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Research paper

Ender nail fixation of humeral diaphyseal fracture: Indications and outcome – A series of 46 cases

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ABSTRACT

Objectives: To evaluate the clinical and functional results of closed fixation of humeral diaphyseal fractures using Ender nails.

Material and methods: This was an observational study conducted between January 2008 and September 2014 in which 46 cases of humeral diaphyseal fractures were treated by closed reduction and percutaneous fixation with Ender nails. Clinical follow up evaluation was done and Serial radiographs were taken to look for the time taken for the fracture union and the fracture alignment, positioning and migration of the nails if any.

Results: Average blood loss during the surgery was 30 ml while average radiation exposure time was 1 min. Fracture united in mean 12.8 weeks (range 12–28 weeks). Primary union was achieved in 40 cases, whereas 6 had delayed union at 24 weeks for which autogenous bone grafting was done. Proximal migration of nails occurred in 6 cases and 3 cases had superficial stitch infection. Full range of shoulder and elbow movement was achieved in 40 cases within 24 weeks. In rest of the cases, there was limitation of abduction (average 75°, Range 65° to 85°).

Conclusion: Ender nailing for fracture shaft of humerus is a cost effective, time saving, minimally invasive technique with minimal blood loss. It has many benefits, with good results attainable and comparable with those seen with conservative modalities and other surgical modalities making it a viable option.

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1. Introduction

Shaft fracture or diaphyseal fracture of the humerus is defined as extra articular fractures of the humerus excluding 5 cm at each ends.¹ This fracture accounts for 3% of all fractures.² With the growing mechanization and increasing road traffic accidents, it often presents in a bizarre way and becomes difficult to manage, especially at the ends. It has a bimodal distribution. In younger age group, there is male preponderance while in older age group there is female preponderance. High energy trauma (especially motor vehicle accidents) is more common in the young males while low

energy trauma (trivial fall at home) is more common in the elderly females.³

There is no universal consensus on the most appropriate method for management. Conservative management is a rational option for the treatment of minimally displaced humeral shaft fractures.^{4,5,6} Sir John Charnley in his treatise “*The closed treatment of common Fractures*” states that “Humerus is one of the easiest major long bone fractures to treat by conservative methods.”⁷ However conservative management has its own limitations: (a) It requires a long period of immobilization, which carries an increased risk of shoulder joint stiffness. (b) Delayed union and nonunion with this method of treatment are common due to excessive weight of the cast.

Surgical management is particularly indicated in cases of Polytraumatized patients, unstable fractures (spiral/long oblique), comminuted fractures, segmental fractures, pathological fractures, open fractures & fractures associated with neurovascular injury. Plate is the unanimous choice and a variety of plates are in use

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today. There has also been a change in the technique from open reduction to minimally invasive fixation. Minimally invasive technique offers the advantage of preservation of fracture hematoma and less disturbance of surrounding soft tissues. In adults, interlocking intramedullary nails are also in use. However, injury to the rotator cuff has restricted its use to a great extent. Problems such as iatrogenic fracture comminution (especially in small diameter canals), and nonunion (with significant difficulty in its salvage) have also been reported. Reoperations for implant removals are also important issues.

The Enders nail (Fig. 1), which is thin, flexible and premolded, was first described by Ender for treating intertrochanteric hip fractures. It works on the principal of three point fixation and achieves stability by stacking. It has been mostly used for tibia and femur fractures, especially in children. This study was conducted to evaluate the functional outcomes of Ender nails in management of humerus fractures by closed technique.

2. Material & Methods

This was an observational study conducted between January 2008 and September 2014 during which 46 cases of humeral diaphyseal fractures were treated in Patna Medical College & Hospital by closed reduction and internal fixation with Enders nail. Our study population consisted of 32 males and 14 females. The mean age of the patients at the time of surgery was 38 years (range, 10–70 years). The Right arm was the predominantly affected limb. Only cases having closed or grade I or grade II open fractures as determined by Gustilo-Andersons classification with fracture angulation more than 20 degrees in the sagittal or coronal plane, with or without overriding between the segments (more than 2 cm) were included in the study. Cases having sustained multiple system trauma were also included in the study. Patients with Open grade III fracture, severely comminuted fractures, segmental fractures, fractures of proximal fourth or distal fourth of humerus, pathological fractures and fractures associated with neurovascular injury were excluded. There were 6 cases of open fracture and 5 patients were having other long bone fracture as well.

2.1. Surgical technique

The surgery was performed under general anesthesia or regional block. An intravenous antibiotic was administered preoperatively. The patients were placed in supine position on a reversed operating table to allow clearance for the image intensifier. Shoulder was elevated with folded towels or sand bag under the medial border of scapula and arm adducted. In those cases with open fracture thorough debridement of the wound was done. The entry portal was made under fluoroscopy guidance,



Fig. 1. Enders nail instrumentation set.

lateral and approximately 5 mm distal to the upper margin of greater tuberosity. At this point, a longitudinal incision of around 2 cm was made and an entry portal in the bone was made using a bone awl (Fig. 2).

Fracture was manipulated to align proximal and distal fragment and achieve reduction, nails were negotiated across the fracture under image intensifier guidance. Most often only two nails were used. Nail diameter should measure 40% of the narrowest diameter of the diaphysis. Nails should be contoured with long, gentle bend such that apex of the convexity will be at the level of the fracture and distal tip of the nail fans out and engages in the metaphysis of the distal humerus. (Fig. 3B) Fanning of distal ends of the nails was one of the most crucial steps to achieve stability at the fracture site. It was decided to insert three nails when instability was observed at the fracture site after arm rotation tests during surgery (Fig. 3).

2.2. Post-operative protocol

Patients were put in U-slab after surgery. On 3rd postoperative day wound inspection was done and Patients were given shoulder immobilizer. They started flexion and extension exercises for the elbow and pendulum exercises for the ipsilateral shoulder as the pain subsided. An initial follow-up was done at 10 days for wound review. At 3 weeks, patients were encouraged to start active shoulder exercises. Patients were further followed up at 6 weeks, 3 months, 6 months and 1 year. Minimum duration of follow up was 1 year.

Functional evaluation of the patient was done for presence of pain, Range of motion of shoulder and elbow, ability to perform activity of daily living and appearance of complications, if any. Serial radiographs were taken for evaluation of fracture union and consolidation at the fracture site at each visit. (Fig. 4) Radiographic union was defined as observation of an osseous bridge between the fragments. Clinical union was defined as absence of motion or tenderness on movement or manipulation of the arm.



Fig. 2. Entry portal being made by bone awl.

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