

Evaluation of Results of different treatment modalities in the management of diaphyseal fractures of the humerus

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Citation

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Abstract

Introduction

This paper presents evaluation of 103 patients of diaphyseal fractures of humerus treated by different modalities with a mean follow up of 2 years.

Materials and Methods
This is a prospective and retrospective study conducted at Dr. Rajendra Prasad Govt. Medical College and Hospital, Kangra (Tanda), HP, India during yr 2005-2006. It aimed at finding out comparison of the results obtained by different modes of treatment in fractures of humeral diaphysis. We studied a total of 103 patients out of which prospective study involved 72 patients and retrospective study (2003-2004) involved 31 patients (whose records were available). All the cases were examined clinically and radiologically and were managed with an appropriate method of treatment. The closed fractures were classified by Muller's classification while Gustillo Anderson was used for open fractures. The non-operative methods included Coaptation or U shaped Brachial splint or U-slab, Hanging arm cast, Velpeau dressing, Shoulder spica cast, Functional brace. The patients with failure of closed reduction, with complex fracture geometry or open fractures were treated by operative methods. The patients were followed up weekly for the first 3 weeks and then at six weekly intervals to a maximum of 2 year (range 16-26 months) or till the union was achieved. From prospective study 3 patients were lost to follow up and hence excluded from the study. Functional outcome was assessed by Modified Stewart and Hundley (1955) criteria. Results
Out of 100 patients there were [44 A fractures (A1-13, A2-9, A3-22), 36 B fracture (B1 - 26, B2 - 9, B3 - 1), and 20 C fractures (C1-15, C2-4, C3-1)]. Out of these 14 fractures were associated with open injury (2 grade I, 4 grade II, 4 grade IIIA, 3 grade IIIB, 1 grade IIIC). 46 cases treated conservatively united at 24 weeks (15.65 weeks) and 54 patients which were treated by different modalities united at 36 weeks (Ex fixator), 22 weeks (Nail), 20.3 weeks (Plate and screws). Good results were obtained in 100% by velpeau dressing in children, 85% by U slab, 50% by plate and screws and 33.3% with nailing. There were postoperative complications like infection (6%), radial nerve palsy (2%) and non-delayed union (5-6%).
Conclusion
Conservative management is method of choice in management of closed diaphyseal fractures of humerus as it gives early union, better limb function and is devoid of any of the routine postoperative complications. Patients with failed conservative treatment, open fractures and fractures with complex geometry are better managed operatively. ORIF with plate and screws has proven to be better than nailing procedures in present series in terms of giving better functional outcome. Patients treated with external fixator had mostly fair and poor outcome as injuries dealt by them were open type III injuries.

INTRODUCTION

Diaphyseal Fractures of humerus are commonly seen in Orthopaedic practice. Incidence of this fracture is about 3%. Due to advanced industrialization and high speed, the incidence of this injury is on the increase. Earlier, this fracture was supposed to be caused by less violent force, and was thought to be easier to manage by conservative or non-operative methods after closed reduction and adopting simpler modes of immobilization like Hanging arm cast, Coaptation or U shaped brachial splint, Velpeau dressing, Abduction humeral splint/Shoulder spica cast, Skeletal

traction; and Functional brace.

High energy trauma in present times has led to Fractures with higher degree of comminution and soft tissue damage leading to more invasive approach for their treatment. Surgical intervention is also necessary when closed management of these fractures fails. Intramedullary interlocking nailing, Locking Compression Plate are viable options for operative management of these fractures. They provide stable fixation even in fractures with a complex geometry and underlying osteoporosis and help achieve early limb function.

MATERIAL AND METHODS

This is a prospective and retrospective study aimed at finding out comparison of the results obtained by different modes of treatment in fractures of humeral diaphysis. We studied a total of 103 patients out of which prospective study involved 72 patients and retrospective study(2003-2004) involved 31 patients(whose records were available) .

All the cases were examined clinically and radiologically and were managed with an appropriate method of treatment. The closed fractures were classified by the method of Muller et al ¹ while for open fractures classification by the method of Gustillo et al ² was used . The patients were also examined for involvement of neurovascular structures. The mode of treatment adopted was recorded. The patients were followed up weekly for the first 3 weeks and than at six weekly intervals for 8 months or till the union were achieved. On every follow up, the patients were regularly examined clinico-radiologically for evidence of union. From prospective study 3 patients were lost to follow up and hence excluded from the study. Any complications developed during the course of treatment were also noted.

The mode of treatment consisted of operative and non-operative techniques. The non-operative methods available included Cooptation or U shaped Brachial splint or u-slab, Hanging arm cast , Velpeau dressing, Shoulder spica cast, Functional brace . In our study, the indication for operative treatment was either failure of the non-operative treatment or open fractures so the cases selected for surgery were the problem fractures The operative methods available included External Fixator, Intramedullary Nail (only K Nail/ v Nail /Rush Nail/ interlocking nail), Plate and screws.

Union was defined as absence of pain and motion at the fracture site with manual manipulation and consolidation of visible callus along with obliteration of the fracture line as seen on radiographs. Degrees of union were classified is three categories. Retarded healing was defined as the lack of any clinical or radiographic signs of healing at six week after injury. The ASIF/AO classification of delayed union (failure to unite in 4 to 8 months) and non union (failure to unite in greater than 8 months) was used in this study.

On final follow up of the case, functional assessment was done according to Modified Stewart and Hundley criteria noting union, rang of motion at adjacent joints and subjective complaints³ (Table 1).

Good : No pain , limitation of adjacent joint mobility less than 20 degrees and angulation less than 10degrees.

Fair: Pain after efforts of fatigue, limitation of mobility ranging between 20degrees and 40 degrees and angulation greater than 10degrees.

Poor: Permanent pain, limitation of mobility greater than 40 degrees and non Óunion.

Table 1: MODIFIED STEWART AND HUNDLEY CRITERIA(1955)

RESULTS

Out of 100 patients there were 44 A fractures (A1-13, A2-9, A3-22), 36 B fracture (B1 - 26, B2 - 9, B3 - 1), and 20 C fractures (C1-15, C2-4, C3-1) .Out of these 14 fractures were associated with open injury (2 grade I , 4 grade II , 4 grade IIIA , 3 grade IIIB , 1 grade IIIC) .Male to female ratio was 3:1. . The Mean Age in the present study was 31.54 Years S.D+_18.70 Years (range 1-95yrs). There was a preponderance of humeral fractures in the age group 21-40 years. 72%of the patients had rural background as compared to 28% of the patients were from urban areas. There was no specific predilection for a particular side of the limb in any age group. Majority of the fractures were caused by fall in both the sexes. Dependents (Students and children) were the most vulnerable in the age group 0-20 years.

As per fracture location in diaphysis there were 19 proximal diaphyseal fractures, 46 middle shaft fractures, 35 distal shaft fractures. Maximum number of cases (46%) were located in the middle third of humeral shaft. Maximum numbers(38%) of the fractures were transverse. On first examination there were 12 nerve palsies (radial nerve palsies 10%, median nerve 1% and ulnar nerve 1%) out of which 7 were in the distal and 5 in middle shaft fractures .21% cases were having associated skeletal injuries. 46 cases were managed conservatively (40 with U- slab , 5 with velpeau dressing and 1 with hanging cast).

46 cases treated conservatively were all closed fractures that united at 24 weeks(mean time 15.65 weeks; with U slab 16.2 weeks, hanging cast 18 weeks, and velapeau dressing 10.8 weeks). There was no delayed or nonunion. In 54 cases which were managed operatively (44 by plate and screws, 6 by intramedullary nailing and 4 by external fixator,) 40 were closed fractures, 10 were gr i , ii and iiia fractures while 4 were iiib and iii c fractures. meantime for union was 20.9 weeks. 40 patients showed union by 24 weeks and 49 cases

united by 1 year and 5 reported nonunion . In 44 cases treated by plate and screws meantime for union was 20.3 weeks. Out of total 44 patients 4 united at 12 wks,32 united by 36 weeks,4 went into delayed union and united by 1 year and remaining 4 were nonunions. 6 patients managed by im nailing showed mean union at 22 weeks. 4 of these united at 18 weeks,1 united at 24 weeks, and 1 united at 36 weeks. 4 patients operated by external fixator showed mean union by 36 weeks . While 1 united at 36 weeks,2 united by 1 year and I showed nonunion. In proximal diaphyseal case(n=19) 18 had united at 36 weeks and I reported delayed union. In cases of middle shaft(n=46) only 39 united , 7 showed non/delayed union . In distal shaft(n=35), 32 united and3 went into delayed/nonunion.

In present study closed fractures were first to unite and open grade III fractures united last of all $p=0.013$ (Significant) .

On follow up examination by Modified Stewart and Hundley³ criteria restriction of <20 degree was noted in patients treated by Velpeau dressing in children, U slab and plate and screws. Good results were obtained in 100% patients treated by velpeau dressing, 85% patients treated by U slab and 50% patients treated by plate and screws. Restriction of 20-40 degree was noted in patients treated by nailing methods. None of the cases managed by external fixator qualified for good results. Thus in the operative series 44.4% good results were obtained as compared to 85% good results in the non operative series .(Table2) (Table3)

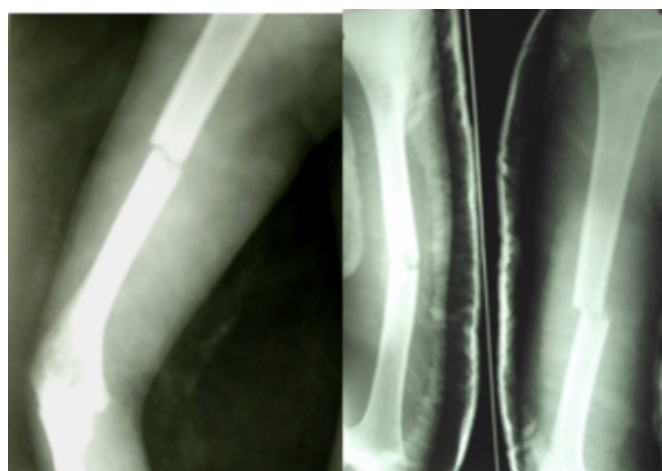
Figure 2

Table 3: DISTRIBUTION OF CASES DEPENDING UPON FINAL RESULT AND METHODS OF STABILIZATION

Result	Operative cases		Non operative cases		Total	
	NO.	%	NO.	%	percentage	
Good	24	44.4	39	85	63	63
Fair	19	35.2	7	15	26	26
Poor	11	20.4	0	0	11	11
TOTAL	54	100	46	100	100	100

Figure 3

Fi g 1.12-A3 Fracture Humerus Fig 2. 12-A3 Fracture showing early callus at 2 wks by U Slab



75% poor results were obtained in cases managed by external fixator application, the reason being that they were Grade III B and III C injuries, with significant pre-operative wound contamination.

Abduction at the shoulder was the movement most commonly restricted in cases managed operatively (maximum restriction being observed in intramedullary nailing due to subacromial impingement of the nail). Some loss of extension at elbow was the next movement to be affected.

Other complications noted in operated series were post – operative infection(6%),Post operative radial nerve palsies(2%), nonunion and delayed union (5% and 6%). Nerve palsies automatically recovered after 12 week. There was no vascular injury.

DISCUSSION

The present study involved 100 cases with an average age 31.59 years with SD_+18.7 years (Range1-95 years). Most of the patients belonged to the age group of 21-40 years. This age group is exposed to more active life style and is more prone to high velocity trauma. This was comparable to age incidence in other studies.^{4,5}

In this series there were 75 males and 25 females (M/F 3:1). In other study ⁵ there were 25 males and 5 females with diaphyseal fractures of humerus (M/F 5:1). Others reported 29 men and 19 women with diaphyseal humeral fractures ⁶ . The greater incidence among males could be attributed to their being earning hands of their families and hence leading a more mobile and active life.

The predominance of right side in humeral fractures has been observed in some studies⁵. In the present study right side was involved in 48% cases and the left in 52% cases, thus showing almost equal distribution in both the sides. This was inconsonance with other studies.⁷

The two most common mechanisms of diaphyseal fractures of humerus are fall and motor vehicle accidents⁸. Road traffic accidents and assault by blunt objects were the mode of injury in 86.5% cases⁷. In our study the predominant mode of injury was fall (49%) followed by motor vehicle accidents (34%), pedestrian injuries (13%) and others like gunshot injuries (4%). This was probably due to hilly terrain of the area involved in our study.

In some studies 40% fractures were transverse, 25% fractures were comminuted and 18% were oblique, 15% were spiral and 2% were segmental⁴. In the present study, 38% of cases were transverse, 28% comminuted, 19% were oblique, 14% were spiral and 1% were segmental.

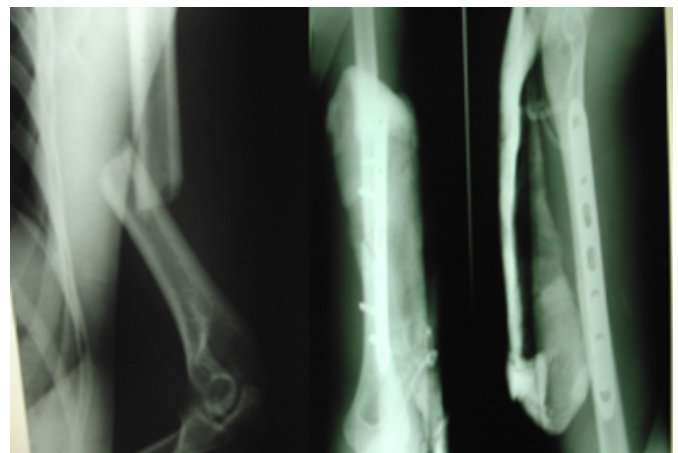
Radial nerve palsies were associated with 18% of the diaphyseal fractures of the humerus⁹. Although Holstein Lewis fracture (oblique distal third) is best known for its association with neurologic injury, radial nerve palsy is most commonly associated with middle third humeral shaft fractures¹⁰. In the present study nerve palsies were observed in 12% cases out of which 10% were radial 1% median and 1% ulnar and all were neuropraxias. Of these nerve injuries 7 were in the distal third fractures and 5 in the middle third fractures. In the present study recovery occurred in 90% patients within 3-12 weeks. In one case, there was post operative radial nerve palsy which also recovered in six weeks. Most nerve injuries represent a neuropraxia or axonotmesis, 90% will resolve in 3-4 months¹⁰.

Associated skeletal injuries were present in 21% diaphyseal fractures of humerus and were comparable to available literature¹¹. In our series 46% cases were managed non operatively (40% cases were treated by U slab, 1% cases by hanging cast, 5% by Velpeau dressing), Mean time for union in different methods noted individually was as follows: U slab-16.2 weeks, Hanging cast- 18 weeks, Velpeau dressing - 10.8 weeks. At 24 weeks all the 46 cases managed conservatively had united. In our series best results were obtained with Velpeau dressing in children as they had good growth and remodeling potential. The average time for union for non operative cases was 15.69 weeks. The average time for union was 19 weeks in another study¹². Hunter (1982)¹³

reported 60 humeral shaft fractures treated with U-slab. 93% fractures united. Some other studies reported union with conservative means like functional bracing from 3-22.5 weeks with a mean of 8.5 weeks and a mode of 7 weeks except 1 having metastatic bone disease¹⁴. Sarmiento in 2000¹⁵ reported a series of 620 patients having humeral diaphyseal fractures treated with prefabricated brace. 6% of open and 2% of closed fractures had non union. 87% patients had angulation less than 16% in anteroposterior view and 81% patients healed with less than 16% angulation in lateral view. At the time brace removal, 98% of the patients had limitation of shoulder motion of 25 degrees or less. The results of treatment of closed humeral shaft fractures are excellent using a variety of techniques including bracing, hanging casts. 54% cases were treated operatively (4% were stabilized by external fixation, 6% by intramedullary nails and the rest 44% with plate and screws. The average time for union for patients treated by operative means was 20.9 weeks.

Figure 4

Fig3.12-A2 Fracture Humerus Fig 4. Fixation with LCP Immediate Postop



In the patients treated by ORIF with plate and screws mean time for union was 20.3 weeks in our study. Out of 44 cases 4 united at 12 weeks and by 36 weeks, 36 cases had united. 4 cases were delayed which united at 1 year and the remaining 4 were non unions. The non unions were either due to faulty surgical technique or due to poor bone stock and comminution at fracture site. In this series they were more evident than in nailing procedures because of large number of patients treated by plate and screws. Such patients were reoperated by interlocking nailing and bone grafting. In literature excellent results have been reported in patients treated by plate and screw fixation^{16,17,18,19}.

Figure 5

Fig5.Showing union at 12 weeks

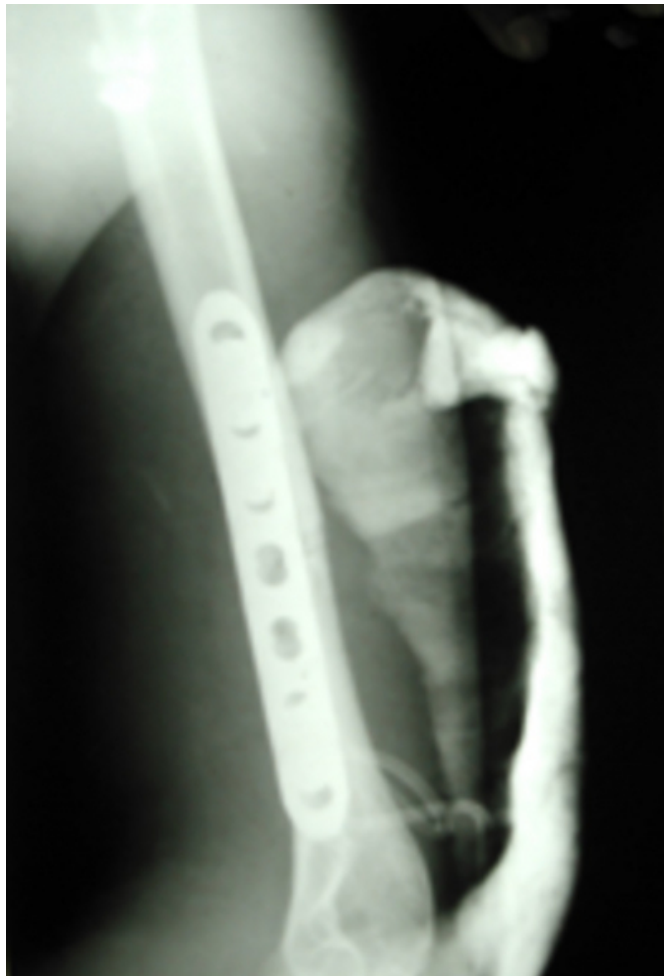


Figure 6

Fig6.12-B1 FractureHumerus Fig 7. 4 weeks postop follow up



In cases of intramedullary nail fixation mean time for union

was 22 weeks. Of the 6 cases, 4 united at 18 weeks, 5th at 24 weeks and 6th case united at 36 weeks. In some literature excellent results were reported with intramedullary nailing.^{4,20} Some other studies reported the good results in non-delayed unions when combined with bone grafting or autologous marrow^{21,22}.

.Some other studies reported higher fracture comminution and more complications especially with antegrade approach to nailing.^{23,23,24}

Figure 7

Fig 8.12-B1FractureHumerus Fig 9.Fixation with K Nail

Fig10.Same fracture showing immediate postop union at 18 weeks

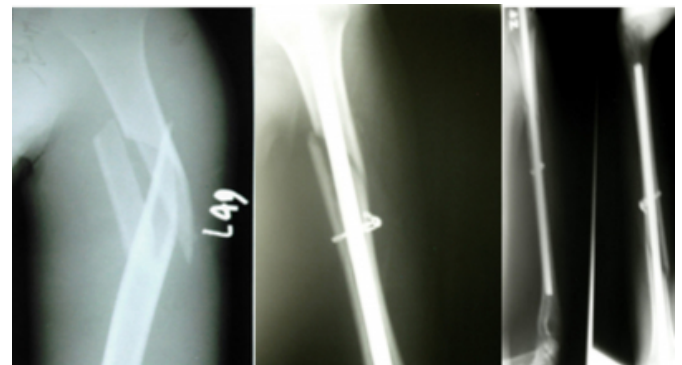
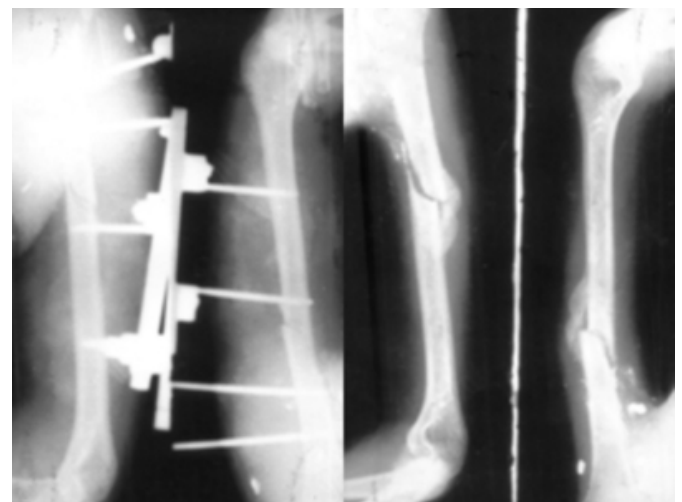


Figure 8

Fig11.12-A2,Gr IIIB Fracture Fig12.Removal of fixator and union at Humerus(external fixation) 36 wks



Out of 4 cases who were applied external fixator, I united at 36 weeks and 2 united by one year. The last case landed up with non union. The mean time of union with External fixator was 36 weeks . Available literature has shown good to excellent result in six out of nine high energy humerus

fractures treated with external fixation²⁶. Other study showed union in 17 out of 20 complex humeral fractures with Hoffman external fixation at 21 weeks²⁷.

In our study we got fair to poor results in management of humeral diaphyseal fractures with external fixator as these were badly contaminated open Grade III B and Grade IIIC injuries.

{image:8}

The average time for union in the proximal third was 15.3 weeks, middle third 20.3 weeks and distal third 17.25 weeks. Proximal third fractures healed sooner as in other study⁷.

Mean time for union in 89 cases which united by 36 weeks was 18.2 weeks. Rest 11 went into non/delayed unions (1 in prox shaft, 7 in middle shaft, 3 in distal shaft)

Closed fractures were first to unite (mean=17.6 weeks) and open fractures were late to unite (Grade I 20.4 weeks, Grade II 24 wks, Grade III 36 weeks). This was comparable to available literature showing the average time to radiographic healing for open fractures being 21 weeks (range 8-30 weeks)

Good results were obtained in 100% patients treated by velpau dressing, 85% patient treated by U slab. This was comparable to available literature^{13,14,15}. In patients treated surgically 50% good results were obtained in patients operated by plate and screws which was better than that obtained by treatment with other surgical modalities and in consonance with available studies. There were 6% non unions and 5% delayed unions. The rate of non union following a humeral shaft fractures ranges from 0-16%. The results of our series were concordant with the above observation.

CONCLUSION

Conservative management is method of choice in management of closed diaphyseal fractures of humerus as it gives early union, better limb function and is devoid of any of the routine postoperative complications. Patients with failed conservative treatment, open fractures and fractures with complex geometry are better managed operatively. ORIF with plate and screws has proven to be better than nailing procedures in present series in terms of giving better functional outcome. Patients treated with external fixator had mostly fair and poor outcome as injuries dealt by them were mainly open Grade III B and IIIC injuries.

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