Internal Fixation And Bone Grafting Of Non-Union Humeral Diaphyseal Fracture

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Abstract

Background: Humeral diaphyseal fracture usually heals with closed methods but when nonunion develops then it needs surgical intervention in the form of plating and bone grafting, intramedulary nailing (open or closed simple or interlocking nails) and external fixators (circular or one plane fixator). In our unit we treated non union humeral diaphyseal fracture with plating and bone grafting shortening of fracture ends up to 4 to 5cm when needed. **Methods:** This **s**tudy was conducted at Orthopaedic Department of AL-Sadar General Hospital from January 2004 till December2005 . We included 20 cases with atrophic non-union in 12(60%) and hypertrophic non-union in 8 (40%) patients. All atrophic non-union were treated with plating, bone shortening by transverse osteotomy and bone grafting, while hypertrophic non-union were treated with decortications of non-union ends and fixation with compression plates, with bone grafting in old age. Follow up measures were based on clinical (range of joints motion) and radiological (healing) findings. Follow up was done for upto 6 months . **Results:** Out of 20 patients the age range was 20- 60 years, 16 (80%)were male and 4(20%) female. Right humerus involved in 15(75 %) while left humerus in 5(25%) patients. In12(60%) patients with atrophic non union bone shortening by transverse cut osteotomy was done while in remaining patients with hypertrophic non-union plating was done in 2(10 %) cases and plating with bone grafting in 6(30%) patients. Union was achieved in all patients after 16 to 20 weeks of surgery. In one patient (5 %) of 75 years age with hypertrophic non-union implant was loosened after 3 months of surgery. At that time healing (Union) was evident on X-rays and humeral brace was applied for further 3 months. Two patients(10 %) got neuropraxia of radial nerve which resolved with in 3 months time. 2 patients (10 %) developed shoulder stiffness which resolved after exercise. **Conclusion:** In Non Union of Humerus shortening by transverse osteotomy & rigid fixation with plates give excellent results in selected cases.

Key words: non-union,humers, shortening, bone grafting.,plating.

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Introduction

Fractures of the humerus constitute approximately 5% to 8% of all fractures. Treatment varies according to location of the fracture. Although most humerus fractures heal uneventfully, nonunion can occur. Nonunions often result in shoulder and/or elbow stiffness, prolonged and debilitating pain, which can lead to narcotic dependence. Risk factors for nonunion include patient conditions such as osteoporosis, obesity, alcoholism and smoking. Comminuted or segmental fractures, soft tissue interposition at the fracture site and infection may also result in nonunion. Finally, iatrogenic factors include overdistraction, inadequate stabilization or immobilization of the fracture.

Treatment of nonunions depends on their location and associated soft tissue involvement.

Proximal humerus fractures are often accompanied by damaged rotator cuff muscle or tendon insertion. There may be very small proximal fragment attached to the articular cartilage, which also contributes to the difficulty of treating these nonunions. In diaphyseal fractures, the radial nerve may be encased in scar, making it more at risk for iatrogenic injury. The insertion of the deltoid limits proximal plating, and the olecranon fossa limits distal plating. Fixation of distal humerus nonunions are complicated by intra-articular fractures and if bone loss has occurred from prior surgical procedures. Before operating on nonunions, the authors first identify patient risk factors and errors in prior surgical technique. In fractures that initially were plated, they remove the hardware, debride the nonunion site, bone graft and then reapply a plate taking care to compress across the fracture site. In fractures that were nailed in distraction, they remove the nail and then attempt to close the fracture gap. If the gap can be closed, they ream 1 mm larger than the nail that was removed and then reinsert another nail (exchange nailing). If the gap cannot be reduced, which is the most common case, they open the fracture site and debride the nonunion. Either nail or compression plating can be used in this setting. The surgeon always must keep in mind the possibility of infection, especially in fractures that initially were open and in fractures that were treated with percutaneous pins. Smoking should be discouraged.

While bone stimulators are commonly used for humeral nonunions, there is little literature support for their use. They do not compensate for poor technique that has resulted in the nonunion.

Proximal humeral nonunions: The treatment of proximal humeral fractures is based on the age of the patient, the number of fragments, and the amount of displacement. Treatment methods include proximal humeral replacement for four-part fractures in older

patients, open reduction internal fixation (ORIF) of surgical neck fractures, tension band wiring, and intramedullary nailing. Patient satisfaction has generally been good and nonunion rates low from these conventional treatments. Those patients with nonunion can experience marked pain, instability and adhesive capsulitis following immobilization. The authors recommend that malunions of the proximal humerus be treated with hemiarthroplasty if the rotator cuff is not repairable, if there is not adequate bone stock for internal fixation techniques and when there is severe osteoporosis. When there is adequate bone stock, the fracture site can be compressed with lag screws, tension band wiring, or by tilting the humeral head into valgus to provide more axial loading of the fracture. When possible, a disrupted rotator cuff should be repaired to bone. The authors do not recommend fixation with locking plates because they do not provide any compression across the fracture site and result in a high failure rate.

Diaphyseal nonunions: Fractures of the humeral shaft generally heal in 6 to 10 weeks, with minimal pain and restoration of functional motion, regardless of treatment. Nonunion rates between 0-13% are reported for nonoperative management. Transverse and short oblique fractures of the humeral shaft are risk factors for nonunion in addition to the aforementioned risk factors. When treated operatively for appropriate indications (e.g., multiple trauma) there is a significantly higher rate of nonunion (15% to 30%). In addition, shoulder and elbow stiffness, pain, and decreased strength are common. Diaphyseal nonunion is treated by various operative procedures including open plating, intramedullary nailing, and external fixation with an Ilizarov device. The fact that there are multiple reports of many different treatment methods underscores the difficulty of treating these fractures successfully. (In his paper, Flinkkilä discusses anterograde intramedullary nailing which can compromise the supraspinatus insertion at the point of entry as well as distract the distal segment as it "jams" against narrow portion of medullary cavity just above olecranon fossa. See reference below).

The authors recommend debridement and bone grafting of the nonunion site, followed by compression plating as the treatment of choice for most shaft nonunions. Synovial pseudarthroses that have a high incidence in nonunions must be excised. To ensure adequate fixation, the surgeon may need to elevate a small portion of the deltoid insertion to place the plate underneath it. To optimize fixation, a minimum of six cortices on each side of the fracture is recommended in patients with good bone quality; in patients with osteoporosis, at least eight cortices is recommended above and below the fracture site. Unnecessary stripping of the periosteum should be avoided.

Distal humerus: Nonunions of the distal humerus are rare and perhaps the most difficult to treat. Bone loss from prior attempts at fixation can limit surgical options. When possible, the authors use plating coupled with iliac crest bone grafting. A lag screw should be placed across the fracture to provide compression.

Methods

This study was done at Al-Sadar General Hospital from January 2004 till December2005 . Inclusion criteria were selected Humeral non-unions in adults of both genders, while exclusion criteria were non-union treated with previous surgical intervention, Proximal and supracondylar humeral non union and infected non-union. Surgical approaches are Anteriolateral approach in mid shaft and Posterior approach in lower third.

During surgery fracture ends were cleaned, medullary canal was opened, fracture site reduced and fixed with compression plates in mid shaft non-union or reconstruction and 1/3rd tubular plates (double plating) in distal 3rd non union.

In case of selected cases bone ends were shortened (decortications) up to healthy bone and cancellous graft was added. Follow up was done as first visit after two weeks for stitches removal and wound check followed by monthly visit for 6 months. During follow up clinical (shoulder and elbow motion) and radiological (healing) assessment was done.

During follow up outcome measures followed were graded as excellent, good and poor on the basis of clinical (joint movements and extremity function , any infection or neurological deficit) and radiological (bone healing or any implant loosening) judgement. Excellent meant full shoulder and elbow movements with normal hand function, no infection and no pain and radiological healing within 12 weeks time. Good meant mild limitation of shoulder movement (upto 20 degrees) or radial nerve neuropraxia and radiological healing within 16 weeks. Poor outcome was shoulder stiffness (beyond 30 degree) or elbow stiffness (greater than 30 degree) which needed physiotherapy exercise and delayed healing after 16 weeks or implant failure or permanent neurological (radial nerve) deficit or infection.

Results

Total number of patients was 20. Age varied between 30-80 years, with 16 (80%) males and 4 (20%) females. Site was mid shaft non-union 16 (80%) and Distal 3rd non-union in 4(20%) cases. Causes of initial injury are given in table-1. The gender distribution of these were Fire Arm Injury (FAI) in 10 patients (8 males, 2 female),Road Trafic Accident(RTA) in 6 Patients (both males) and due to falls in 4 patients (3 male, 1 females). Type of Non-Union was Atrophic non-union in 12 (60%) patients, out of whom 9 (75%) were males & 3 (25%) females. While hypertrophic non-union was seen in 8 (40%) patients out of whom 7(87 .5 %) were males and 1 (22 .5 %) female. Union was

achieved in all patients (100%) with in 16 to 20 weeks. After two months two patients were lost to follow up although radiological union was achieved, one more was lost after 3 months.
In the Shoulder movement lack of abduction 20/35 degrees and lack of external rotation 15/20 degrees was observed in two patients. In Elbow movement two patients with distal 3rd injuries had limitation of full extension up to 15 to 20 degree but full flexion and no functional compromise.

One patient (5 %) of age 75 with atrophic non-union had implant loosening at 3 months. Radiological union however was achieved with supportive brace at 6 months. Two patients (10%) got neuropraxia of radial nerve which resolved within 3 months time. The outcome of our study is shown in table-2 and a set of figures for two treated patients.

Table-1: Causes of Initial Injury

Cause	No. of Cases	%
FAI	10	50
RTA	6	30
FALLS	4	20
Total	20	100

Table-2: Outcome

Outcome	No. of Cases	Percentage
Excellent	8	40
Good	10	50
Poor	2	10
Total	20	100

Discussion

Plating and bone grafting in non-union of humerus is well known treatment modality and bone grafting at non-union site of long bones is still popular treatment option to get union[16]. It is a fact that success rate of union decreases with number of failed operations[17] so therefore one should adopt the treatment modality with great care. In a study by Wu & shih[11], 35 humeral shaft non-union treated with plates and screws (19 patients) and antigrade interlocking nails (16 patients) resulted in 89.5 % union in 4.5 months and 87.5 % union in 4.4 months respectively. In our study union was achieved in all patients (100% union rate) with in 3 to 6 months compatible with a study[13] by Rosen which has 97 % union rate.
In our study we achieved good union in all selected non-union by transverse osteotomy at non-union ends similar to another study by Barquet[12], on 25 patients treated with decortications at non-union ends and internal fixation with broad DCP and bone grafting in 24 patients and bone cement in 1 patient resulted in union in 24 patients with in 6 months period is compatible to our study.
Although in our study there was a little bit shortening of the extremity but with good functional result i.e. joint movements and hand grip.

Conclusion

In Non Union of Humerus shortening by transverse osteotomy and rigid fixation with plates give excellent results in selected cases.

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Al – Kindy Col Med J 2013; Vol. 9 No. 1 P:53

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