ORIGINAL ARTICLE

Management of Fracture of Shaft of Humerus with Intramedullary Interlocking Nail

ZULFIQAR ALI QURESHI[1], ABDUL LATIF JOKHIO[2], JUGDESH KUMAR[3], NADEEM TARIQ[4]
[1]Department of Orthopaedics, University of Lahore/Social Security Teaching Hospital Lahore, [2]Department of Anatomy, Shaheed Mohtarma Benazir Bhutto Medical University at Chandka Medical College, Larkana, [3]Department of Orthopaedics, Ghulam Muhammad Mahar Medical College, Sukkur, [4]Department of Dental Surgery, Lahore General Hospital, Lahore
Correspondence to: Dr. Zulfiqar Ali Qureshi, Assistant Professor, House No.6, Block-C, Phase-I, Ali View Garden, Bedian Road, Lahore Cantt email:dr_zulfikar_ali@yahoo.com

ABSTRACT

Background: Trauma has been one of the major causes of morbidity and mortality and the resultant bony injury if any really brings very tough time to the entire family because the patient has to face prolonged immobilization and loss of wages. The stiff joints and functional disability are common post-injury sequelae. Humeral shaft fractures are not very common. The middle third of the shaft is the usual target site and the high energy trauma is generally required to break it. Traditionally the non-operative measures i.e. hanging cast or brace have been used to treat humeral shaft fractures.

Objectives: To analyze the results of fixation of the shaft of humerus by rigid interlocking intramedullary nailing, to determine the safety, simplicity and reliability of the method and its effect on shoulder and elbow joint function.

Patients and Methods: This prospective randomized study consisted of fifty patients of humeral shaft fractures managed by intramedullary interlocking nail and was carried out at Department of Orthopedics, Social Security Teaching Hospital, Lahore from 1st January 2007 to 31st December 2010. The adult patients aged above 20 years, polytrauma and diaphyseal fractures of humerus were included in the study. Patients with previous osteomyelitis of shaft of humerus, proximal fractures within 2 cm of surgical neck and those within 5 cm of junction of diaphyses and metaphyses on both AP and lateral radiographs and pathological fractures were excluded from the study. Open fractures with segmental bone loss were bone grafted at the time of delayed closure, whether treated with a nail or plate, because the study protocol directed that no bone grafting be performed during the initial stabilization procedure.

Results: Ninety percent of the patients operated with interlocking intramedullary nailing for humerus had callus formation within 8 weeks and 10% requiring more than 8 weeks. Post-operatively the regain range of motion of shoulder including abduction and external rotation was satisfactory. The rate of radial nerve palsy following surgery was only 2%.

Conclusion: The technique interlocking intramedullary nailing plays a key role in the management of humeral shaft fractures. Its relative simplicity, firm fixation, lesser complications, early use of extremity and cost effectiveness of implant are the golden landmarks.

Key words: Humeral shaft fractures, Rigid intramedullary fixation, Antegrade nailing, No external protection

INTRODUCTION

Traditionally humeral shaft fractures have been treated non-operatively with hanging cast or brace. Sarminto et al[1] reported use of plastic sleeve with early introduction of functional activity. Prolonged immobilization in cast or brace sometimes as long as for 6 months is the major disadvantage of non-operative treatment. The need for constant patient cooperation and repeated hospital visits are other demerits. Ideal fracture treatment is the dream of both surgeon and the patient and its important parameters include early restoration of joint motion, minimal morbidity and early return to normal physiologic function. The primary operative treatment is indicated in polytrauma patients, bilateral fractures, floating elbow, open fractures, pathologic fractures, vascular complications, secondary radial nerve palsy, persistent mal-alignment, delayed union, obesity, poor cooperation, unstable fractures, comminuted

fractures, segmental fractures, non-unions and failed conservative treatment.[2-5]

The high rate of union after plate fixation has been an element of great satisfaction to the surgeon but the surgery requires extensive soft tissues assault with stripping from bone. Other disadvantages are increased chances of infection or nerve damages, less secure fixation in ostepenic bone if crutch walking is required and delayed mobilisation of shoulder and elbow.[6,7] Different intramedullary nailing devices e.g. conventional "V" nail of Kuntscher, rods of Rush, Enter or Hackethal have given variable results.[8,9] Since these devices act merely as internal splints and rotational stability is not achieved after their use, therefore unrestricted movements cannot be allowed in every patient and external protection in some form is needed. Rigid intramedullary nailing technically avoids these problems. The development intramedullary interlocking systems for the humerus has given a new impetus to surgical treatment of humerus shaft fractures. The anatomical structure of the humeral marrow cavity does not allow regular jamming of nail into bone so interlocking mechanism is needed to provide stability to these systems.[10] Rotatory and torsional stability and alignment are most reliably achieved by transverse locking screws at each end, thus allowing early mobilization and its obvious advantages. The availability of image intensifier control has made closed interlocking nailing easily possible in most centers, thus permitting the advantage of closed over open techniques. The present study attempts to highlight the use of unreamed interlocking intramedullary nailing of the humerus and evaluate the results and complications related to the procedure.

PATIENTS AND METHODS

This prospective randomized study consisted of fifty patients of humeral shaft fractures managed by intramedullary interlocking nail and was carried out at Department of Orthopedics, Social Security Teaching Hospital, Lahore from 1st January 2007 to 31st December 2010. The adult patients aged above 20 years, polytrauma, diaphyseal fractures of humerus (transverse, oblique, comminuted), segmental, compound fractures and fracture shaft humerus associated with radial nerve palsy were included. Patients with previous osteomyelitis of shaft of humerus, recent infections, immunesuppressive therapy, proximal fractures within 2 cm of surgical neck and those within 5 cm of junction of diaphyses and metaphyses on both AP and lateral radiographs, compound grade III fractures, pathological fractures, pseudoarthrosis and implant failure were excluded from the study. Radial nerve exploration was undertaken in all cases of preoperative nerve deficits and in those cases in which preoperative nerve status could not be determined (e.g., traumatic brain injury, high quadriplegia). Primary stabilization of all open fracture was carried out after irrigation and excisional debridement of the open wound. Re-evaluated of all compound wounds was done within three to five days for delayed primary or secondary closure depending on their appearance at the time of the secondary procedure. Open fractures with segmental bone loss were bone grafted at the time of delayed closure, whether treated with a nail or plate, because the study protocol directed that no bone grafting be performed during the initial stabilization procedure. Fixation with AO-UHN is appropriate for humeral fractures between 3 cm proximal to the olecranon fossa and 2 cm distal to the surgical neck. All nails in this series were placed in an antegrade fashion and 86,8% of them were statically locked. The ipsilateral shoulder is pulled to the edge of the table, and the head is turned to face the contralateral side. The fluoroscopic imager is placed perpendicular to the operating table, ipsilateral to the injured extremity to allow easy anteroposterior imaging. A scapular Y view of the shoulder is obtained by rotating the C arm approximately 30° to 45°. All open fractures are treated with immediate debridement and irrigation and exploration of the fracture site to ensure that the radial nerve is not entrapped. A 1-cm incision is made in the rotator cuff in line with its fibers. An awl is used to create the entry portal just medial to the greater tuberosity in the sulcus between the greater tuberosity and the articular margin. The nail is inserted without reaming. Canal diameter was measured on preoperative radiographs. The nail is inserted until its tip lies 1.5 to 2 cm proximal to the olecranon fossa. The proximal end of the nail is seated approximately 5 mm beneath the bone to prevent impingement. The nail should be inserted with the fracture well aligned to avoid intraoperative comminution. Proximal interlocking screw is placed with the use of a proximal drill guide. The screw should be directed so that it exits medially, distal to the articular margin of the humerus. A drill sleeve is inserted through a stab incision after soft tissues have been dissected

bluntly down to bone. A hole is made with a 2.7-mm drill bit, and a 4-mm bicortical screw is inserted. Distal locking was performed using a freehand technique. Before the distal screw was inserted, the fracture site is compressed by placing an axial load on the elbow. Correct rotation is obtained by pointing the forearm and hand perpendicular to the ceiling. The patient's arm was supported simply in a neck sling for the first few days after surgery. Range of motion (ROM) exercise was encouraged as early as tolerable. For acute fractures, the patients and radiographs were examined every 2 or 3 weeks until union was achieved.

RESULTS

Most of the patients had callus by 8 weeks (90%) with only 5 patients (10%) requiring more than 8 weeks (Table 1). Almost all the patients regained a good range of shoulder abduction. 88% patients had more than 90° of abduction. 12% patients had abduction less than 90° which was mainly due to impingement of nail on the acromian in 4 cases, 3 of which were due to inadequate insertion and one was due to proximal migration of the nail.

Table 1: Time for bridging soft callus

Time in weeks	No. of cases	Percentage
4	12	24.0
6	25	50.0
8	8	16.0
10	5	10.0
12	-	-

Table 2: Range of shoulder abduction and external rotation

Shoulder abduction (degrees)	No. of cases	Percentage
Less than 90°	6	12.0
90°-140°	12	24.0
More than 140°	32	64.0
External rotation (degrees)		
>45°	42	84.0
20°-45°	8	16.0
<20°	-	-

This proximal migration was seen only in osteoporotic bone with severe comminution. No elbow problems were recorded in our series. 84% of our patients had excellent external rotation. None of the patients in our series had external rotation less than 20 (Table 2). Of the total 50 patients, 6 patients (12%) had mild and 2 patients (4%) had moderate shoulder pain. Impingement and increased comminution was found in 4 patients (8%), postoperative radial nerve palsy in 1 patient (2%). Infection was present in 4 patients (8%) all of which were superficial and responded to oral antibiotics. No non-union or fracture of greater tuberosity was recorded in our series (Table 3).

Table 3: Complications

Complication	No. of cases	Percentage
Shoulder pain		
Mild	6	12.0
Moderate	2	4.0
Severe		
Impingement	4	8.0
Radial nerve palsy (Postoperative)	1	2.0
Infection	4	8.0
Non-union	-	-
Increased comminution	4	8.0
Fracture greater tuberosity	-	-
Total	21	42.0

DISSCUSSION

The non-operative methods have proved satisfactory while treating isolated and low energy humeral shaft fractures whereas acute, high energy humeral shaft fractures often need operative stabilization to improve healing, fracture alignment, and functional results.[11-14] In previous studies, the union rate of antegrade nailing of acute humeral fractures using nails with transfixing screws has ranged from 71% to 100%.[15,16] Inspite of efficacy and safety of nonoperative measures there is a growing interest in treating acute humeral shaft fractures operatively.[17] Operative treatment has usually been reserved for the treatment of non-union, poly trauma patients and those with neurovascular complications.[18] The results in operated patients have been generally favourable. Fracture union is the major determinant of outcome. It is noteworthy that few

studies have examined function of the shoulder and elbow.[19]

The antegrade humeral nailing may have unpleasant effects on shoulder function. In a series of humeral fractures stabilized predominantly by Rush rods, Stern et al reported the development of adhesive capsulitis in 56% of fractures treated with antegrade nailing.[20,21]The insertion point violated the rotator cuff in most of these patients, and proximal migration of nails was common. Shoulder function returned to near normal after implant removal. In 28 humeral fractures stabilized with antegrade Rush or Ender nails, Brumback et al[13] reported excellent results in 18 (64%), good results in seven (25%), and poor results in three (11%). Eight of the 10 shoulders with good or poor function had nails inserted through the rotator cuff. Seven of the eight had impingement symptoms that required implant removal. Stern et al[21] and Brumback et al[13] recommended an antegrade insertion point lateral and distal to the rotator cuff. Shoulder problems also have been reported with antegrade insertion of more rigid nails. Robinson et al[20] reported that 12 of 30 (40%) humeral fractures treated with Seidel nails had protrusion of the nail above the humeral tuberosity, usually because of failure of the locking mechanism. Five other patients in whom the nail was prominent also had poor shoulder function, which the authors attributed to local rotator cuff damage during insertion. Riemer et al[22] also reported that five of 12 patients in whom a Seidel nail was inserted through a lateral deltoid incision had persistent shoulder stiffness. No patients with nails inserted through an anterior deltoid incision had restricted shoulder motion; however, it sometimes took as many as 6 months for full shoulder function to return.

In a series of 30 acute humeral fractures treated with antegrade Russell-Taylor nails, Ikpeme reported that six (20%) patients had shoulder pain and decreased shoulder abduction because of impingement of the proximal locking screws.[15] Removal of the proximal screws in five of these patients resulted in complete resolution of symptoms. Two other patients had proximal nail migration because of proximal interlocking through an area of comminution. In our series, shoulder pain due to nail impingement occurred in eight (16%) patients in whom the nail was not properly countersunk. Shoulder pain was related to the proximal locking screws in two (4%) patients. Symptoms resolved in all patients after implant removal. This prospective randomized study of 50 humeral shaft fractures treated with AO-UHN system revealed acceptable data's in time to union, shoulder and elbow function. Antegrade interlocking humeral nailing does not require extensive soft tissue dissection, infrequently requires bone grafting, does not require external immobilization, and may be more suitable for comminuted and segmental fracture patterns than plating or flexible nailing techniques. We believe that antegrade locked nailing in humeral shaft fractures are reliable and also effective in multiply injured patients.

CONCLUSION

Intramedullary interlocking nail is a satisfactory device for stabilization of humeral shaft fractures. This method allows the device to be used in comminuted fractures and also in low diaphyseal fractures which would be difficult to fix from below (Retrograde route) and with plating as bone drilling near the fracture could split the bone further. Patients who need crutches or frame for mobilization were able to walk because humeral fractures were stable.

REFERENCES

1. Sarmiento A, Jagorski JB, Zych GA - Functional bracing for the treat ment of the fractures of humeral diaphysis. JBJS Am. 2000; 82 : 478-486
2. Watanahe R S. Intramedullary fixation of complicated fractures of the humeral shaft. Clin Orthop 1993; 292: 255-63.
3. Jensen A T, Rasmussen S. Being overweight and multiple fractures are indications for operative treatment of humeral shaft fractures. Injury 1995; 26: 263-4.
4. Flemming J E, Beals R K. Pathologic fracture of the humerus. Clin Orthop 1986; 203: 258-60.
5. Redmond B J, Biermann J S, Blasier R B. Interlocking nailing of pathological fractures of the shaft of the humerus. J Bone Joint Surg (Am) 1996; 78: 891-6.
6. Crenshaw AH Jr. Campbell's operative orthopaedics - 9th ed, Mosby Publications 1998.
7. Rockwood CA, Green DP, Bucholz RW - Fractures in adults, 4th ed,1994, pg 1028-1029
8. Kuntscher G - The Kuntscher method of intramedullary fixation. JBJS 1958 ; 40A : 17-26

9. Kuntscher G - Intramedullary surgical technique and its place in orthopaedic surgery - My present concept. JBJS 1965 ; 47A : 809 - 81
10. Vécsei N, Kolonja A, Mousavi M, Vécsei V. Intramedullary fixation of humerus shaft fractures. An analysis of complications of 2 implants with special reference to outcome after management with the unreamed humerus interlocking nail. Wien Klin Wochenschr 2001;113):597-604.
11. Balfour GW, Mooney V, Ashby ME. Diaphyseal fractures of the humerus treated with a ready-made fracture brace. J Bone Joint Surg 1982;64A:11-3.
12. Sarmiento A, Kinman PB, Galvin EG, Schmitt RH, Phillips JG. Functional bracing of fractures of the shaft of the humerus. J Bone Joint Surg 1977;59A:596-601.
13. Brumback RJ, Bosse MJ, Poka A, Burgess AR. Intramedullary stabilization of the humeral shaft fractures in patients with multiple trauma. J Bone Joint Surg Am 1986;68:960-70
14. Henley MB, Chapman JR, Claudi BF. Closed retrograde Hackethal nail stabilization of humeral shaft fractures. J Orthop Trauma 1992;6:18-24.
15. Ikpeme JO. Intramedullary interlocking nailing for humeral fractures: Experiences with the Russell-Taylor humeral nail. Injury 1994;25:447-55.
16. Ingman AM, Waters DA. Locked intramedullary nailing of humeral shaft fractures. J Bone Joint Surg 1994;76B:23-9.
17. Heim D, Herkert F, Hess P, Regazzoni P. Surgical treatment of humeral shaft fractures-the Basel experience. J Trauma 1993; 35: 226-32
18. Müller CA, Henle P, Konrad G, Szarzynski M, Strohm PC, Südkamp NP. The AO/ASIF flexnail a flexible intramedullary nail for the treatment of humeral shaft fractures. Unfallchirurg. 2007 Mar;110(3):219-25.
19. Mast JW, Spiegel PG, Harvey JP Jr, Harrison C. Fractures of the humeral shaft: a retrospective study of 240 adult fractures. Clin Orthop 1975; 112: 254-62.
20. Robinson CM, Bell KM, Court-Brown CM, McQueen MM. Locked nailing of humeral shaft fractures. Experience in Edinburgh over a two-year period. J Bone Joint Surg Br 1992;74:558-62.
21. Stern PJ, Mattingly DA, Pomeroy DL, Zenni EJ Jr, Kreig JK. Intramedullary fixation of humeral shaft fractures. J Bone Joint Surg 1984;66A:639-46
22. Riemer BL, Butterfield SL, D'Ambrosia R, Kellam J. Seidel intramedullary nailing of humeral diaphyseal fractures: A preliminary report. Orthopedics 1991;14;239-46.