

Results of Surgical treatment of Nonunion of Humeral Shaft Fracture with Dynamic Compression Plate and Cancellous Bone Grafting

Ajaz Ahmad Bhat¹, Suhail Wani², Javed Ahmad Nabir³

ABSTRACT

Introduction: Nonunion of humeral fractures after conservative or surgical treatment represents a disabling condition for the patient and a challenge for the surgeon. Study aimed to evaluate the outcome of treatment of humeral shaft nonunions with dynamic compression plate and cancellous bone graft.

Material and Methods: This study was conducted at Department of Orthopaedics, GMC Srinagar from June 2016 to December 2019. Twenty patients were operated over this period. Trauma was the cause of injury in majority of the patients. Nonunion was atrophic in 80% and hypertrophic in 20% of the individuals. All the patients had closed fracture at presentation, and 70% had received previous treatment from traditional bone setters and 30% had failure of the conservative cast management.

Results: The average time to union was 18 weeks. Treatment previously from traditional bone setters significantly affected the time to fracture union ($p < 0.05$). All fractures united successfully.

Conclusion: we concluded that treatment with dynamic compression plating and cancellous bone grafting remains an effective treatment option for nonunion of humeral shaft.

Keywords: Humeral Fractures, Nonunion, Dynamic Compression Plate

INTRODUCTION

The rate of Nonunion of humeral fractures ranges between 2% and 20% after conservative treatment and between 8% and 12% after operative treatment.^{1,2} Conservative treatment with cast immobilization and bracing results in excellent outcome in over 90% of patients with union for humeral shaft fractures.^{3,4} Nonunion however, is a documented complication of this fracture when conservative treatment is undertaken. In developing countries, patients usually seek traditional bone setters, nonunion remains one of the most common presentations of fractures.⁵ Results of different methods of fixation are varying, with associated morbidity to each method. These fixation methods and their common limitations include unlocked intramedullary nail with poor rotational stability, locked intramedullary nail with rotator cuff dysfunction and limitation of shoulder movement, pin tract infection with external fixation and wound infection and iatrogenic radial nerve palsy are well documented complications associated with dynamic compression plating.^{4,6,7} We evaluated the outcome of operative treatment of humeral shaft nonunions with use of dynamic compression plate (DCP) and cancellous bone graft.

MATERIAL AND METHODS

This prospective study was conducted on 20 patients in the Department of Orthopaedics, Government Medical College Srinagar from June 2016 to December 2019. 15 males and 5 females with nonunion of humeral shaft were included in this study. The inclusion criteria are humeral shaft nonunion (which was defined as no evidence of union after a six-month period), non-infective, and no previous surgical intervention. Part of the humerus 2cm below the surgical neck and 3cm above the olecranon fossa was considered as humeral shaft.⁶ Nonunion was classified as per the criteria laid by Paley et al.⁸ Time to union was the outcome measure. Complications were also observed. Union was evaluated by use of plain radiographs. Anterolateral approach was used for fractures in upper and middle third and posterior approach for fractures in the distal third. After exposing the nonunion site, pseudoarthrosis was excised, bone ends were nibbled until fresh bleeding was obtained and location of medullary cavity established. After this bone graft was harvested from iliac crest and used to fill the nonunion site. For internal fixation Narrow 4.5mm DCP was used. Successful union was defined as the appearance of bridge callus or bridging of the cortex with at least partial obliteration of the fracture site observed on antero-posterior and lateral radiographs.³ Demographic characteristics of the patients such as age, sex, site, fracture location and description, cause of fracture, previous treatment, and primary radial nerve palsy were recorded. Patients were followed at two-week intervals for the first month and then monthly for six months and once every two months for another six months.

STATISTICAL ANALYSIS

Continuous variables were stated as mean, median and standard deviation. The comparison of continuous variables between independent variables was performed by using the Student t-test or Mann-Whitney U test in accordance with

¹Medical Officer, Department of Health, J&K, ²Postgraduate Scholars, Department of Orthopaedics, GMC, Srinagar, ³Postgraduate Scholars, Department of Orthopaedics, GMC, Srinagar, India

Corresponding author: Suhail Wani, Rawalpura, Srinagar, J&K India

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Location	
Proximal third	2 (10%)
Middle third	12 (60%)
Lower third	6 (30%)
Fracture Pattern	
Transverse	15(75%)
Oblique	2 (10%)
Spiral	2 (10%)
Comminuted	1 (5%)
Type of nonunion	
A1	15(75%)
A2	3 (15%)
B1	2(10%)
Surgical Approach	
Anterolateral	14(70%)
Posterior	6 (30%)
Table-1: Fracture characteristics and surgical approach	

Previous Treatment	Number of Patients	Time to Union (in weeks)
Traditional Bone Setter	14 (70%)	22
Failed conservative treatment	6 (30%)	14
Total	20 (100%)	
Table-2: Previous treatment and time to union.		

normality testing. P value of less than 0.05 was considered statistically significant.

RESULTS

Twenty patients with humeral fracture nonunion were treated. The mean age was 48.5 years with range of 30 to 66 years and male to female ratio of 3:1. Road traffic accident was cause of injury in majority of patients (60%), fall from height in 20% and fall in 20%). Treatment previously from bone setters was in 70% of patients and failed conservative treatment in 30% of patients. Atrophic nonunion occurred in 80% and hypertrophic nonunion in 20% of the patients. Transverse fracture pattern was common and distal and middle third shaft nonunions were common. All fractures were closed. Paley A1 type nonunion was the commonest type. The complications were superficial wound infection in three patients. The superficial wound infection got resolved with daily dressings and antibiotic administration. The fracture characteristics and surgical approach were shown in Table 1. 18 weeks was the average time to union. Patients with treatment previously from bone setters had union time of 22 weeks and 14 weeks was the time to union for those with previously failed conservative treatment and was statistically ($p < 0.05$) as shown in Table 2. Treatment by traditional bone setter significantly affected the time to union after operative intervention.

DISCUSSION

Treatment of humeral shaft nonunions nonunion continues to pose a challenge to orthopedic surgeons. Kontakis et al⁹, in their systemic review documented the superiority of plating for humeral shaft nonunions. Tannura et al¹⁰, reported atrophic

nonunion in 15 patients out of 16 in their study. Ayotunde OA et al¹¹, also observed high rates of atrophic nonunion in their study. In our study atrophic nonunion was also in majority of patients. Primary radial nerve palsy occurred in 25% of patients in our study, with majority of fractures involving the middle third of humerus. This is probably due to closeness of the proximal part of the radial nerve to the bone (in the radial groove). This report was similar to Tsai et al¹² and Ayotunde OA et al.¹¹ Transverse fracture pattern was the most common pattern associated with nonunion in our study. Ayotunde OA et al¹¹, also reported same, but Ring¹³ and his associates found oblique or spiral fracture with butterfly fragment were the most common fracture pattern associated with nonunion. It was also observed that 70% of the patients in our study had previous treatment with traditional bone setters. These traditional bone setters are alternative practitioners involved in the care of fractures. Their mode of treatment of fractures includes the use of local splints made from raffia palms and bamboo sticks. These splints are usually too tight, jeopardizing the blood supply to the affected limb which may result in gangrene from compartment syndrome.¹⁴ Nonunion was most common in proximal and middle third shaft fractures in Rang et al¹³ and Ayotunde OA et al¹¹ studies. In our study middle and distal third nonunion were common. The average time to union of all the fractures after plate fixation and cancellous bone grafting was 18 weeks. This was consistent with the reports by other authors.^{15,16} Those who were treated earlier by traditional bone setters had time to union of 22 weeks and those with failed conservative treatment had time to union of 14 weeks and was statistically significant. This may be due to the manner of application of the splint which is often too tight leading to progressive diminution of the blood supply to the affected limb. Superficial infection occurred in 15% of patients in our study. Changulani et al⁷, reported 20% superficial infection whereas Reignier M et al¹⁷ and Ayotunde OA et al¹¹ reported superficial infection rate of 3-5%.

CONCLUSION

We concluded that treatment by dynamic compression plate and cancellous bone grafting is an effective method for humeral shaft nonunions.

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