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ORIGINAL ARTICLE

ASSESSMENT OF FUNCTIONAL OUTCOME OF HUMERAL DIAPHYSEAL FRACTURES TREATED WITH DYNAMIC COMPRESSION PLATE AT NATIONAL MEDICAL COLLEGE AND TEACHING HOSPITAL, BIRGUNJ, NEPAL

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ABSTRACT

Introduction: *Fractures of the humeral shaft account for roughly 3-5% of all fractures and result from direct and indirect trauma. Common mechanism for this fractures include fall on the motor vehicle accidents, fall on out stretched hand and direct loads to the arm. The shaft of humerus fracture is managed largely conservatively, but with the advent of new surgical techniques and implant options, less tolerance for acceptable deformity and functional deficits, more time consuming with conservative management, many surgeon are increasingly likely to consider surgical management. The aim of our study is to assess the functional outcome of dynamic compression plate in shaft of humerus fracture.*

Materials and Methods: *This is a prospective observational study conducted in department of orthopedic surgery, NMCTH, Birgunj among 45 patients from 17 years and above presenting with shaft of humerus fracture. The fracture was classified according to AO classification. The patients were treated with open reduction and internal fixation with dynamic compression plate and followed up at 2 weeks, 6 weeks, 12 weeks and 24 weeks till the radiological union was achieved. American shoulder and elbow surgeon's scoring system was used to assess the final outcome of the study.*

Results: *45 patients meeting inclusion criteria were included in the study, 3 patients lost follow up hence removed from study. Out of 42 patients, mean age of the patient was 31.95 years. Most of them 27(64.3%) were male. Predominant fracture was on left side 73.8% (31 patients). The study finding showed that 31(73.8%) sustained injury due to road traffic accidents. Majority of the fractures 32(76.20%) were in middle 1/3rd. Most of the patient had A3 type of fracture according to AO classification. The mean post-operative immobilization was 15years .Forty one (97.61%) fracture united with one (2.39%) fracture going into non-union with mean time of 16.04 weeks. Thirty-seven (88.10%) patients has excellent range of motion of elbow and shoulder while 3(7.10%) had good and 2(4.8%) patient had poor functional outcome. The average ASES score obtained at 24 weeks was 47.07.*

Conclusion: *From our study, it is concluded that open reduction and internal fixation with DCP in shaft of humerus fracture provides excellent functional outcome.*

Keywords: *Dynamic compression plate, Functional Outcome, Humerus Shaft Fracture, Reduction*

INTRODUCTION

Fractures of the humeral diaphysis constitute approximately 3% of all fractures and 20% of fractures of the humerus.[1] Humeral shaft fractures are a relatively common fractures with an incidence of 13 per 100000 per year.[2] The predominant causes of humeral diaphyseal fractures include simple falls or rotational injuries in the older population and higher energy mechanisms in the younger patients including road traffic accidents, physical assaults, fall from height and throwing injuries.[3]

Functional bracing, initially popularized by Sarmiento in 1977, has essentially replaced all other conservative methods and has become the "gold standard" for non-operative managements.[4,5] However, conservative

methods of treatment in patients with multiple injuries led to a high incidence of malunion and nonunion.[6]

With recent advancement in fracture fixation techniques and biomaterials, success of improved Surgical treatment and low complication rate, surgical management of humeral fracture has become a potential option which is under acceptance as a first choice of management.[7] Besides, Operative treatment is indicated in specific circumstances including open fractures, associated neurovascular injury, proximal and distal articular extension, patients with multiple injuries or polytrauma, floating elbow, progressive radial nerve deficits, significant soft tissue injury (unable to brace), pathologic fractures and failed non-operative management, Surgical stabilization of humeral shaft fracture has undergone revolutionary changes and treatment modalities adopted are compression plate fixation, intramedullary fixation and external fixation.[8,9] The goal of operative treatment of humeral shaft fractures is to reestablish length, alignment, and rotation with fixation that allows early motion and early weight bearing on the fractured extremity.[7]

The most important advantage of compression plate fixation is that it provides a very stable fixation maintaining rotation, length and angulation of the fracture without injuring the rotator cuff and the elbow joint. It makes early mobilization of limb possible and a pain free extremity with reliable fracture union and excellent function.[10]

The current study has been carried out to evaluate the functional and radiological outcome of shaft of humerus treated by open reduction and internal fixation with dynamic compression plate.

MATERIALS AND METHODS

With the ethical clearance from the Institutional Review Committee of National Medical College and after obtaining the informed consent of the patient, prospective observational study was conducted. This is a prospective observational study conducted in department of orthopedic surgery, NMCTH, Birgunj among 45 patients from 17 years and above presenting with shaft of humerus fracture. The fracture was classified according to AO classification. The patients were treated with open reduction and internal fixation with dynamic compression plate and followed up at 2 weeks, 6 weeks, 12 weeks and 24 weeks till the radiological union was achieved. American shoulder and elbow surgeon's scoring system was used to assess the final outcome of the study.

Operational method:

All cases of shaft of humerus fracture meeting inclusion criteria were included. The required information was recorded and proforma was prepared. Radiographs were taken in anterior-posterior view and lateral view and diagnosis were established by clinical and radiological means. 'U' slab was applied for immobilization prior to surgery. All patients were taken for elective surgery as soon as a patient is fit for surgery. All patients were operated using a standard prescribed surgical technique by the experienced surgeon. Patient's attendants were explained about the nature of injury and its possible complications and the need for surgery. Written and informed consent were taken from the patients and attendants. Preoperative intravenous 2nd generation antibiotics (cefuroxime 1.5gm) was given and continued postoperatively.

All patients were operated under general anesthesia. Patient was positioned supine with arm on the arm board. Under all aseptic precautions, painting and draping of the affected part was done. Antero-lateral approach (Henry's approach) was used in all cases. Skin incision was made in the line starting proximally along the anterior margin of deltoid, 5 cm below the acromian process which was curved as it run distally, parallel to the lateral border of the biceps and ending just proximal to the origin of brachioradialis muscle, 7.5 cm above the elbow joint. Superficial and deep fascia were divided in line with the incision and cephalic vein protected and retracted medially. Distal to the insertion of the deltoid, brachialis was split longitudinally at the junction of medial two third and lateral one-third. The humerus was exposed subperiosteally. The distal end of this approach was extended to the groove between the biceps and brachioradialis to end in the antecubital fossa when required. Then, the fractures end were exposed, reduced with reduction forceps, and fixed with a narrow 4.5mm Dynamic compression plate (DCP), engaging a minimum of six cortices with screw fixation in each fragment. None of the cases required primary bone grafting. Wound was closed in layers under negative suction drain.

Post operatively Limb elevation and active finger movements were advised.Intravenous antibiotics was given for three days post operatively and then switched over to oral antibiotics .Suction drain was removed after 24 hours.Check X-rays were taken post operatively both Anteroposterior and lateral view.If uneventful, patients were discharged on the fifth post-operative day after proper dressing.

RESULTS

Total of 45 patients with shaft of humerus fracture aged more than 17 years and was admitted in National Medical College, Birgunj in Orthopedics department from September 2018 to August 2019 were included in this study. These patients were followed up for 6 months post-surgery, 3 patients didn't came for follow-up in

subsequent visit so was excluded from this study result.

Out of 42 patients, majority of patients was due to RTA, i.e 31 patient (73.8%), which was more common in 26-35 years age group.

Table 1: Age group distribution in relation to mode of injury

		Mode of injury			Total	P-value
		RTA	Assault	Fall		
Age Group	17-25	7	2	1	10	0.461
	26-35	16	1	3	20	
	36-45	5	0	3	8	
	>46	3	0	1	4	
Total		31	3	8	42	

Most of the patients, 27 (64.3%) were males and only 15 (35.7%) were females.

There was significance difference in the involvement of the sides in this study. The left side was affected more commonly, in 31 (73.8%) patients, whereas right side was affected in 11 (26.2%) patients.

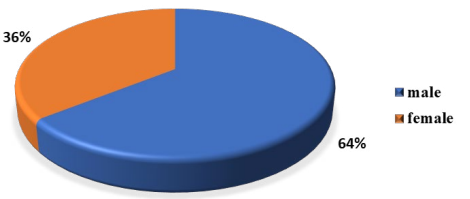

Figure 1: Gender Distribution of patients

In this study, 7 patients had associated injuries, which comprise of 16.7% of the total sample.

Figure 2: Distribution of patient with associated injury

Thirty seven (88.1%) of the cases had closed fractures, remaining 11.95% had open fractures.

Table 2: Distribution of fracture type

Type of Fracture	Frequency	Percent
Close	37	88.1
Open	5	11.9
Total	42	100

Fractures were classified according to AO classification system. Most of the fractures were 12 A3 (45.2%) followed by 12 B2 (19%).

Table 3: Distribution according to AO Classification

AO classification	Frequency	Percent
12A1	5	11.9
12A2	3	7.1
12A3	19	45.2
12B1	4	9.5
12B2	8	19
12B3	3	7.1
Total	42	100

The mean duration of hospital stay was 15.28 days. There was however a big variation. It ranged from 6-23 days.

In this study, forty one (97.61%) fracture united with one (2.39%) fracture going into non-union. Non-union was due to infection. Twenty eight fracture united within 12 weeks i.e, 66.66%, while 13 (30.96%) fractures were united within 24 weeks. The average fracture union time was 16.04±5.80 weeks.

Table 4: Duration of fracture union

		Type of Fracture		Total	P-value
		Close	Open		
Duration of Fracture Union	6-12 wks	27	1	28	0.005
	12-24 wks	10	3	13	
	>24wks	0	1	1	
Total		37	5	42	

The American shoulder and elbow surgeons (ASES) shoulder score is for 13 activities of daily living requiring full shoulder and elbow movement. The maximum possible score is 52 points. The average ASES score obtained at 24 weeks was 47.07 ± 3.21. It ranged from 38-52. (Median: 47.0)

Table 5: Distribution of ASES score

Mean	47.071
Median	47
Mode	48
Std. Deviation	3.2112

In this study, 37(88.1%) patients had excellent results, 3(7.1%) patients had goodresults and 2 (4.8%) patients had poor results.

Table 6: Distribution of functional Outcome

Results (Rommen et al. grading)	Freq	Percent
Excellent	37	88.1
Good	3	7.1
Poor	2	4.8
Total	42	100

DISCUSSION

This prospective observational study had been undertaken with the approval of the ethical review board of National Medical College, Birgunj to analyze the functional outcome of diaphyseal fracture of humerus treated with DCP in Nepalese population aged 17 years and above.

Total of 45 patients with diaphyseal fracture of humerus admitted in orthopedics department of National Medical College, Birgunj between "September 2018 to August 2019" meeting all inclusive criteria were studied. Out of which three patients lost to follow up, so were removed from the study and the remaining 42 cases were included in study. During admission detail clinical history was taken focusing on mechanism of injury and co-morbidities. Radiographs were taken to confirm diagnosis and to classify fracture according to AO Muller classification of shaft of humerus fracture. The management of fracture of humeral shaft has always been a challenging problem, as they are frequently associated with multiple injuries. They are prone to complications like shortening, malunion, infection, delayed union and non-union etc. The aim of treatment in these fractures is to achieve length, proper alignment and to maintain favorable environment for bone and soft tissue healing.

In our study, the mean age of the patient was 31.95 years with the maximum number patients in 2nd and 3rd decades. Vander Griend et al,in their study suggested mean age of the patient to be 36 years.(5) Tingstad et al, in their study suggested mean age of the patient to be 32.8 years.(11) In most of the studies done by the several author, the mean age of the patient was in between 3rd to 5th decades of life, which is similar to our study.

The Sex distribution in our study revealed 64.3% male and 35.7% female. In a study performed by Changulani et al, they found 79% male and 21% female.(12) Another study performed by Haveri et al,found 74% male and 26% female. Most of the studies found Male preponderance compared to female which is similar to our study.[13]

In our study out of 42 cases of humeral diaphyseal fractures, 31 (73.8%) cases were involved in RTA and 8 (19.06%) had fall from height and 3 (7.14%) cases of humeral shaft fracture was from physical assault due to direct trauma to arm. vander Griend et al, and Haveri et al, also found RTA to be the commonest cause of humerus shaft fractures.[5,13] The least common was physical assault.

In our study non dominant arm were involved and 31 (73.8%) were on left side in right handed patient and 11 (26.2%) on right side. Study done by Heim et al,also found majority of fracture on left side,[14] while Hee et al, showed nearly equal proportions of fractures occurring on both right and left side.[6]

Diaphyseal fractures of the humerus is a prototype fracture. It can be at any level of the bone and of any pattern. Fracture was classified according AO classification system in which majority was A3 19 (45.2%), which was comparable with putti et al,12 (34.5%)[15] and Kumar et al, (33.33%).[8]

In this study, forty one (97.61%) fracture united with one (2.39%) fracture going into non-union. Nonunion was due to infection. Twenty eight fracture united within 12 weeks i.e, 66.66%, while 13 (30.96%) fractures were united within 24 weeks. The average fracture union time was 16.04±5·80 weeks· In a study performed my Singisetti K and Ambedkar M,[16] out of 16 cases of ORIF with DCP 12 (75%) fracture united within 16 weeks while 4 (25%) united after 16 weeks which is similar to our study. Vander Griend et al[5], treated 36 patient of humeral shaft fracture with DCP and had 1 (2.8%), McCormack et al, treated 44 patient of humeral shaft fracture and found 4% nonunion with compression plate, while 8% with intramedullary nail group.[17]

The American Shoulder and Elbow Surgeon's (ASES) score is for 13 activities of daily living requiring full shoulder and elbow movement. The maximum possible score is 52 points. The median ASES score obtained was 47 in this study which is similar to the average ASES score of 48,48,45,45 obtained by McCormack et al.[17] Haveri et al[13] Putti et al[15] and Changulani et al.[12]

Out of 42 patient in our study there was infection in 1 (2.4%) case, in a study performed Haveri et al out of 35 cases there was infection in 2(6%) cases(13). All the study were comparable with our study.

Overall, we had forty patients (95.20%) patients with good results in this study. The results in this aspect i.e. function of shoulder and elbow joints are comparable with those of Vander Griend et al, Heim et al and Haveri et al that are 83.33%, 87.3% and 91% good function of shoulder and elbowm, respectively.[5,13,14] The higher percentage of stiffness in this study emphasizes on patient education and physiotherapy during postoperative management.

CONCLUSION

At the end of the study we came to the conclusion that

dynamic compression plating of the humerus produces excellent results in case of fracture shaft of humerus. It is a demanding procedure, proper preoperative planning, cautious soft tissue handling, strict asepsis, proper postoperative rehabilitation and patient education are more important to obtain good results. It provides adequate stabilization of fracture and provide good fixation, if proper preoperative planning, good reduction and surgical technique are followed. Early post-operative mobilization following rigid fixation of the fracture of humerus, with DCP lowers the incidence of stiffness. Fixation by IMIL may be indicated for specific situations, but is technically more demanding and has a higher rate of complications. Thus, dynamic compression plating remains the management of choice for the fractures of shaft of humerus.

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