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SURGICAL OUTCOME OF DIAPHYSEAL FRACTURES OF HUMERUS BY ANTEGRADE INTERLOCKING NAILING IN CLOSED REDUCTION

Koramutla Harsha Kumar¹, Jenne Paranjyothi²

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ABSTRACT: BACKGROUND: Fractures involving the shaft of humerus are commonly encountered by orthopedic surgeons in day to day practice. Humeral shaft fracture can be treated using intramedullary fixation technique. Flexible intramedullary nails like Rush nail, Enders nail have been used utilizing ante grade and retrograde methods. This technique has largely replaced plating method very often. But, retrograde nailing can be regarded as a minimally invasive procedure and justifiable to use for fixation of isolated humeral shaft fractures in certain situation. In this study we have evaluated the effectiveness of surgical and functional outcomes of closed ante grade interlocking nailing in the management of diaphyseal fractures of humerus.

METHODS: A series of 30 patients with diaphyseal fractures of humerus were treated with ante grade interlocking nailing during October 2008 to October 2010. All the patients were followed up 6 weeks, 12 weeks and 24 weeks and results were analysed. X rays were taken to assess radiological union of fracture during the follow up. Assessment of fracture union and shoulder and elbow movement was recorded. Final evaluation was done at the end of 6 months. Data was presented as mean \pm SD, actual numbers and percentages. Wilcoxon test and chi-square test were used appropriately.

RESULTS: All 30 patients in our study were followed up for a minimum period of 6 months. 56.7% cases were male patients 43.3% were female patients. More than 50 % of cases in the series were between the ages of 18-35 years. 60% fractures were comminuted 6.6% were of oblique type, 33.3% were of transverse type. The average time interval from the time of admission to the time of surgery was 3 days. The most common mode of injury was road traffic accident. Comminuted fractures are predominant in our study. Clinical outcome was 60% of cases had excellent results and 30 % had moderate result. 3 patients (10%) had poor result, due to limitation of shoulder abduction, resulting from irritation of rotator cuff from protruding proximal end of the nail.

CONCLUSION: Closed intramedullary interlocking nailing in humeral diaphyseal fractures results in early fracture union and early recovery of range of movements at shoulder and elbow joints. This method also preserves fracture hematoma facilitating early periosteal callus formation and union. It also limits extensive soft tissue dissection, periosteal stripping and devitalization of bone fragments in comminuted and segmental fractures thereby minimizing the changes of nonunion. Closed nailing minimizes the risk of iatrogenic, radial nerve injury, reduces the operative time and blood loss.

KEYWORDS: Diaphyseal Fracture, Humerus, Antegrade Interlocking Nailing.

INTRODUCTION: Fractures involving the shaft of humerus are commonly encountered by orthopedic surgeons accounting for approximately 3% of all fractures. These fractures can be broadly divided into traumatic & pathological. Traumatic fractures of humeral shaft may be

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caused by direct or indirect violence and usually result due to falls from a height, road traffic accidents or direct blows to arm.⁽¹⁾ These fractures can occur as an isolated injury or may be associated with other injuries to the body or to the same limb. In a series of humeral shaft fractures reported by Klenerman (1966), almost 75% occurred as an isolated injury. In 25% of patients there were associated injuries.⁽²⁾ Until Caldwell described hanging arm cast in 1933, humeral shaft fracture had the distinction of being one of the common site for nonunion. According to the published literature, conservative methods give well to excellent results, despite the success attained by the non-surgical methods, operative stabilization may be required in patients with multiple injuries, pathological fractures, segmental shaft fractures, fractures with neuro vascular complications, failed conservative treatment and spiral fracture involving the distal humerus as described by Holstein & Lewis.⁽³⁾ Osteosynthesis using plate and screws has stood the test of time and has been regarded as an alternative to conservative treatment in a selected group of patients (Heim et al 1993).⁽⁴⁾ - However there are certain drawbacks with this procedure like the need for extensive periosteal stripping, which might result in delayed or nonunion, radial nerve injury and implant failure (Bell -1985).⁽⁵⁾

Humeral shaft fracture can be treated using intramedullary fixation technique. Flexible intramedullary nails like Rush nail, Enders nail have been used utilization of antegrade and retrograde methods. Frequently additional external support is needed as they do not provide enough rotational stability (Brumback et al 1986).⁽⁶⁾ Not only that, they have a tendency to back out & when inserted antegrade, shoulder impingement is'a major problem (Hall & Pankovich 1987).⁽⁷⁾ A statically locked intra medullray nail provides longitudinal and rotational stability and allows the patient to use the arm straight away. High rate of fracture union have been reported, when intramedullary nailing was done (Haberneck & Orthner -1991).⁽⁸⁾ This technique has largely replaced plating and has become the method of choice, whenever internal fixation is indicated. Ronimens felt that retrograde nailing can be regarded as a minimally invasive procedure & justifiable to use for fixation of isolated humeral shaft fractures in certain situation⁽⁹⁾ This study was undertaken to evaluate the effectiveness of surgical and functional outcomes of closed ante-grade interlocking nailing in the management of diaphyseal fractures of humerus.

METHODS: This study was conducted during the period August 2008 to October 2010. Institutional ethics committee approved the study protocol and written informed consent was obtained from study participants. Adult patients with diaphyseal fractures of humerus in were treated by closed ante grade interlocking intramedullary nail with the help of image intensifier were evaluated. Patients above 18 years (Skeletally mature adults), traumatic diaphyseal fractures of humerus 2 cm below surgical neck and 3 cm above olecranon fossa and Grade 1 compound fractures of humerus were included into the study. Patients were excluded if they had pre-existing shoulder or elbow disability or concomitant ipsilateral shoulder or elbow injury or pathological fractures or neglected fractures of the humerus or Grade 2 & 3 compound fracture of humerus or preoperative radial nerve palsy. Patients were then admitted, stabilized, antero-posterior and lateral X-rays of injured arm including shoulder and elbow were taken. Radial nerve function was assessed clinically for integrity. Primary stabilization was done with 'U' slab. Blood investigations were done to evaluate fitness for surgery.

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Preoperative Planning: Proper length and alignment of the humerus must be attained with traction before beginning closed ante grade nailing. Ideally the nail selected is inserted medial to the tip of the greater tuberosity, approximately 0.5 cm posterior to the bicipital groove (To minimize damage to the rotator cuff), and should be temporarily buried in the bone proximally to minimize subacromial impingement. It is important that the entry portal to be in line with the plane of the humerus. The nail length and diameter should take into account the distal narrowing of the humerus. The nail should end approximately 1 to 2 cm proximal to the olecranon fossa. Because of the circular cross section of the humerus in its proximal two thirds and the narrowing and flattening of the medullary canal distally, a true interference fit is difficult to obtain; therefore static locking should be strongly considered for these fractures. To have an approximate length & diameter of the nail to be inserted, opposite side uninjured humerus x rays are studied.

Patient positioning and Preparation: With the patient supine, the head is turned to the contra lateral side to increase exposure of the shoulder. Rotational alignment is obtained by placing the shoulder in anatomical position and rotating the distal fragment so that the arm and hand are pointing toward the ceiling and the elbow is flexed 90 degrees. Patient is prepared and draped in the usual manner including in the operative field, the shoulder proximal to the nipple line, the midline of the chest to the nape of the neck, and the entire extremity to the fingers.

Incision: A longitudinal skin incision is made. From the most lateral point of the acromion and extended distally centered over the tip of the greater tuberosity. The fascia of the deltoid is incised in the same plane and the greater tuberosity is palpated. Using the small curved awl, the entry portal is established JIM medial to the tip of the greater tuberosity and this is confirmed with image intensification.

Reduction: A 2.4 mm guide wire is inserted through entry portal. Closed reduction of the fracture is done using image intensifier and guide wire is negotiated into distal fragment and confirmed in both Antero-posterior and lateral views under image intensifier. The guide wire is advanced until its tip is 1 to 2 cm proximal to the olecranon fossa.

Determination of nail Length: Nail length is determined with the help of nail length gauge. Antibiotics-Intravenous antibiotics (Third generation of cephalosporins eg:cefotaxime 1 g twice a day) were given postoperatively for 3 days, for simple fractures. For compound fractures along with the third generation of cephalosporins, aminoglycoside and metronidazole were added. Shoulder arm sling support was given for all patients for 12 weeks. Postoperative x-rays were taken on 2nd postoperative day. Patients were discharge after 3 days. Suture removal was done on 10th post-operative day. Patients were encouraged active assisted shoulder and elbow movements as soon as pain subsided.

Follow Up: Patients were advised to report immediately if there is any raise in temperature or any increased pain or discharge from the suture line. The routine follow up is at 6 weeks, 12

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weeks and 24 weeks. X rays were taken to assess radiological union of fracture during the follow up. Assessment of fracture union and shoulder and elbow movement was recorded. Final evaluation was done at the end of 6 months. (24 weeks)

Criteria for Assessment: Final Assessment of the patient were done and followed Rommen et al criteria at the end of 6th month.

Rommen Criteria	Loss of range of motion	Clinical & Radiological Union	Significant Subjective symptoms
Excellent	< 10%	Good	No
Moderate	10-30 %	Good	Minimum
Poor	>30%	No signs of union	Moderate

Table 1

STATISTICAL ANALYSIS: Data was presented as mean \pm SD, actual numbers and percentages. Wilcoxin test and chi-square test were used appropriately. A two tailed p value less than 0.05 was considered statistically significant.

RESULTS: All 30 patients in our study were followed up for a minimum period of 6 months. 56.7% cases were male patients 43.3% were female patients. There is male predominance in our series. More than 50 % of cases in the series were between the ages of 18-35 years. 60% fractures were comminuted 6.6% were of oblique type, 33.3% were of transverse type. The level of fracture was middle third in 60% of patients, lower third on 40% of the cases. The average time interval from the time of admission to the time of surgery was 3 days. Predominantly the injury was right sided. 12 cases of grade 1 were included.

The most common mode of injury was road traffic accident. Comminuted fractures are predominant in our study. In three cases (10%) we had superficial infection in the form of stitch abscess. which was subsided by antibiotics for one week. 60% of cases had excellent results and 30 % had moderate result. 3 patients (10%) had poor result, due to limitation of shoulder abduction, resulting from irritation of rotator cuff from protruding proximal end of the nail. In two cases (6.6%) we had limitation of shoulder abduction (80 degrees). Infection: Superficial infection in the form of stitch abscesses at the proximal entry point of the nail, had developed in three cases (10%) which subsided following higher antibiotic therapy for 10 days.

DISCUSSION: The management of fractures of humeral shaft is always a challenging problem to Orthopaedic surgeon, as they are very frequently associated with multiple injuries, leading to complications like shortening, malunion, infection, delayed union and nonunion. Operative treatment may be considered to avoid complications such as malunion, delayed union, rotational deformity, shoulder and elbow stiffness, limb length discrepancy, psychological problems and long hospital stay.⁽¹⁰⁾

Most surgeons agree that intramedullary nailing is the best internal fixation for femoral and tibial shaft fractures, but there is no agreement about the ideal procedure for fractures of the

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humeral shaft. Plate osteosynthesis requires extensive soft tissue dissection with the risk of radial nerve damage.⁽¹¹⁾ Both the modalities of treatment i.e. dynamic compression plating and interlocking nailing are good as far as union of the fracture is concerned, but considering the functional outcome and rate of complications But Nagesh R et al are of the opinion that dynamic compression plating offers better result than interlocking nailing with respect to pain and function of the shoulder joint.⁽¹²⁾ In our study we have treated 30 cases with this procedure. Analysis of results of management of diaphyseal fractures shaft of humerus with closed ante grade interlocking nailing, were compared by different modalities of treatment and evaluated based on the union rate, stability & range of movements and our observation is shown in the tabular form in, comparison with other studies.^{(9) (13,14)}

Study	No. of patients	Excellent	Moderate	Poor
Robinson. et al(1991)	30	17 cases (56.6%)	9 cases (30%)	4 cases (13.3%)
Rommens. et al (1995)	39	33 cases (84.6%)	4 cases (10.3%)	2 cases (5.1%)
Changulani and Jain(2006)	23	20 cases (86.9%)	----	----
Present study (Aug 008-Oct 2010)	30	18 cases (60%)	9 cases (30%)	3 cases (10%)

Table 2

CONCLUSION: In our study 30 cases of Diaphyseal fractures of Humerus were treated with inter locking intramedullary nailing at Narayana Medical College & Hospital during the period of August 2008 - October 2010. Most of the patients were of younger age group at an average age incidence of 42 years and the commonest mode of injury was RTA. 60 % (IS Cases) had excellent results in terms of fracture union and good range of movement at shoulder joint. 30% (9 cases) had moderate result and 10% (3 cases) had poor result. Persistent pain and restriction of shoulder movement after ante grade nailing was noted in 2 cases. Interlocking Intramedullary nailing of diaphysium of the humerus in adults is a safe and reliable method of treatment. Closed intramedullary interlocking nailing in humeral diaphyseal fractures results in early fracture union and early recovery of range of movements at shoulder and elbow joints.

Closed nailing preserves fracture hematoma facilitating early periosteal callus formation and union. Provide good axial and rotational stability in comminuted and segmental fractures. Avoid the exposure of the fractures to the exterior, thereby minimizing the chances of infection. Avoid extensive soft tissue dissection, periosteal stripping and devitalization of bone fragments in comminuted and segmental fractures thereby minimizing the changes of nonunion. Closed nailing minimizes the risk of iatrogenic, radial nerve injury. Closed interlocking intramedullary nailing reduces the operative time and blood loss.

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Table 1: Surgical and functional outcome by interlocking nailing		
Clinical Parameters	No. of Cases	Percentage
Age in years		
18-35	15	50%
36-45	12	40%
46-55	3	10%
Sex		
Male	17	56.7%
Female	13	43.3%
Side		
Right	19	63.3%
Left	11	36.7%
Types of Fracture		
Closed	18	60%
Open grade -I	12	40%
Type		
RTA	16	53.3%
Fall	14	46.6%
Anatomical type		
Transverse Fracture	10	33.3%
Spiral Fracture	0	0%
Oblique Fracture	2	6.6%
Comminuted Fracture	18	60%
Complications		
Superficial infection	3	10%
Shoulder dysfunction	2	6.6%
Non union	0	0
Result		
Excellent	18	60%
Moderate	9	30%
Poor	3	10%

Table 3

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AUTHORS:

1. Koramutla Harsha Kumar
2. Jenne Paranjyothi

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Orthopaedics, Sri Muthukumaran Medical College Hospital & Research Institute, Chennai.
2. Tutor, Department of Orthopaedics, Sri Muthukumaran Medical College Hospital & Research Institute, Chennai.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. K. Harsha Kumar,
Associate Professor,
Department of Orthopaedics,
Sri Muthukumaran Medical College,
Hospital & Research Institute,
Chennai-600069.
E-mail: drharshaortho@gmail.com

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