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Original research article

Study of effectiveness of interlocking nail in management of fracture shaft humerus

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Abstract

Background & Objectives: Operative management of humeral shaft fractures can be with plate osteosynthesis or with intramedullary nailing. As the intramedullary nails can be introduced in a closed manner, they preserve the fracture hematoma, providing early fracture consolidation with higher union rates and low infection rates. Interlocking achieves rotational stability providing early mobilization of the neighbouring joints. But, with antegrade nailing they do have a disadvantage of causing shoulder stiffness.In this study we have tried to analyse the outcome in terms of time for consolidation, union rates, functional results and complications of humeral shaft fractures managed with intramedullary nailing.

Methods: 36 adult patients with acute humeral shaft fractures were treated with closed intramedullary nailing in antegrade manner. There were 28 males and 8 females with an average age of 35.75 years (21-60 years). All the patients were followed over a period of 2 years and results were analysed.

Results: 32 (90%) fractures united with a average consolidation time of 13.5 weeks (10-16 weeks),3(8%) fracture ended in delayed union which needed bone grafting.1(3%) case needed redoing with plate osteosynthesis due to severe nail prominence. There was no case of iatrogenic radial nerve palsy. Nail impingement was seen in 4(11%), shoulder stiffness in 1(3%) and none of the patients got infected. Functional results were excellent in 30(75%), moderate in 5(14%) and poor in 1(3%).

Conclusion: Closed intramedullary nailing offers a safe and reliable method of Stabilizing humeral shaft fracture, with early fracture consolidation and higher union rates. It provides early rehabilitation and reduces the hospital stay.

Keywords: Study of effectiveness, interlocking nail, fracture shaft humerus

Introduction

It is generally admitted that most humeral shaft fractures can be managed successfully by non- operative methods. Whenever operative treatment is required, a choice has to be made between plate osteosynthesis and intramedullary nailing.

Fixation with plates requires extensive dissection and is complicated by the proximity of the radial nerve and the risk of mechanical failure due to osteopenia in bones.

Biomechanically intramedullary nail is a better implant. They are subjected to smaller bending loads and are less likely to fail by fatigue, they act as load sharing devices, stress shielding with resultant cortical osteopenia is minimum, refracture after implant removal is rare and they do not require extensive exposure[1, 2].

With the use of image intensification, Nailing can be done without exposure of fracture site avoiding soft tissue dissection thus scarring and low infection rates. This also preserves the fracture hematoma, which provides early fracture consolidation with higher union rates.

With interlocking mechanism, they achieve rotational stability and provide early mobilization of the neighboring joints and decrease the morbidity.

Due to reduced hospital stay and early return of the patient to his job, financial burden on one's family is less.

Keeping all these aspects in mind, we took up this study to assess the role of intramedullary nailing with an interlocking nail in managing humeral shaft fractures.

Aim of study

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- To study the fractures of humeral shaft.
- To study the mechanism of injury in humeral shaft fractures.
- To assess the advantages and disadvantages, of closed intramedullary nailing in managing humeral shaft fractures.
- To study the pitfalls and complications of the nailing technique in managing humeral shaft fractures.
- To analyze the outcome in terms of period of fracture consolidation, union rates and functional results of humeral shaft fractures managed by intramedullary nailing.

Materials and Methods

Our study is a series of 20 cases of acute humeral shaft fractures treated with closed intramedullary interlocking nailing. This study was conducted over a period of 2 years from July 2013 to June 2015.

Inclusion criteria

- Patients were selected based upon following criteria.
- Age more than 17 years, when the physis is fused.
- Fractures of humeral shaft from 3cm proximal to the olecranon fossa to within 2cm of the surgical neck of the humerus.
- Closed fractures and grade I open fractures.

Exclusion criteria

- Patients aged 17 years or below, when the physis is open.
- Humeral shaft fractures involving the proximal 2 cms and distal 3 cms of the humerus.
- Grossly contaminated, open fractures-Grade II, III.

A careful history was elicited from the patients and from attenders to reveal the mechanism of injury and the severity of trauma. The patients were then assessed clinically to evaluate their general condition and local injury. The vital signs were recorded and associated injuries were carefully assessed.

Local examination was carried out to detect the signs of fracture like, swelling, deformity, tenderness, abnormal mobility and crepitus. Any associated neurovascular deficit was noted.

Appropriate Radiographs of the affected arm including shoulder and elbow joints were taken in antero-posterior and lateral views.

The limb was immobilized in a U-slab with collar and cuff sling and analgesics were given.

The operative procedure, its advantages and likely complications were explained to the patient and informed consent was obtained.

All the necessary blood investigations (complete blood count, blood urea, serum creatinine, blood sugar, HIV, HBsAg), ECG and if necessary, chest X-ray were taken. Physicians' fitness for surgery was obtained when required.

All the cases were treated by intramedullary interlocking nailing in antegrade manner.

Postoperatively, the arm is placed in a sling and early range of motion exercises for shoulder and elbow were started as discomfort subsided, usually on 5th or 6th postoperative day. Shoulder range of motion exercises is emphasized to avoid stiffness.

In patients where there were no associated injuries or their presence did not warrant hospital stay, after instructing regarding range of motion exercises patients were discharged on 4th or 5th postoperative day and were asked to come for suture removal on 12th postoperative day.

Follow up

All the patients were followed up at monthly intervals for the first 3 months, later on 2 monthly intervals till fracture union and once in 6 months till the completion of study.

Rommen's et al Criteria

Grade	Range of motion (ROM) (Shoulder/elbow)	Subjective complaints
Excellent	$<10^0$ loss of ROM in any direction	None
Moderate	Loss of ROM between 10^0 to 30^0 in any direction	Mild
Poor	Loss of ROM $>30^0$ in any direction	Moderate to Severe

Special stress was laid on shoulder and elbow range of movements and subjective complaints. Radiographs were taken both in anteroposterior and lateral views and signs of union were looked for.

Assessment of Results

Assessment of the patient was done on the basis of clinical and radiological union, range of motion at shoulder and elbow joints and subjective complaints like pain in shoulder/elbow. Functional results were graded by the criteria of Rommens*et al*.[3].

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Shoulder and elbow functions were graded excellent, moderate or poor depending upon the loss of range of motion in any direction, subjective complaints like pain were also taken into account.
The total functional out come at the time of review took both joints (shoulder and elbow) were taken into account.

Results
The present study consists of 36 cases of humeral shaft fracture treated by closed intramedullary nailing by antegrade method. The study is conducted over a period of two years between July 2013 to June 2015. All the patients were available for follow up.

Following observations were made
Our patient's age ranges from 21 years to 75 years with an average of 23.5 years.28 male and 8 female patients. Right side commonly affected.

Type of Fracture
35 were closed fractures and 3 were grade-I open fractures. All the fractures were classified according to AO classification system

Fracture Union
Period of fracture union ranged from 10 to 16 weeks, average period being 13.5 weeks.

Table I

Period of Union	No. of Patients	Percentage
10 to 12 weeks	27	75
13 to 16 weeks	8	22.3
Non-union	1	2.7

Functional Assessment
Functional results were graded by the criteria of Rommens*et al*.[3].
Shoulder and elbow functions were graded excellent, moderate or poor depending upon the loss of range of motion in any direction, subjective complaints like pain were also taken into account.

Table II: Shoulder and elbow function

Shoulder and elbow function						
Grade	Shoulder		Elbow		Total Outcome	
	No	%	No	%	No	%
Excellent	30	83	36	100	30	83
Moderate	5	14	0	0	5	14
Poor	1	3	nil	nil	1	3

Table III: Complications

Complications	No. of Patients	Percentage
Non-union	1	2.7
Transient Iatrogenic Radial nerve palsy	0	0
Shoulder stiffness	1	2.7
Nail Impingement	4	11

Discussion
Most of the acute humeral shaft fractures used to be treated by conservative methods. But operative stabilization is preferred by most of the surgeons in recent time in need of early mobilization and return to work. Plate osteosynthesis has yielded high success rate but it needs extensive dissection with the risk of radial nerve damage and refracture after implant removal. Intramedullary nailing has the advantages of less soft tissue trauma and less chances of radial nerve injury, but the use of unlocked, flexible nails has been complicated by poor rotational stability and slipping out of the nails causing joint irritation. Locked nailing overcomes these deficiencies and has produced satisfactory clinical results.
In this study we have treated 36 acute humeral shaft fractures with antegrade, interlocking nailing. We evaluated our results and compared them with those obtained by various other studies opting different modalities of treatment for humeral shaft fractures.
Fractures of the humeral shaft are commonly seen in middle aged adults. The average age in our study was 33 years. (Range 21 to 75 years). Out of 20 cases 12 were males, 8 were females. Male: female ratio being 3:2 which is comparable to similar studies[3, 4, 5].

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In our study 11(55%) patients, presented with H/O of road traffic accident which was in conformation with other similar studies conducted[3, 5, 6, 7].

In the present study, right extremity was commonly involved and in 29(80.5%) patients middle third of shaft was involved.

In studies by Crates *et al*., Rommens*et al*and Jinn LinMiddle third of the shaft is the most common location of the fracture[3, 4, 5].

2 (5.55%) of our patients had associated injuries. In Crates *et al*. series,60(84%) patients sustained multiple injuries. In Jinn Lin series 12 out of 48 patients had multiple injuries. In Rommens*et al*. series 20 patients (out of 39) had poly trauma[3, 4, 5].
In our study out of 36 cases 25 (70%) fractures were of category A of AO classification system. This was comparable to most of the studies conducted, fractures were of category A of AO classification system. In Jinn Lin[4] series 34(out of 48,70%) fractures were of category A. In Rommens*et al*. [3]series 25 (out of 39,64%) fractures were of category A[3, 4].

Most of the operative methods for stabilization of humeral shaft fractures have acceptable rates of union[6, 8].
Dabezies*et al*. all reported union in 97%, Tingstad reported 94% union of humeral shaft fractures treated with AO plating techniques[7, 9].
As the flexible intramedullary nails lack rotational control, they are frequently associated with non-union.
Durbin *et al*. reported union in 92% of 30 humeral fractures treated with hackethal nailing[10].
Brumback*et al*. obtained union in 94% of 58 fractures treated with Rush and Ender nails[11].
Riemer *et al*. reported no non-union in 28 acute humeral shaft fractures treated with seidel nails[12].
Rommens*et al*. reported union in 95% of fractures with a mean time for union of 13.7 weeks[3].
Jensen *et al*. reported 92% fracture union after seidel nailing in 16 patients[13].
Jinn Lin[4]reported 100% union with a mean time to union of 8.6 weeks[4].
Crates *et al*. reported 97% union of fractures treated with antegrade, Russell-Taylor nailing. with a mean time of 3.2 months[5].
In our series 32(90%) out of 36 fractures united with a mean time for union of 13.5 weeks (range 10 to 16 weeks). This was comparable to the studies mentioned above[3, 4, 5, 11, 12, 13].
There were 3(8%) cases which had delayed union one case was open fracture and other patients had severe osteoporosis.
Transient iatrogenic radial nerve palsy was not seen in our study which is in conformity to studies done by Jinn Lin and Riemer *et al*.[4, 12]
Because the radial nerve lies in close proximity to the humeral shaft, it may be injured by any operative approach to the humerus. Vander Griend *et al*. and Bell *et al*. reported transient iatrogenic nerve palsies in 2.9% humeral fractures treated with plating[6, 8].
Hence this Method of fixation is stable and safe.
In ourstudy we encountered no cases of intraoperative fracture comminution as seen in study done by Crates *et al*.[5]
Jinn Lin reported one case and Rommens*et al*.reported three cases of additional fracture comminution[3, 4].
In our study none of the fractures got infected. Even there were no cases of superficial infections. Because of the good vascular supply and large soft tissue surrounding the humerus, infection is relatively infrequent and seems to be more common after open techniques which was comparable to other study done by Riemer *et al*.[12]
In series of acute humeral fractures treated with Russell-Taylor nails, Rommens*etal*.,Ikpeme*et al*.and Crates et al reported no infections as well[3, 5, 14].
In our study 30 (83%) patients had excellent shoulder function with near normal range of motion of shoulder. 5(13%) patients shoulder function was moderately good. Among these one had impingement of proximal end of the nail. One (2.7%) patient had severe shoulder stiffness and had significant restriction of shoulder motion which was comparable to study done by Petsatodes*et al*.
None of our Patients had elbow stiffness comparable to other studies.

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Clinical Photo 1

Clinical photo 2

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Clinical Photo 3

Conclusion

Based on our experience and results we conclude that closed intramedullary nailing with an interlocking nail is a safe and reliable method of treating humeral shaft fractures.

- Essentially all closed and Grade I open humeral shaft fractures extending between 2 cm from surgical neck to 3 cm proximal to the olecranon fossa can be stabilized with closed intramedullary nailing.
- It is excellent mode of managing comminuted and unstable humeral shaft fractures.
- It is the best surgical method available to fix humeral shaft fractures in patients with polytrauma and osteoporosis where reduction in operating time and early rehabilitation are the primary objectives.
- In available surgical Method of Intervention, closed nailing is the least invasive surgical technique and has got the least chance of postoperative infection hence reduces the hospital stay.
- Since closed nailing preserves the fractures hematoma, it appreciably decreases the time required for fracture to consolidate and achieves high rate of fracture union.
- Complications like non-union can be avoided by intraoperative compression and avoiding distraction at fracture site.
- Postoperative early mobilization of the shoulder and elbow was very critical in attaining full range of movements.
- It was observed that the movements and the functional ability of the shoulder depended upon the patient's adherence to rehabilitation program and early intensive physiotherapy hastened the recovery of shoulder function.

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