



Case Report

Secondary Radial Nerve Palsy Following Plate Osteosynthesis in Shaft of Humerus Fracture: A Case Report

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Abstract

Fractures of the humeral shaft account for roughly 2-3% of all fractures. The commonest associated injury to a closed diaphyseal humeral fracture is the injury of the radial nerve. Radial nerve function is likely to return spontaneously after primary as well as secondary nerve palsy in the absence of any level of neurotmesis. The management of primary and secondary radial nerve palsy associated with humeral shaft fractures is still controversial. Identification and protection of radial nerve during surgery may prevent secondary nerve palsy. We present a case of 22 year old female, right handed, tailor by occupation with radial nerve palsy after failed plate fixation of right humerus shaft fracture using anterolateral approach. During exploration of radial nerve and revision fixation of the fracture, we found that the nerve was stretched, scared and impinged by a screw. Full recovery of radial nerve function occurred eventually.

Keywords: Humeral shaft fracture, Secondary radial nerve injury, internal fixation with plate.

Introduction

Fractures of the humeral shaft account for roughly 2-3% of all fractures.^{[1][2][3]} Most can be treated non-operatively. Up to the age of 60 years, diaphyseal humeral fractures occur equally in men and women. After the age of 60 years, 80% are women and humeral shaft fractures become more frequent.^{[4][5][6]} The most common reason for a humeral shaft fracture is a fall followed by motor vehicle accident.^{[7][8]} Other causes that account for less than 10% of humeral shaft fractures include sporting activities, working accidents, fall from a height, violence and bone pathology. The commonest associated injury to a closed

diaphyseal humeral fracture is the injury of the radial nerve (10% to 12% of all closed humeral shaft fractures).^{[9][10][11]} The clinical manifestation is the inability to dorsiflex the wrist and digits while numbness occurs on the dorsoradial aspect of the hand and the dorsal aspect of the radial 3 ½ digits. Primary radial nerve palsy is more common with transverse and spiral fractures than with oblique or comminuted fractures.^[12] Secondary radial nerve injury may occur during closed manipulations or at the time of surgical intervention using compression plate or intramedullary nail.^{[13][14]} Usually the radial nerve injury is a neuropraxia, with recovery rates of

100% in low-energy injuries and up to 71% in high-energy injuries.

Regarding treatment, no clear consensus exists regarding if and when the nerve should be explored surgically. A “wait and see” strategy seems to be widely accepted for spontaneous recovery in patients with primary radial nerve injury. In contrast, the opinions differ about necessity of early nerve exploration in patients suffering from secondary radial nerve palsy after initial humeral fracture fixation. Some authors recommend early exploration^[15] while others recommend 4-6 months observation period.^{[16][17]} According to literature, there is no significant difference in overall recovery rate in primary (88%) and secondary radial nerve palsy (93%).^[14] In patients with radial nerve palsy for whom operative treatment of a humeral shaft fracture is indicated (open fractures), the nerve should be explored at the time of fracture fixation.^{[18][19][20]} Nerve conduction studies and electromyography (EMG) can be used for the assessment of the functional status of a nerve and its recovery rate and are used mostly after radial nerve palsy. Union rates of 90-100% have been reported with conservative management especially with functional bracing.^[21] Guidelines for acceptable reduction include less than 3 cm of shortening, angulation of less than 20 degrees and rotation of less than 30 degrees.^{[22][23]} Options for operative fixation include plate osteosynthesis, intramedullary nailing and external fixation. Plate osteosynthesis remains the gold standard of fixation for humeral shaft fractures with an average union rate of 96.7%. The most commonly used plate for fixation of humeral shaft fractures is the broad, 4.5-mm, limited-contact dynamic compression plate.^[24]

Case Report

A 22 years old female, right handed, normotensive, non-diabetic, tailor by occupation came to hospital with secondary radial nerve palsy after plate fixation of right humeral shaft fracture by antero-lateral approach. Initially, the patient

had presented to emergency with a closed fracture shaft of humerus without neurological deficit 2 ½ year prior, due to fall of roof on her right arm (Figure 1). In the emergency room, the patient was managed with intravenous analgesics and splint. After 8 days of admission in the hospital, the patient was operated with open reduction and internal fixation (ORIF) with limited contact dynamic compression plate (Figure 2). The patient was doing well without any neurological deficit for 1 year following surgery. After 1 year post surgery, she has started developing features of radial nerve palsy that increasingly interfered with her daily activities. Nerve conduction velocity study was done and it showed radial nerve palsy. The patient was managed non-operatively with a dynamic cock up splint. 4 months later, the patient still experienced pain and loss of function in right hand. In the absence of signs of recovery, the patient underwent plate removal and radial nerve exploration. Intraoperatively, the radial nerve was found stretched and impinged by the screw (Figure 3). An external neurolysis was performed (Figure 4). Post-operatively, after one month of plate removal and radial nerve exploration, patient again sustained trauma to her right arm due to fall in April 2019. Then, she was managed by non-operative method with U slab application and observed for clinical and electromyographic signs of recovery. Serial radiographic evaluation was done and showed non-union of fracture humerus (Figure 5).

Now we performed revision fixation using compression plating technique and bone grafting using posterior approach (Figure 6). There were no postoperative complications. Post-operatively after 4 weeks, the first signs of radial nerve function recovery were already observed. At 10 weeks, the fracture shows signs of radiographic union and patient showed recovery of motor and sensory deficit but had not fully recovered. Muscle strength of radial nerve innervated muscles of wrist, fingers and thumb improved.



Figure 1: Shaft of humerus fracture at her first presentation



Figure 2: Immediate Post OP radiograph

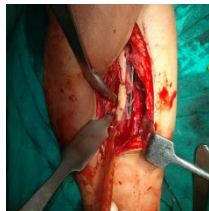


Figure 3: Stretched and impinged Radial nerve with exposed plate



Figure 4: Radial nerve after neurolysis and exploration



Figure 5: Non-union at 3 months after plate removal



Figure 6: Revised fixation and bone grafting done using posterior approach

Discussion and Conclusion

The commonest associated injury to a closed diaphyseal humeral fracture is the injury of the radial nerve (10% to 12% of all closed humeral shaft fractures).^{[4][9][10][11]} Radial nerve functions are likely to return spontaneously after primary as well as secondary nerve palsy in the absence of any level of neurotmesis.^{[14][20][25]} The management of primary and secondary radial nerve palsy associated with humeral shaft fractures is still controversial. There is high rate of spontaneous recovery of radial nerve palsy after closed humeral fractures and operative exploration associated with increased complications like secondary infection and further nerve damage. Thus, majority is managed without surgery.^[14] Claessen *et al* found radial nerve palsy in humeral shaft fractures significantly associated with high energy trauma, open fractures, as well as surgical approach.^[26]

Dealing with secondary radial nerve palsy detected after a surgical fracture fixation, we believe that a nerve exploration if not already done during the first surgery, is obligatory and should be performed shortly after the first operation. When secondary radial nerve palsy does occur, the treatment approach varies among surgeons. The chance of recovery depends on the condition of the nerve. Compression or traction injuries without neurotmesis are likely to recover spontaneously within 4 months, while the prognosis of transected nerve is poor.^{[9][27][28]}

There are several risks and reasons for secondary radial nerve palsy during fracture fixation: even light tension to the nerve during exploration might causes neuropraxia. Another potential source for

injury is the positioning of the patient before and after surgery. Traction damage can occur because of excessive indirect fracture manipulation during nailing. A strong tension to the surrounding radial nerve or an entrapment between bone fragments can be the consequence.^{[17][18][29][30]}

We used the posterior approach for exposure of humerus. This approach allows for increased visualization of the posterior aspect of humerus with identification and protection of the radial nerve. Most of the primary radial nerve palsies recover spontaneously and therefore nerve exploration is only exceptionally needed. The incidence of secondary radial nerve palsy after surgery may be seen after plate fixation. In these cases, some recommend early nerve exploration to detect and treat potential curable neural lesions while others recommend 4-6 months observation period.

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