ORIGINAL RESEARCH PAPER
Volume - 11 | Issue - 06 | June - 2022 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

INTRA-MEDULLARY NAILING FOR HUMERAL SHAFT FRACTURES:A CASE SERIES

Orthopaedics

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ABSTRACT

Humeral shaft fractures have always been amenable to conservative treatment with good success. However, there are many fractures which need to be operated. Intra-medullary nailing, while being a very popular method of fixation of long bone fractures of the lower extremity, has not gained similar traction in the humerus. We investigate a series of patients operated at our institution with intramedullary nailing, and outline the success of this procedure, and the problems encountered. This study was conducted at the Government Hospital for Bone & Joint Surgery, Srinagar, and included a total of 31 patients with humeral shaft fractures from August 2017 to September 2021. All these fractures were fixed using reamed intramedullary nailing. Of the 31 patients, 22 were male, and 9 were female, with a mean age of 35.28 years. Mean time to union was 12.6 weeks. We encountered many complications in our series of patients. Three (9.6%) patients had a delayed union, one (3.22%) had proximal nail impingement, one (3.22%) had entry site iatrogenic comminution, two patients (6.4%) had superficial surgical site infection, and 11 (35.5%) patients had persistent shoulder pain. We concluded that Intramedullary nailing of the humerus is a safe, and effective procedure for humerus shaft fractures. However, problems related to the entry site are possible, and are a common cause for morbidity even after fracture union.

KEYWORDS

Introduction

Humerus diaphyseal fractures are among the common injuries encountered in an orthopaedic trauma clinic. Although many humerus fractures do well and frequently unite in a functional brace[1–3], there are instances where operative intervention is needed. Also, some fracture configurations do not respond favourably to conservative management[4].

Intra-medullary nailing for shaft of humerus fractures enables the surgeon to stabilize the fracture by closed means, involves minimal periosteal stripping, and has lesser chances of injuring the radial nerve, a complication seen not uncommonly during humerus plating. Also, due to the load-sharing nature of this device, it is favoured in patients who have osteopenic bones, patients with pathological fractures, and patients with segmental fractures of the shaft[5].

The aim of this study was to study and document the experience of intra-medullary nailing of Humerus shaft fractures in resource limited settings, and list out the results of the same.

Materials and Methods

The study included 31 patients, with 31 humeral shaft fractures. 22 were male, and 9 were female. Their ages ranged from 18 to 65 years with a mean age of 35.28 years.

The patients were prospectively reviewed from August 2017 to September 2021, Informed consent from the patients was taken to be included in the study, after obtaining consent from the institutional ethics committee.

Inclusion criteria were: Patients suffering from diaphyseal type A, B, or C fractures of the humerus, unstable humerus fractures, types 1 and 2 fresh (<3 weeks) open fractures of the humeral shaft.

Exclusion criteria were: non-unions, pathological fractures, open fractures, fractures in which conservative treatment had already been tried for more than 3 weeks, fractures already managed by a different fixation technique, type 3 open fractures, humerus fractures with radial nerve palsy, and patients with less than 6 months of follow up following surgery.

Reamed ante-grade intramedullary nailing was done in all cases. The results were assessed radiographically on follow up x-rays, and clinically using the quickDASH score.

All the selected patients were evaluated thoroughly before proceeding with surgery. The fractures were classified according to the AO/OTA fracture classification system. The surgeries were all performed under general anaesthesia, in the supine position. Only the Russel Taylor intramedullary nail was used for the fixation, with reaming, proximal, as well as distal locking.

Patients were discharged on the 2nd post-operative day, with advice given on physiotherapy, stitch removal, and oral antibiotic coverage. Oral antibiotics were prescribed for a period of 5 days, with analgesics on a need basis.

Operative details: Stainless steel Russel Taylor nails were used in all patients, locked using two locking bolts, both proximally as well as distally. A deltoid-splitting incision was given lateral to the acromion. The supraspinatus tendon was retracted, and entry was made using an awl, on the posterior aspect of the greater tuberosity. Guidewire was passed through the entry, and subsequently through the fracture site. Sequential reaming was done, after ensuring there was cortical contact at the fracture site. The nail was subsequently locked: proximally by means of the targeting sleeve, distally free-hand.

Patients were assessed for their functional improvement, and the scores were recorded during every follow-up. Functional results were evaluated using the QuickDASH score[6,7].

First follow-up was advised at 2 weeks, followed by monthly follow-ups till fracture union. Union was defined as three out of four healed cortices on orthogonal x-ray views within 4 months of surgery. Beyond 4 months, fractures not yet healed, were classified as delayed union. Beyond 6 months, they were classified as non-unions.

RESULTS

In our study, 31 cases of fracture shaft of humerus were fixed using intra-medullary nails.

The mean age of patients was 35.28 years, with a standard deviation of 8.95 years.

Majority of the fractures were of AO type 12A, followed by type 12B, and type 12C. Most of the fractures were caused by road traffic accidents, followed by falls from height.

The average admission to surgery interval was 5.4 days.

The mean fluoroscopy time was 6.7 minutes. Fluoroscopy time significantly reduced as we gained confidence with the procedure.

Table 1: OTA CLASSIFICATION OF INCLUDED FRACTURES

12A	A1	7
	A2	7
	A3	8
12B	B1	2
	B2	4
	B3	1
12C	C1	0
	C2	1
	C3	1

Table 2: MODE OF TRAUMA

RTA	21	68%
Fall from height	6	19%
Sports	4	13%

Out of the 31 fractures, 26 were closed injuries, whereas 4 were open fractures. Three of the open fractures were type 1 (Gustilo & Anderson)[8], while one was type 2.

All the fractures included were in the middle third of the humeral shaft. There was no pre-operative neurodeficit in any patient. Post-operatively as well, there was no instance of neurodeficit recorded.

All the fractures were reduced by closed means, and there was no need for open reduction in any case. Reaming of the canal was performed in all cases.

The QuickDASH score at final follow-up was less than 40 in all patients. In many series, a score of >40 is indicative of ongoing disease[6].

The mean time to union in our study was 12.6 weeks. Union was defined as bridging callus seen on 3 out of 4 cortices on x-ray, and clinical evidence of union. There was no non-union in our case series.

We reported quite a few complications in our experience with humeral nailing. Three patients had delayed union, defined as fracture union achieved after 12 weeks of surgery. One patient had proximal nail impingement and had restricted shoulder abduction due to the same. Nail removal was performed in this patient after fracture union. Persistent shoulder pain, and restriction of motion without evidence of proximal nail impingement was observed in 11 patients. These symptoms persisted even after fracture union in these patients. These patients were managed with short course of NSAIDs, and active physiotherapy targeted at improving shoulder range of motion, and muscle strengthening. Infection was reported in two cases. Both were open type 1 fractures and were diagnosed with superficial surgical site infection which resolved with a short course of antibiotic. There were no deep infections reported in our study. One patient had an entry site iatrogenic fracture of the greater tuberosity. It was managed conservatively by delaying post-operative physiotherapy. The fracture united uneventfully, and the patient regained full shoulder function.

Table 3: COMPLICATIONS

Delayed Union	3
Infection (superficial)	2
Proximal migration	1
Iatrogenic fracture	1
Shoulder pain & stiffness	11

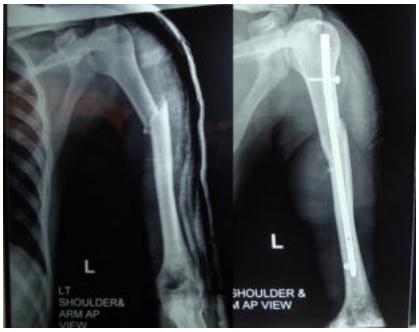

Figure 1: Pre-operative, and final follow-up of a case operated by antegrade humeral interlocking nailing.

DISCUSSION

Extensive research has been conducted on the management of humerus fractures, with excellent results of conservative treatment.[1–3] Increasingly though, with lower patience for conservative treatment, and many studies documenting the problems associated with conservative management of these fractures[1,9], there has been a resurgence of interest in fixation of humeral shaft fractures. Some of the recent literature also suggests that rates of non-union in conservatively managed humeral shaft fractures could be as high as 33% [10]

ORIF of humerus fractures has conventionally been the de-facto first choice among the operative techniques for fixing humeral shaft fractures[12]. However, humerus nailing involves minimal surgical trauma, less blood loss, and faster return to activity, especially in cases where bones are osteopenic, and the nail acts as an important load-sharing device[5,13].

In one of the earliest papers on humeral nailing, Ingman and colleagues reported fracture union by 12 weeks in 85.7% of all the acute humerus fractures operated in their study.[14]. Similar times to union were reported by later surgeons as well[15,16]. Not all studies have reported favourable outcomes with respect to intramedullary nailing of the humerus. Ajmal and colleagues reported a union rate of only 70% in fresh fractures managed by intramedullary nailing[17]. Our study did not report any non-union, and all the fractures included in our study united by final follow-up. One of the reasons for this could be our inclusion of only fresh cases (less than 3 weeks old) in our study.

Antegrade intramedullary nailing of the humerus has been reported to be associated with entry site complications like nail impingement, proximal nail migration, and persistent shoulder pain[18]. Injury to the rotator cuff is thought to be the one of the culprits behind the incidence of persistent shoulder pain and stiffness [19–21]. Other causes of persistent shoulder pain following humerus nailing have been proposed to be related to prominent hardware, impingement, varus collapse of the fracture, and altered distance between the greater tubercle and humeral head[23].

We used the standard entry portal in our cases, and this could have been a contributory cause for the relatively higher incidence of residual shoulder pain or stiffness observed in 14 patients (31%). These cases were all managed by sessions of vigorous physiotherapy, with varying degrees of success. At last follow-up, 3 out of the 14 patients still had residual shoulder pain.

McCormack et al [25] described severe nail impingement proximally in 3 out of their 44 patients. Two of these patients had impingement severe enough to warrant subsequent nail removal following fracture union. One of our patients also had to deal with significant shoulder impingement due to proximal nail migration. The patient had limitation in his shoulder range of motion as well. This necessitated nail removal following fracture union. Post-hardware removal, the patient regained full shoulder motion, and was pain-free. Nail impingement is a relatively common complication after antegrade humeral nailing, reported by many authors[19,22,26]

A study by Baltov et al, in 2014 described a 1.8 % incidence of entry site fracture of the greater tubercle in his case series[26]. He attributed the entry site fracture to the design of the first-generation nails. As we have used the Russel-Taylor nail in our series, it being a first-generation nail, we encountered entry site comminution of the greater tubercle in one patient (3.22%).

Mocini et al [23] also concluded that newer, straight humeral nails have a better follow-up than the conventional curved nails, with respect to time to union, as well as function.

Conclusion

Intramedullary nailing for diaphyseal fractures of the humerus is an effective and biological alternative to open reduction and internal fixation by conventional plate and screws. With all the advantages of preserving biology, load-sharing nature of the implant, and benefits in osteopenic patients, it has a much steeper learning curve, and lesser margin for error especially around the entry site. While being advantageous in many scenarios, complications are not infrequent when opting for antegrade humeral nailing in diaphyseal humerus fractures. With the advent of MIO techniques for humeral shaft

fractures, and the already popular open reduction and internal fixation technique using compression plates, it remains to be seen whether the benefits of intramedullary nailing outweigh the potential benefits of other methods of humerus fixation. More research is needed in this regard.

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