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Research Article

Radial nerve palsy following plate osteosynthesis of shaft humerus in relation to posterior verses anterolateral approach

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ABSTRACT

Background: Fracture shaft of humerus is a relatively common upper limb injury. Although it can be managed conservatively still surgical management is the recent trend worldwide. Open reduction and plate osteosynthesis is the gold standard and commonly practiced method of management. Iatrogenic radial nerve palsy following fracture fixation is a usual complication. Though most cases recover with time, but the incidence is variable in different approach. We compared two common approaches for fixation of middle 1/3rd of shaft of humerus fracture based on frequency of secondary radial nerve palsy and fracture healing.
Methods: A prospective comparative study of management of all middle 1/3rd shaft humerus fracture was undertaken in our institute from Jan 2012 to Nov 2014. Total 42 patients were operated in this period of which six patients lost to follow up, so all total 36 cases were included in the study. Among these 36 patients 16 patients were operated by posterior approach and rest 20 were operated by Anterolateral approach. All patients were followed up at 2nd post-operative day, 2 weeks, 6 weeks, 3 months, 6 month and 1year. Frequency of radial nerve palsy with its outcome and fracture union was accessed in postoperative follow-ups.
Results: There were total 3 cases of iatrogenic radial nerve palsy found in patients operated by posterior approach but all these patients recovered by average 5 month (3 to 6 months). There was not a single case of radial nerve palsy seen following humerus fixation by anterolateral approach. All 36 patients had good radiological union by 1 year, of which 2 patients of anterolateral approach and 1 patient from posterior approach required bone grafting to achieve union.
Conclusions: Both the approaches had similar outcome in terms of fracture healing but there was significant difference in frequency of secondary radial nerve palsy, commonly seen in posterior approach.

Keywords: Humerus fracture, Anterolateral approach, Posterior approach, Radial nerve palsy, Fracture union

INTRODUCTION

Fracture of shaft of humerus accounts for 3-5% of all fractures and usually seen in young patients.[1,2] Most humerus shaft fractures can be managed by non-operative methods like hanging cast, functional brace, abduction cast.[3-5] Conservative management usually leads to shoulder and elbow stiffness and also there is a high risk of non-union.[6-10] Now a days there is increase in surgical intervention for management of shaft humerus fracture to allow earlier mobilization and rapid return to work.[11,12] Usual method of fixation is by dynamic compression plate or interlocking nail. Restriction of shoulder movement and delayed union are common complications associated with nailing.[13-15] Up to 20% patients complain of shoulder pain due to injury to rotator cuff, protrusion of nail or adhesive capsulitis.[13,16] Similarly secondary radial nerve palsy is a common complication associated

with plating of humerus as observed by Shao et al.[17] although both procedures have benefits and complication Still plate and screw fixation for middle 1/3rd of shaft humerus remains the gold standard for surgical management as observed by Paris H et al.[18]

Different approaches for humeral shaft fractures are anterolateral, posterior, postero-lateral and lateral.[10,18-20] among these anterolateral and posterior are the commonest approaches. Both the approaches have its own limitations due to fracture location, patient position and possibility of secondary radial nerve injury. Preferably middle 1/3rd and proximal shaft fractures are exposed by anterolateral approach incision which can be extended proximally and distally without much handling the radial nerve. Distal shaft fractures are usually approached by posterior approach due to shape of distal humerus. The limitation with this approach is proximal extension and need for exploration of radial nerve. Besides patient had to be in lateral position which is difficult in poly trauma and spine injury patients or when the procedure is performed with brachial anaesthesia. Incidence of iatrogenic or secondary radial nerve palsy are reported to be from 5.1% to 17.6%.[18,22] This makes selection of approach difficult and sometimes nerve exploration is unavoidable to obtain sufficient fixation space.[23-25] still some surgeon prefers posterior approach for all shaft humerus fracture because of quick exposure and easy fracture reduction. Fracture shaft humerus excluding proximal and distal 5 cm can be safely approached by both the approaches as per surgeon's preference. There are very limited published articles comparing both approach and complications associated with it. We had made a prospective analysis of both approaches for fracture shaft humerus with its outcome and frequency of radial nerve palsy.

METHODS

A prospective comparative study of management of 42 humerus shaft fractures by dynamic compression plate by anterolateral and posterior approaches is conducted from Jan 2012 to June 2014 in IMS and SUM hospital. Out of 42 operated patients with humerus shaft fractures 6 patients lost to follow up, so 36 patients are included in this prospective analysis. All patients were operated in alternate manner to avoid surgeon bias to any procedure but one patient with spinal injury and another patient with associated forearm fracture were operated by anterolateral approach instead of posterior approach.

Total 20 patients operated by anterolateral and rest 16 patients were operated by a posterior approach. The inclusion criteria are fracture humerus shaft excluding proximal and distal 5 cm, aged between 18 to 65 years, less than 3 weeks of trauma. The exclusion criteria are skeletally immature patients, primary radial nerve palsy, compound fracture, pathological fractures, and segmental fracture.

All the patients after routine pre-anaesthetic check-up selected for one of the two approaches in alternate fashion. All surgeries are performed by two orthopaedic surgeons well versed with both the approaches.

Surgical technique

Anterolateral approach

Patient placed in supine position following general or brachial anaesthesia as per anaesthetist preference and other general condition of patient. After painting and draping, skin incision is put along the lateral border of biceps tendon. Along the lateral border of biceps, brachialis muscle was split to expose the fracture site. The medial border of humerus was exposed subperiostealy. The advantage of putting plate on anteromedial surface avoids stripping of deltoid insertion irrespective of fracture location. After reduction dynamic compression plate was fixed with or without interfragmentary screw. Fixation was done with minimum 3 screws (6 cortices) in each segment to get adequate stability. After plate fixation closure of wound was done with negative suction drain in place. Arm was splinted for two weeks. Post-operative radiographs were done to see adequacy reduction and clinical examination to see secondary radial nerve palsy. Physiotherapy for shoulder and elbow started as per tolerance.

Posterior approach

Patient placed in lateral position following anaesthesia. After painting and draping midline longitudinal skin incision put palpating the fracture site. Triceps muscle was split along its fibres exposing the fracture site. Radial nerve is explored and demarcated with a strap. With proper handling the radial nerve dynamic compression plate is fixed with minimum 6 cortices on each side. Rest closure, postoperative protocol and physiotherapy are followed as per anterolateral approach.

All the 36 patients irrespective of surgical approach are followed with radiographs and clinical examination at 2nd post-operative day, 2 weeks, 6 weeks, 3 months, 6 month and 1 year. We assessed radiological union, secondary radial nerve palsy and its recovery.

RESULTS

In our study of total 36 patients we found road traffic accident is the most common mode of injury followed by history of fall from height. Total 27 (75%) shaft humerus fractures are due to RTA followed by 6 (16.6%) are due to fall and rest 3 (8.3%) are due to direct trauma to arm. 28 patients (77.7%) are male patients and rest 8 (22.3%) are female patients.

Among 20 patients operated by anterolateral approach 15 are males and 5 are females, with average age of 35.6 years. Whereas 16 patients operated by posterior approach 13 are males and 3 are females, with average age of 38.3 years. All 36 patients irrespective of approach attained radiological union by 1 year. 2 patients operated by anterolateral approach and one patient by posterior

approach need iliac crest bone grafting in due course but ultimately had radiological union by 1 year. Among all operated patients we found 3 cases of secondary or iatrogenic radial nerve palsy on the first post-operative day. Interestingly all 3 patients are operated by posterior approach. We advised to use dynamic cock up splint to these patients. As we had seen that the radial nerve was intact in all these cases, we just followed up these three cases with physiotherapy and active exercise. Besides no such investigations were done like NCV, electromyography as there was no wrist drop preoperative and radial nerve was intact at operation. All three 3 patients recovered completely by 3 to 6 months (average 5 month).

Table 1: Observation table of patients operated by posterior approach.

NO	Radial nerve status						Radiological union					
	2nd Post OP	2nd Weak	6th Weak	3rd Month	6th Month	1 Year	2nd Post OP	2nd Weak	6th Weak	3rd Month	6th Month	1 Year
1	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
2	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
3	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
4	W	W	W	W	N	N	NO	NO	NO	NO	NO	YES
5	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
6	N	N	N	N	N	N	NO	NO	NO	NO	YES	YES
7	N	N	N	N	N	N	NO	NO	NO	NO	YES	YES
8	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
9	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
10	W	W	W	W	N	N	NO	NO	NO	NO	YES	YES
11	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
12	W	W	W	W	N	N	NO	NO	NO	NO	YES	YES
13	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
14	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
15	N	N	N	N	N	N	NO	NO	NO	NO	YES	YES
16	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES

N- Normal radial nerve; W- Radial nerve weakness

Table 2: Observation table of patients operated by anterolateral approach.

NO	Radial nerve status						Radiological union					
	2nd Post OP	2nd Weak	6th Weak	3rd Month	6th Month	1 Year	2nd Post OP	2nd Weak	6th Weak	3rd Month	6th Month	1 Year
1	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
2	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
3	N	N	N	N	N	N	NO	NO	NO	NO	YES	YES
4	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
5	N	N	N	N	N	N	NO	NO	NO	NO	YES	YES
6	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
7	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
8	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
9	N	N	N	N	N	N	NO	NO	NO	NO	YES	YES
10	N	N	N	N	N	N	NO	NO	NO	NO	YES	YES
11	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
12	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
13	N	N	N	N	N	N	NO	NO	NO	NO	YES	YES
14	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
15	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
16	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
17	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES
18	N	N	N	N	N	N	NO	NO	NO	NO	YES	YES
19	N	N	N	N	N	N	NO	NO	NO	NO	YES	YES
20	N	N	N	N	N	N	NO	NO	NO	NO	NO	YES

N- Normal radial nerve

Figure 1A: Clinical photo posterior approach.

Figure 1B: X-ray posterior approach.

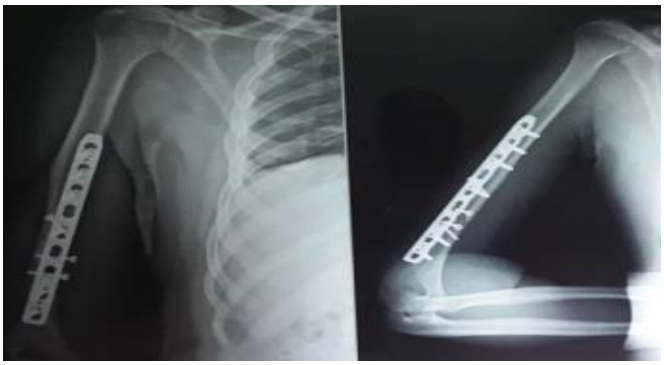

Figure 2A: Clinical photo anterolateral approach.

Figure 2B: X-ray anterolateral approach.

Figure 3A: 2nd post OP showing radial nerve palsy.

Figure 3B: Pre OP x-ray.

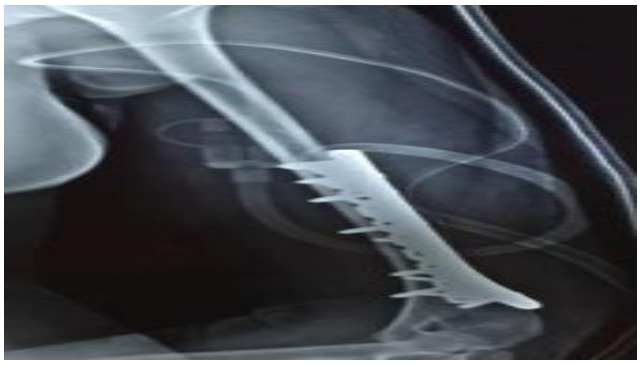

Figure 3C: Post OP X-ray posterior approach.

Figure 3D: 6 month post OP with recovery of radial nerve palsy.

Figure 4A: Clinical photo anterolateral approach.

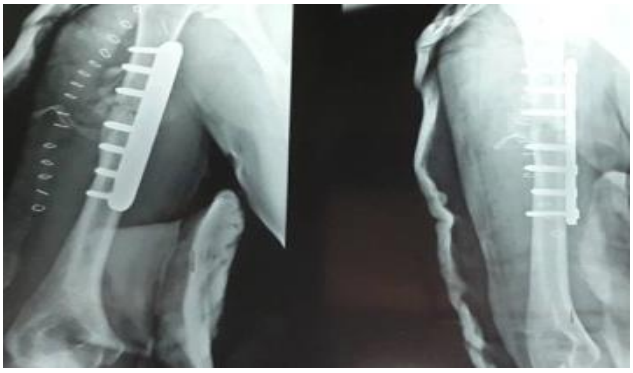

Figure 4B: X-ray anterolateral approach.

Figure 5A: Clinical photo posterior approach.

Figure 5B: X-ray posterior approach.

DISCUSSION

Fracture shaft of humerus is the commonest long bone fracture of upper limb, comprising 3% of all fractures.[1,2] Humerus fracture is more common in males with peak incidence in third decade and road traffic accident is the commonest cause.[26] The indications for surgical management are as following.

- Failed reduction by closed method
- Primary radial nerve palsy
- Floating elbow
- Compound fracture
- Pathological fracture
- Segmental fracture
- Associated with neurovascular injury

Although most shaft fracture can be managed by conservative method still there is a growing trend worldwide for surgical fixation to get early mobilization and to prevent stiffness. Among fixation method dynamic compression plating shows better results as compared to nailing in most published literatures.[27,28]

Plating of fracture shaft humerus is usually done by anterolateral or posterior approach depending on surgeon preference. Infection, Non-union and secondary radial nerve palsy are usual complications associated with plating.[13,28] But in a published meta-analysis results of plate fixation from pooled data did not show higher risks of Infection, Non-union and secondary radial nerve palsy compared to nailing.[16] Still secondary radial nerve palsy is a matter of concern as some study shows frequency up to 11.14%.[18,22,28] Analysing our study we did not found a single case of non-union among all 36 patients although 2 patients operated by anterolateral and 1 patients operated by posterior approach need bone grafting that is due to comminution at fracture site rather than approach.

But there is a significant difference in frequency of secondary radial nerve palsy in relation to the approach adopted. There were three cases of iatrogenic radial nerve injury in the posterior approach fixation of humerus. This is statistically significant. Secondary radial nerve lesion usually happens due to radial nerve handling while fixing the bone. Traction injury, damage by forceps, knife or drill-bit, sharp bony fragments or entrapped nerve in between bone fragment or bone and plate are the usual cause of radial nerve injury. Interestingly anterolateral approach did not require exploration of radial nerve even with extension of incision in both sides. Whereas posterior approach in most instances need exploration of radial nerve and there is a high risk of traction injury (neuropraxia). A distinguished feature of neuropraxia in radial nerve palsy is incomplete loss of sensation in dorsal radial aspect of hand towards first web space, with presence of perspiration in the radial nerve innervation zone, muscle dysfunction without atrophy.[29] We also found all 3 patients improved by 5 month with

conserving treatment like dynamic cock up splint and physiotherapy.

Usually secondary radial nerve palsy are reversible with very high chance of complete recovery, still it can be avoided or minimised by just changing approach for the surgery. Anterolateral approach is a versatile and safe approach for fracture fixation of humerus.

CONCLUSION

Both the approach have similar outcome in terms of fracture union by one year where as there is statistically significant difference in iatrogenic radial nerve palsy. It is common in posterior approach, though there was complete recovery by five months. We presume anterolateral approach would be a better approach for mid shaft humerus fracture than posterior approach. But cases with radial nerve palsy at the time of insult better should be approached with posterior approach, as radial nerve injury can be managed simultaneously with the humerus fracture.

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