



## STUDY OF THE FUNCTIONAL OUTCOME OF RETROGRADE ENDER'S NAIL FOR HUMERAL SHAFT FRACTURES IN ADULTS.

### Anatomy

|                         |                                                                                                                      |
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### ABSTRACT

**Background:** The fracture of the Humerus shaft is commonly encountered to orthopaedic surgeons and representing between 3% to 5% of all fractures. Most humerus shaft fractures will heal with appropriate conservative management, though a small but consistent number will require surgery for optimal outcome. Plate osteosynthesis for fracture shaft humerus has undebatable place in operative management but it requires extensive exposure of fracture site and also disturbing the biology of fracture with due risk of iatrogenic radial nerve injury. Closed reduction with ender's nail is another better option for management of humerus shaft fracture.

**Methods:** In the period of 18 months from October 2018 to March 2020, prospective study of 30 cases of diaphyseal shaft humerus fracture treated by enders nails done in retrograde fashion was carried out in Tertiary care Hospital.

**Results:** Our study had overall functional outcome of 70% excellent result and 17 % good results, 10 % with fair and 3% patients with poor results according to ASES (American Shoulder and Elbow Surgeons) score. 24 fractures out of our 30 cases united with 5 cases of delayed union and 1 case of nonunion. Fracture united in mean 14 week (range 12-22 week). The most common complication associated with operative method of ender's nail is delayed union in 5 cases, with 1 case of non-union and 1 case of radial nerve palsy.

**Conclusion:** Ender's fixation using retrograde technique requires very minimal soft tissue dissection and as it is a closed technique, the biology of fracture is also not disturbed. Thus, early fracture union can be anticipated. Another added advantage of Ender's nail fixation is it requires very minimal operative instrumentation and less surgical skill than plate osteosynthesis. So, flexible intramedullary Ender's nailing done by retrograde technique gives equally good results, advantages of physiological consolidation (biological) and flexible stability (mechanical) with comfort for the patient comparable to any plate osteosynthesis or interlocking intramedullary nailing.

### KEYWORDS

Shaft Humerus, Ender's Nail, Radial Nerve Palsy.

### INTRODUCTION

The fracture of the Humerus shaft is commonly encountered to orthopaedic surgeons and representing between 3% to 5% of all fractures.<sup>1,2</sup> Most humerus shaft fractures will heal with appropriate conservative management, though a small but consistent number will require surgery for optimal outcome.

Current researches in this area focuses on health care resources required to treat this trauma, redefining the indications for surgical intervention, decreasing the surgical failure rate through recent advanced implants and techniques and minimize the duration and magnitude of disability postinjury.<sup>2,4</sup>

The two possible management of internal fixation in shaft of humerus fractures are plate osteosynthesis and intramedullary nailing<sup>4</sup>. The successful treatment of a humeral shaft fracture requires a good knowledge of anatomy, appropriate surgical indications, surgical approaches and selections of implants, patient functions and expectations<sup>5</sup>. With this background, this study was performed to evaluate the results of retrograde intramedullary enders nailing in diaphyseal fracture of the humerus.

### MATERIAL AND METHODS

It was a prospective study which was carried in Tertiary care Hospital. In this study period 30 cases of fracture shaft of the humerus were treated by closed reduction and internal fixation using Enders nailing in retrograde fashion.

1. Study Design: Prospective observational study
2. Study Duration-15 to 18 months
3. Inclusion Criteria (All/ any of the following):
  - Both male and female patients above 15 years of age with closed and OG type I & II diaphyseal fractures of Humerus
  - Consent for the surgery and to participate in the study
4. Exclusion Criteria (All/ any of the following):
  - Pathologic fracture
  - OG III fractures
  - Multiple trauma patients. (Glasgow coma score <8)

- Old neglected fractures
- Refusal to provide informed consent
- Fractures with neuromuscular disorders / neurovascular insufficiency.

A careful history was elicited from the patients and/or attendants to reveal the mechanism of injury and the severity of trauma. Detailed examination of swelling, deformity, distal neurovascular deficit was looked for and noted. Patient posted for surgery were subjected to routine investigation and were referred to physician for fitness for surgery. In preoperative planning pre-operative x ray were taken antero-posterior and lateral views including shoulder and elbow joint. Consent for surgery was taken.

### Surgical Procedure:

Patient is placed in Supine position and the entire limb is prepared and draped. A radiolucent arm board is placed under the arm with the shoulder abducted 90° and the elbow flexed to 90°. A 1 to 2 cm linear longitudinal incision was put on either side of olecranon process. The superficial and deep fascia was divided. The muscles were split to approach the distal humerus. Using a 3.2 mm drill bit, 2 holes were made on either side of the olecranon fossa. Using flexible reamers track was made. Then depending upon the diameter of medullary cavity, 2/2.5/3 mm flexible nail was introduced using universal T-handle. The nail was pre bent and hammered. Progression of the nail was checked under image intensifier both AP and lateral views. Once the nail is at the fracture site, reduction was achieved manually and the nail progressed proximally. Similarly, second/third/fourth nail was passed as the first one, through the second entry point.<sup>6</sup>

All the patients were followed up at monthly intervals for the first 3 months, later at 2 monthly intervals till fracture union and once in 6 months till the completion of study. Functional evaluation was done by using ASES (American Shoulder and Elbow Surgeons) score<sup>7</sup>

### RESULTS

Out of 14 patients in age group of 31-50 showed excellent results. No age group seems to be immune to fair and poor results. Factors other

than age seem to influence the fractures more in functional outcome.

**Table 1: Results with Age**

| Age in years | Excellent | Good     | Fair     | Poor | Pts. |
|--------------|-----------|----------|----------|------|------|
| 15-20        | 1(33.33)  | 2(66.67) | 0        | 0    | 3    |
| 21-30        | 2 (33.33) | 3(66.67) | 0        | 1    | 6    |
| 31-40        | 8(80%)    | 0        | 2(20%)   | 0    | 10   |
| 41-50        | 6 (85.7%) | 0        | 1(14.3%) | 0    | 7    |
| >51          | 4(100%)   | 0        | 0        | 0    | 4    |
| Total        | 21        | 5        | 3        | 1    | 30   |

There is no difference in time for union between open and closed fractures. Mean time of union for open fracture is 19.2 weeks and 18 weeks for closed fracture

**Table 2: Type of fracture with time for union**

| Type of fracture | Mean time of Union (weeks ) | Patients |
|------------------|-----------------------------|----------|
| Open             | 19.2 weeks                  | 6        |
| Close            | 18 weeks                    | 24       |
| p value          | 0.2663                      |          |

The average time to union was more in lower third fractures. Mean time for lower third fracture is 19 weeks.

**Table 3: Fracture type with Union Time**

| Type         | Mean time of Union(weeks) | No. of Patients |
|--------------|---------------------------|-----------------|
| Upper third  | 17                        | 6               |
| Middle third | 18                        | 18              |
| Lower third  | 19                        | 6               |

There is significant difference between Injury Surgery interval and range of motion at final follow-up. *p* value is 0.0325

**Table 4: Injury Surgery Interval and range of motion**

| Interval | Patients | Mean Forward Flexion At final follow-up | Mean Abduction At final follow-up |
|----------|----------|-----------------------------------------|-----------------------------------|
| < 1 week | 22       | 140                                     | 115                               |
| > 1 week | 8        | 135                                     | 100                               |
| P value  |          |                                         | 0.0325                            |

There is significant difference between duration of union and ROM at final follow up. *p* value is 0.048.

**Table 5: Duration of union**

| Duration of Union (weeks) | Patients | Mean Forward Flexion At final follow-up | Mean Abduction At final follow-up |
|---------------------------|----------|-----------------------------------------|-----------------------------------|
| <14                       | 3        | 140                                     | 115                               |
| 14 – 18                   | 18       | 135                                     | 100                               |
| 18 -22                    | 3        | 137                                     | 104                               |
| >22                       | 6        | 132                                     | 107                               |
| p value                   |          |                                         | 0.048                             |

Transverse fracture showed maximum (87.58%) excellent results.

**Table 6: Results with Classification**

| Classification Type | Excellent | Good      | Fair       | Poor       | Patients |
|---------------------|-----------|-----------|------------|------------|----------|
| Transverse          | 14(87.5%) | 2(12.5%)  | 0          | 0          | 16       |
| Oblique             | 7(77.78%) | 1(11.11%) | 1(11.11 %) | 0          | 9        |
| Spiral              | 0         | 1(33.33%) | 1(33.33 %) | 1(33.33 %) | 3        |
| Comminuted          | 0         | 1(50%)    | 1(50%)     | 0          | 2        |
| Total               | 21        | 5         | 3          | 1          | 30       |

There is significant difference between Injury Surgery interval and range of motion at final follow-up.

**Table 7: Results with injury surgery interval**

| Injury Surgery Interval | Excellent  | Good      | Fair     | Poor     | Patients |
|-------------------------|------------|-----------|----------|----------|----------|
| <1 week                 | 17(77.27%) | 3(13.63%) | 2(9%)    | 0        | 22       |
| >1 week                 | 4(50%)     | 2(25%)    | 1(12.5%) | 1(12.5%) | 8        |
| Total                   | 21         | 5         | 3        | 1        | 30       |

24 (80%) patients had full recreation and were able to perform activities which they were performing before trauma. 6(20%) patients had partial recreation; most of cases were of delayed union and non-union.

**Table 8: Recreation**

| Recreation    | Patients | Percentage (%) |
|---------------|----------|----------------|
| Full          | 24       | 80             |
| Partial       | 6        | 20             |
| No Recreation | 0        | 0              |
| Total         | 30       | 100            |

ASES (American Shoulder and elbow surgeons) score<sup>7</sup> was applied to access outcome. Our study has found overall functional outcome of 70% of excellent result, 17% good result, 10% fair result, 3% poor results.

**Table 9: Results with cases**

| Results   | Cases          |
|-----------|----------------|
| Excellent | 70% (21 Cases) |
| Good      | 17% (5 Cases)  |
| Fair      | 10%(3 Cases)   |
| Poor      | 3% (1 case)    |

The most common complication associated with operative method of ender's nail I delayed union in 4 cases, with 1 case of non-union and 1 case of Radial nerve palsy.

**Table 10: Complications**

| Complications                   | Number |
|---------------------------------|--------|
| Delayed union                   | 5      |
| Nonunion                        | 1      |
| Radial Nerve Palsy <sup>8</sup> | 1      |

## DISCUSSION

Concepts in the management of trauma in Orthopaedics are very rapidly changing to keep pace with the increasing severity and complexities of the fractures. The management of humeral shaft fractures 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 non-union etc. The aim of treatment in these fractures is to achieve length and alignment and produce favorable environment for bone and soft tissue healing. The classical method of treatment of humeral shaft fractures has been the use of U-plaster cast. Although satisfactory results can be obtained with this method but residual angulations, malrotation and limb length inequality is well documented.

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. This study was done to determine the efficacy of Enders nails in the treatment of fractures of the shaft of humerus. 30 cases of fracture shaft of humerus were treated with closed reduction and internal fixation using Enders nails by retrograde method. We evaluated our results and compared them with those obtained by various other studies like Heim D et al<sup>9</sup>, McCormack RG et al<sup>10</sup>, Tingstad EM et al<sup>11</sup>, Gongol T, Mracek D<sup>12</sup> utilizing different modalities of treatment. The results obtained by various authors using various modalities of treatment have varied from 75% good or excellent results to 100% good or excellent results. Our study had a 70% excellent result and 17% good results.

**Table 11: Overall Results Obtained in Various Studies**

| Study                            | No of patient | Method of treatment               | Results (%) (Excellent / Good) |
|----------------------------------|---------------|-----------------------------------|--------------------------------|
| Heim D et al <sup>9</sup>        | 127           | DCP                               | 87.3                           |
| McCormack RG et al <sup>10</sup> | 44            | DCP& Intramedullary nail fixation | 95.7                           |
| Tingstad EM et al <sup>11</sup>  | 44            | AO plating                        | 94                             |
| Gongol T, Mracek D <sup>12</sup> | 32            | Functional brace                  | 93.8                           |
| Present study                    | 30            | Flexible nailing                  | 87                             |

## CONCLUSION

Fracture shaft of humerus in adults is common with an overall

incidence of about 3 % in all fractures.

The mode of injury is usually a motor vehicle accident following domestic fall, a detailed neurovascular examination is a must at presentation to rule out radial nerve palsy. Majority of the fractures were transverse and oblique in the middle third and all of them were closed injuries.

Although plate fixation of fracture shaft humerus using 4.5 mm narrow DCP/LC-DCP/LCP has its undebatable place in operative management, it requires extensive exposure of fracture site and also disturbing the biology of fracture with due risk of iatrogenic radial nerve injury. Thus, Ender's fixation using retrograde technique requires very minimal soft tissue dissection and as it is a closed technique, the biology of fracture is also not disturbed. Thus, early fracture union can be anticipated.

Another stable internal fixation can be obtained by Interlocking intramedullary nail but as it is anterograde technique the major disadvantage of nailing is rotator cuff problem. Another added advantage of Ender's nail fixation is it requires very minimal operative instrumentation and less surgical skill than plate osteosynthesis.

So according to our study, flexible intramedullary Ender's nailing done by retrograde technique gives equally good results, advantages of physiological consolidation(biological) and flexible stability(mechanical) with comfort for the patient comparable to any plate osteosynthesis or interlocking intramedullary nailing.

### CONFLICTS OF INTEREST

There are no conflicts of interest in authors.

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