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The comparative study of diaphyseal fracture of shaft of humerus treated with dynamic compression plate (DCP) versus intramedullary interlocking nailing

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Abstract
Introduction: There is still no consensus regarding management of fracture shaft humerus. We performed a prospective and retrospective study to compare clinical and functional outcome of humerus shaft fracture fixation by Nail and Plate
Material and Methods: The study was performed at tertiary care centre after taking necessary approval from institutional ethics committee. Fourty patients were followed up for minimum six months. Patients were followed up at 6 weeks, 12 weeks, and 16 weeks and at the end of six months. Plating as well as nailing patients were included in the study.
Results: In this study age ranges from 19 to 74 years with an average 33.22 years. The overall mode of injury in both groups was Road Traffic Accident (RTA) in 34 (85%), Fall 2 (5%), other causes, including industrial injury, assault in 4 (10%) cases. Average time taken for radiological healing overall was 16.83 weeks. In the interlocking group 18.95 weeks and plating group 14.72 weeks. So the healing rate was relatively faster in the plating group as compared to the interlocking group.
Conclusion: Clinical and functional outcome after fixation of fracture shaft of humerus by plate and nails both were better (assessed by ASES Scores) with less postoperative complications. Both the modalities of treatment i.e. Plating and Nailing are good as far as union of the fracture is concerned, but considering the functional outcome and rate of complications, we are of the opinion that Plating offers better result than Nailing which is compared and evaluated statistically.

Keywords: Fracture shaft humerus, plating, ante grade nailing.

Introduction
Humeral shaft fractures are uncommon injuries and are most commonly caused by high energy trauma and most commonly occurs in middle third of the shaft. Traditionally humeral shaft fractures have been treated non-operatively with hanging cast or brace. Sarmiento *et al* reported use of plastic sleeve with early introduction of functional activity. In a review of 51 fractures, there were no non-union among 49 non-pathological fractures and there was good restoration of joint motion [1]. But non-operative treatment has disadvantages of prolonged immobilization in cast or brace which sometimes may be required as long as 6 months resulting in huge morbidity. Moreover, not all fracture shaft humerus can be treated conservatively.
Bandi advised anatomical reduction and stable internal fixation in accordance with AO principle [2]. Plate and screws osteosynthesis seemed to be the most appropriate choice. Open reduction and internal fixation causes extensive soft tissue damage, insertion of plate may injure radial nerve. Risk of infection and nonunion due to opening of fracture hematoma, periosteal stripping and contamination of fracture site is also present. It also provide less secure fixation especially in osteoporotic bone and if crutch walking is required.
Stabilization of humeral fractures with rods placed in the medullary canal was introduced by Kuntscher (1940), Rush (1950) & Hackethal (1961) [3-4]. Kuntscher proposed the slotted elastic nail with the classical self-fitting technique. He used both the proximal and the distal entry to the medullar canal. Rush proposed two elastic rods with three point fixation. He preferred the proximal entrance. Hackethal used a bundle of elastic rods and preferred the proximal approach.

But the operative treatment of humeral fractures has been dominated by the plating technique after AO group of Muller, Allgower, Schneider and Willenegger (1977). Analysis of Kuntscher's technique has shown that complications like proximal instability with distraction or telescoping, rotation instability, pseudoarthrosis, malalignment and protrusion of the nail on the top of the shoulder joint are common. The advantage of this technique was the closed procedure and the Biological callus consolidation of the fracture.

Advantages of closed intramedullary nailing are well establish. It does not disturb the fracture hematoma. Avoid dissection at fracture site thereby reducing contamination of fracture site. Although closed intramedullary nailing with interlocking is a good treatment for fracture shaft humerus, it has some disadvantages including infection, radial nerve palsy, restriction and painful shoulder movements in antegrade and that of elbow in retrograde nailing.

Materials and Methods

Prospective and retrospective study of patient managed surgically from March 2015 to March 2016 by intramedullary nailing or plate fixation for humeral shaft fractures. These patients were divided into two groups of dynamic compression plating and Interlocking nailing.

The retrospective review of record of patients managed surgically 6 months before start of study by IM nailing or plate fixation for humeral shaft fractures was done. Patients were called and informed about the study, written consent was taken, and then they were evaluated. Inclusion criteria were age more than 18 years with minimum follow-up of six months. Exclusion criteria were patient less than 18 years, active infection, pathological fractures, Gustilo Anderson grade 2 and 3.

When patient came in hospital a thorough history and clinical examination was done. The status of radial nerve injury was recorded. Roentgenogram of the arm with shoulder and elbow was taken in both antero-posterior and lateral views. The humeral shaft fracture was temporarily immobilized with a U-slab and arm pouch.

The surgery was done by using alternate Plating and Nailing as management modality. Once the patient selected for surgery, pre-operative planning and investigations were done and the patients were posted for open reduction and internal fixation with LCP or closed reduction and internal fixation with interlocking nailing; alternately.

Anterolateral approach was used in patients with fractures of the shaft of the humerus. Only ante grade nailing was done in case of interlocking nailing group, none of the cases were treated by retrograde nailing. In the first group, 4.5 mm DCP was used, and in second group standard intramedullary interlocking nail was used. Post operatively a compression bandage was applied and a broad arm pouch was given. Parenteral antibiotics were given for a period of 3 days. Wound is inspected on the [2-5-7-11] post-operative day. Sutures were removed between the 11th and 14th post-operative days.

Patients were followed up on 6th week, 12th week and 24th week and assessed for pain at the fracture site, evidence of union, functional outcome using DASH score. If there are no radiological signs of union by 16-18 weeks, the fracture was categorized as delayed union and if absence of fracture union after 32 weeks after injury was categorized as non-union.

Results

The present study consists of 40 cases of fracture shaft humerus treated surgically. Care of associated injuries was taken with equal enthusiasm. In this study age ranges from 19 to 74 years with an average 33.22 years. The youngest case was 19 year male and oldest was 74 years female. Maximum numbers of patients were in age group 40-50 years. The mean age was 39.22 years for nail group and 39.45 in plate group.

The overall mode of injury in both groups was Road Traffic Accident (RTA) in 34 (85%), Fall 2 (5%), other causes, including industrial injury, assault in 4 (10%) cases. Only one patient had open fracture in nailing group. Out of 18 cases of plating, 18 united primarily as defined by disappearance of fracture line. Out of 18, 15 cases i.e. 83.33% united in less than 17 weeks, and 3 cases i.e.16.66% united in between 17 to 24 weeks. We found no cases of nonunion. Out of 22 cases of interlock nailing which we have done, 8 cases i.e. 36.36 %, united in less than 17 weeks. 10 cases i.e. 45.45% united in between 17 to 24 weeks. And 4 cases i.e.e18.18% united from 24 to 39 weeks. We found no nonunion. Average time taken for radiological healing overall was 16.83 weeks. In the interlocking group 18.95 weeks and plating group 14.72 weeks. So the healing rate was relatively faster in the plating group as compared to the interlocking group.

There was statistically significant difference in the time taken for radiological union (P=0.001). All radiographs were assessed and healing was considered as bone bridging the fracture in two planes. If there are no radiological signs of union by 16-18 weeks, the fracture was categorized as delayed union and if absence of fracture union after 32 weeks after injury was categorized as non-union.

Discussion

This study focuses on 40 cases of fractures of shaft of humerus. Out of 40 cases, 18 cases were treated with dynamic compression plating and 22 cases were treated with interlock nailing. The results of both are compared with previous standard series. Males formed the majority of the cases, because of outgoing nature and as they form the majority in any type of work including driving. Age distribution, incidence, side of injury were comparable to other standard studies.

It requires a force of considerable magnitude to cause fracture of this tubular bone. Majority of the fractures in our study were caused by road traffic accidents (85%). In Chapman *et al*. series 75 % fractures were caused by RTA while in S Raghvendra *et al.* study it caused fractures in 44.5% cases. ln our series out of 18 cases of plating, 18 united primarily as defined by disappearance of fracture line. Out of 18, 15 cases i.e. 83.33% united in less than 17 weeks, and 3 cases i.e.16.66% united in between 17 to 24 weeks. We found no cases of nonunion. Out of 22 cases of interlock nailing which we have done, 8 cases i.e. 36.36 %, united in less than 17 weeks. 10 cases i.e. 45.45% united in between 17 to 24 weeks. And 4 cases i.e.18.18% united from 24 to 39 weeks. We found no cases of nonunion. In the series of Chapman JR *et al*., nonunion rate with dynamic compression plate was 2.7% and with interlock nailing was 5.2% i.e. nonunion rate was higher with interlock nailing than with dynamic compression plating.

Average healing period in the plate group in our study was 14.72 weeks, while in the interlock nailing group 18.95 weeks. In Chapman J R series average healing period was 17 weeks for dynamic compression plating and 20 weeks for interlock nailing. We had 4 cases of delayed union in the Intramedullary nailing group but it progressed to union without intervention. Plating group showed better radiological evidence of union at 24 weeks follow up. Usually distraction

at the fracture during insertion lead to delayed union of fracture in nailing group. Raghvendra S *et al* study also had concluded delayed union in nailing group.

Superficial infection is the only complication seen in dynamic compression plating group with 3 cases i.e. 16.66%. In Interlock nailing group complications occurred in 5 cases with the rate of 22.72% which is higher than that with dynamic compression plating.

Full range of movement were seen in shoulder and elbow joint in 81.81 % of patients of interlock nailing and 100 % of patients of dynamic compression plating. Mild restrictions of movements were seen in 18.18 % cases of interlock nailing and not in dynamic compression plating. Raghvendra S *et al* study also had found normal range of shoulder joint after plating in 16 i.e.89 % patients out of 36 while in only 8 cases of 36 in nailing group i.e. 45 %. In Chapman J R series, restriction of shoulder movement was a problem in the interlock nailing group and stiffness of elbow joint was problem with dynamic compression plating group, especially cases with fracture involving distal third of the humerus. In interlock nailing stiffness of the shoulder was due to rotator cuff damage and restriction of abduction due to impingement of the nail under acromion. Most of the case with minimal to moderate stiffness seemed to be due to inadequate physiotherapy. Some patients did not want to use the operated limb due to apprehension.

In cases of humerus fractures treated operatively by IM nailing the most common problem in post-operative period is restricted abduction movement at shoulder. In our study we found that following the rehabilitation/mobilization plan our patients were able to achieve a good functional range of motion at elbow in 4-6 weeks where as we had 70˚ abduction at shoulder by 4-5 weeks and 90˚ abduction by 5-6 weeks.

The cause of pain could be disruption of the rotator cuff in its avascular zone within 1 cm of its insertion to the greater tuberosity that may lead to poor healing. The complications were more in the interlocking nailing group with most of them pertaining to poor shoulder function or pain. A study conducted by Sunil kulkarni *et al*. 51, used ASES score to compare these 2 modalities of treatment and their results were functional outcome is similar in both groups. DCP group (29.04) compared to interlocking nailing group (31.4). Rate of healing was marginally better in DCP group as compared to I.M nail. Concluded that both modalities of treatment i.e. plating and interlocking nailing are good as far as union of fracture is concerned, but considering number of complications and functional outcome, plating offers better result than ante grade interlocking nailing with respect to pain and function of shoulder joint.

In Study conducted by Arun K N, functional results of ante grade intramedullary interlocking nail were excellent in 21(84%), moderate in 2(8%) and poor in 2(8%). Our study concluded that Dynamic compression plating and interlocking nailing both give better outcome for fracture shaft of humerus.

Conclusion

Clinical and functional outcome after fixation of fracture shaft of humerus by plate and nails both were better (assessed by ASES Scores) with less postoperative complications. Both the modalities of treatment i.e. Plating and Nailing are good as far as union of the fracture is concerned, but considering the functional outcome and rate of complications, we are of the opinion that Plating offers better result than Nailing which is compared and evaluated statistically.

We therefore conclude that in cases where both Plating and Nailing can be done, we would prefer to use Plating, as the results are better than Nailing. In our study; because of short study duration, maximum follow up is till 6 months post operatively. We recommend long term follow up of at least 2 years to evaluate for complications.

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