P, Rommens.P. M. and Broos. P. L. Is a radial nerve paralysis in a humeral shaft fracture an indication for surgery? Indications Acta.Chir- Belg.; 1989; 89(4): 215-220.
36. Watson Jones R- Fractures and Joint Injuries. 6th edition, 1992.

Table 1: Outcome Vs Level of Fracture

**Outcome ve Level of the fracture**

| | | | M3 | | | | |
|---|---|---|---|---|---|---|---|
| | | | L/3 | L3 | M/3 | U/3 | Total |
| DUR1 | <6 | Count | 0 | 0 | 0 | 1 | 1 |
| | | % | .0% | .0% | .0% | 100.0% | 5.6% |
| | 6 -- 18 | Count | 2 | 0 | 4 | 0 | 6 |
| | | % | 50.0% | .0% | 33.3% | .0% | 33.3% |
| | >18 | Count | 2 | 1 | 8 | 0 | 11 |
| | | % | 50.0% | 100.0% | 66.7% | .0% | 61.1% |
| Total | | Count | 4 | 1 | 12 | 1 | 18 |
| | | % | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

a. x2=19 P=.004 HS

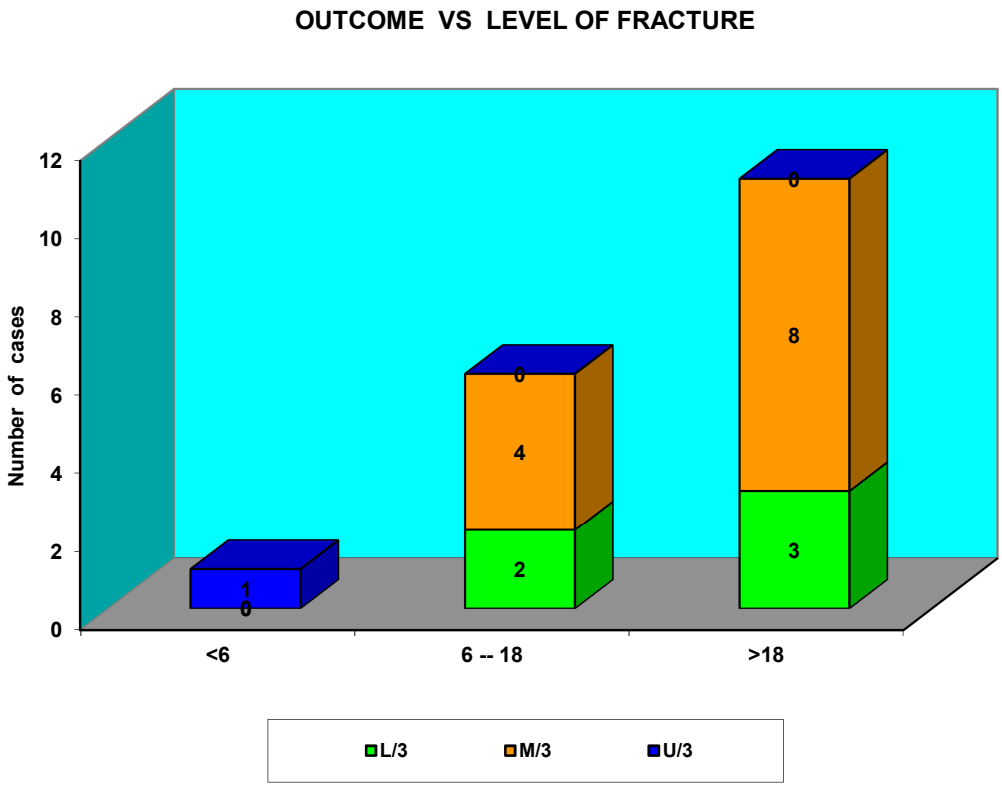


Figure 1: Outcome Vs Level of Fracture