



ISSN: 2395-1958
IJOS 2019; 5(3): 151-155
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www.orthopaper.com
Received: 16-05-2019
Accepted: 20-06-2019

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Management of fracture shaft of humerus by interlocking nailing

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DOI: <https://doi.org/10.22271/ortho.2019.v5.i3c.1522>

Abstract

Background: Humeral shaft fractures which account for approximately 1-3% of all fractures and 20% of humeral fractures are known to cause significant disability in the young which is often temporary and in the old often permanent disability. The use of locked intra-medullary nailing for the treatment of humeral shaft fractures is gaining popularity because of its biomechanical and biological advantages.

Methods: We present a prospective study of 30 patients with acute humeral shaft fractures presented in HIMS Orthopaedic out-patient were treated using an ante-grade interlocking nail. Fracture union, functional outcome measured with criteria of Rommens et al and complications were assessed.

Results: Patient age ranged from 20 to 65 years (Average, 39 years). There were 24 male patients and 6 female patients. Fracture of the middle third was most common accounting to 70% (21/30) of the fractures. Fracture union was achieved in 96.6% (29/30) of our cases. 1 patient had nonunion for which secondary surgeries were needed. 1 patient had superficial infection. None of the patients had radial nerve palsy postoperatively. Functional results were graded according to the criteria of Rommens et al. Overall functional results were, Excellent in 26(86.6%) of patients, moderate in 3(10%) of patients and poor in 1(3.33%) of patients.

Conclusions: Gentle progressive reaming, correct entry point, minimal damage to rotator cuff, properly embedding the tip of the nail, good apposition of fracture fragments, static locking will help make ante grade intra-medullary nailing, a dependable solution for the treatment of humeral shaft fractures and in achieving successful union with preserved/good shoulder and elbow function.

Keywords: Closed reamed interlocking nail, humeral shaft fractures, Ante grade

1. Introduction

Humeral shaft fractures account for 3–5% of all fracture. ^[1, 3] Non-operative management has historically been the treatment of choice for many humeral shaft fractures; however in certain clinical scenarios these fractures may be well served by compression plating. ^[4] It is advocated that compression plating offer the best treatment for humeral shaft fractures that require surgical intervention. ^[5] However, the risks of any musculoskeletal procedure cannot be overlooked and in the case of compression plating include extensive dissection, iatrogenic radial nerve injury, an increased risk of infection, and nonunion. For these reasons, intra-medullary (IM) fixation has become increasingly popular, offering load sharing biomechanics especially in osteoporotic bone. It is less invasive. IM devices such as ender nail failed to provide optimal rotational alignment. ^[6] Interlocking screws addressed this problem, offering rotational control and length stability. ^[7, 8] Shoulder pain and healing problems are complications reported ^[9, 12]. There is considerable debate regarding the best method of treating humerus fractures. A method closely approaching this perfection is IM interlocking nails. The objective of this prospective study was to evaluate the clinical outcome with the use of an ante grade interlocking intra-medullary nail for the humeral fractures.

2. Material and Methods

This prospective study was carried out at Department of Orthopedic Surgery in HIMS, Hassan from January 2016 to December 2018. The work was approved by institutional ethics committee. A total of 30 patients with fracture humerus admitted to our institute were included in the present study. A written informed consent was obtained from all the patients; they were

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Explained about treatment plan and complications of surgery and anesthesia.

Examination of patients was done thoroughly at the time of admission to exclude other injuries. In the majority of the patients close reamed interlocking nailing of the shoulder was performed within 7th to 14th day after the injury. In patients who were not fit for surgery due to associated injuries to vital organs, were hemodynamically unstable or due to active infection at injury site, interlocking nailing was performed when their overall condition improved.

2.1 Inclusion criteria

Patients with closed humerus shaft fracture with age between 18-65 years and had presented within a week of the injury and did not have any previous surgical treatment for a fracture.

2.2 Exclusion criteria

Patients with open fractures, arterial injuries, nerve injuries, infected fractures and nonunion.

2.3 Surgical technique

All nailing procedures were performed under general anesthesia or brachial block and image intensifier. The procedures were done in the supine position with the head rotated to contra lateral side on a radiolucent table. A longitudinal skin incision 1–3 cm centered over the tip of the greater tuberosity was given. An awl was passed just medial to the tip of the greater tuberosity, 0.5 cm posterior to biceptal groove to make an entry point. Close reduction was achieved under C- arm guidance and guide wire was passed, the length of the nail was measured by subtracting exposed guide wire from the total length of the guide wire. In cases, where closed reduction failed minimum open reduction was done. The nail of proper length and diameter was passed till its proximal end was beneath the bone by 0.5 cm to avoid sub-acromial impingement and distal tip was 2 cm above the olecranon fossa. Proximal and distal locking was done. The type of nailing is static ante grade interlocking nails. Postoperatively soft bulky dressings were used, and the limb was kept in shoulder arm pouch. Check X-ray was taken of the full humeral length. Patients were kept on antibiotic for 3–5 days depending upon the wound condition in most cases.

2.4 Rehabilitation

Passive range of motion exercises at shoulder and elbow were started on the 3rd postoperative day when pain and swelling had subsided. Regular antiseptic dressings were done, and the patients were discharged on 3rd postoperative day. Stitches were removed on 10th day postoperatively. Thereafter active ranges of motion exercises were started.

Each patient's demography including mechanism of injury, associated injuries, time to radiographic union, shoulder and elbow function, patient satisfaction and complications including infection, iatrogenic nerve injury, delayed union and nonunion were recorded. Clinical union was noted as absence of pain at the fracture site with return to full activities. Fracture healing was assessed by sequential plain radiographs obtained every six weeks, until evidence of fracture healing was confirmed. Radiological union was defined as cortical bridging of at least three of four cortices and nonunion as failure of radiological union at six months, requiring surgical intervention. Final assessment of the patient was done at the end of the 6th month on the basis of the criteria derived from Rommen et al series. (Table 1).

3. Results

Sin this study, 30 cases of humeral shaft fractures treated by intra-medullary nailing were evaluated. Study population consisted of 24(80%) males and 6(20%) females, with a mean of 39 years; minimum age was 20 years while maximum was 65 years. Laborers and agriculturists (n=12, 40%) were most frequently affected followed by homemakers (n=6, 20%). There was no significant difference between the sides affected; right side involvement was seen in 16(53.4%) and left in 14 patients (46.6%). Road traffic accident was the frequent cause (n=21, 70%) and rest (n=9, 30%) had a history of fall. Indirect injury was the cause in 20 (66.66%) and direct injury in 10(33.33%) patients. Middle 1/3rd of shaft of humerus was fractured in 21(70%) patients. 9 (30%) patients had associated injuries, ipsilateral rib fracture, fracture both bone forearm on the contralateral side, ipsilateral fracture shaft of tibia, mandible fracture, blunt abdominal injury, and head injury were noted in one patient each. Mean time interval between occurrence of injury and surgery was 3.5 days; eighteen (60%) patients were operated within a week of trauma while the rest were operated within a week.

All were treated with closed intra-medullary nailing in ante grade manner except 5(16.66%) cases that required open procedure. The procedure was done either under general anesthesia (n=20) or brachial block (n=10). Closed intra-medullary nailing was performed for 25(83.4%) patients. These nails were passed in ante grade manner and locked in static mode. 5(16.6%) patients required open reduction, because of difficult reduction due to soft tissue inter-position and the fracture was fixed with interlocking nail in static mode. Mean operative time was 40.3 minutes.

Functional results were graded according to the criteria of Rommens et al. Overall functional results were excellent in 26(86.6%) of patients, moderate in 3(10%) of patients and poor in 1(3.33%) of patients. (Table 2).

4. Discussion

Majority of uncomplicated humeral shaft fractures can be managed non-operatively, with an expected union rate of more than 90% and continues to be the mainstay of treatment [13]. Methods include functional bracing, hanging-arm casts, modified Velpeau dressings, coaptation splints, shoulder spica casts, and abduction-type splints. Sarmiento *et al* in 1977 described functional cast bracing with a moldable splint which allowed early return to activity, acceptable functional outcomes, and minimal morbidity [4]. West rick *et al* in a retrospective cohort study of 296 patients with humeral shaft fractures found nonunion rate was significantly higher in the non-operative group (23.2% vs. 10.2%) [14].

Difficulty in immobilization due to the very much mobile scapulohumeral joint and distraction at fracture site by effects of gravity leading to delayed union and non-union, prolonged immobilization leading to joint stiffness, muscle weakness, less tolerance to acceptable deformity, impatient patients eager to return to early function and surgeons reluctance towards more labor-intensive methods of conservative management are cited for increasing trend for surgical management [15, 16].

Plate osteosynthesis has yielded high success rate but it needs extensive dissection with the risk of radial nerve damage and re-fracture after implant removal. Intra-medullary nailing has the advantages of less soft tissue trauma and less chance of radial nerve injury, but the use of unlocked flexible nails has been complicated by poor rotational stability and slipping out of nails causing joint irritation. Locked nailing overcomes

these deficiencies and has produced satisfactory clinical results. In this study we have treated 30 acute humeral shaft fractures with ante grade 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 humeral shaft are commonly seen in middle age adults. Crates *et al* [17] treated 73 acute humeral shaft fractures in 71 patients with intra-medullary nailing. There were 43 male and 28 female with an average age of 32 years (range 13 to 70 years). Jinn Lin *et al* [11] treated 48 patients of acute humeral shaft fractures with intra-medullary nailing, there were 29 male and 19 women with mean age of 48 years (range 21 -76 years). Rommens *et al* [7] treated 39 fractures with locked retrograde nailing. There were 20 males and 19 females with average age 43.8 years (range 15.5 to 97 years). Tings tad *et al* [18] treated 83 patients with plating. There were 44 males and 38 females with mean age of 32.8 years. The average age in our study was 39 years. Out of 30 cases 18 were men and 12 women.

Road traffic accident was commonest mode of injury in most of the studies. In study conducted by Crates *et al* [17] out of 73 patients, 48 presented with history of road traffic accident. In Rommens *et al* [7] series out of 39 patients, 21 gave history of road traffic accident. In study by Bell MJ *et al* [19], Jinn Lin *et al* [11] and Tings tad *et al* [18] road traffic accident was commonest mode of injury. In our study 21 patients presented with road traffic accident.

In studies by Crates *et al* [17], Jinn Lin *et al* [11], Rommens *et al* [7] middle third shaft was the common location of the fracture. In our study also, middle third fractures 21 (70%) was the commonest site. Right extremity was commonly involved.

9(30%) of our patients had associated injuries. In Crates *et al* [17] series, 60(84%) had multiple injuries. In Jinn Lin *et al* [11] series 12 out of 48 patients had multiple injuries. In Rommens *et al* [7] series 20 patients out of 39 had poly-trauma.

Most of the operative methods of stabilization of humeral fractures have acceptable rates of union. Vander Griend *et al* [20], Bell *et al* [19], Dabezies *et al* [21]. All reported union in 97%, Tings tad *et al* [18] reported 94% union of humeral shaft fractures treated with AO plating techniques. As the flexible intra-medullary nail slack rotational control, they are frequently associated with non-unions. Durbin *et al* [22] reported union of 92% of 32 humeral fractures treated with nailing. Brumback *et al* [23] obtained union in 94% of 58 fractures treated with rush and Enders nails. More rigid locked intra-medullary nails have better rotational control than flexible nails, which theoretically should decrease the nonunion frequency. Riemer *et al* [24] reported no non-unions in 28 acute humeral shaft fractures with Siedel nails. Rommens *et al* [7] reported union in 95% of fractures with a mean time for union of 13.7 weeks. Jensen *et al* [25] reported 92% fracture union after Siedel nailing in 16 patients. Jinn Lin *et al* [11] reported 100% union with a mean time for union of 8.6 weeks. Crates *et al* [17] reported 97% union of fractures treated with ante grade Russell Taylor nailing, with mean time of 3.2 months.

In our series, 29(96.6%) out of 30 fractures, united with a mean time for union of 13 weeks. This is comparable with the other series. We attribute, early fracture consolidation and higher union rates to closed nailing technique, which preserves fracture hematoma and promoting early fracture union.

Because the radial nerve lies in close proximity to the humeral shaft, it may be injured by any approach to the humerus.

Vander Griend *et al* [20] and Bell *et al* [19] reported transient iatrogenic nerve palsies in 2.9% humeral fractures treated with plating. Crates *et al* [17] reported 2.7% iatrogenic radial nerve palsies after locked intra-medullary nailing. There were no transient iatrogenic radial nerve palsies in present study and this frequency is consistent with the other studies.

Because of the good vascular supply and large soft tissue surrounding the humerus, infection is relatively infrequent and seems to be common after open techniques. Bell *et al* [19] reported 2.9%, Vander Griend *et al* [20] reported 5.9% infection after plate fixation humeral fractures. Brumback *et al* [23] reported 1.7% infection after fixing humeral shaft fractures with various flexible nails. Most of them occurred after open nailing and with nailing in open fractures. In present study one case of fracture got superficial infection which subsided with antibiotics.

The most frequent criticism of ante grade humeral nailing has been its potential deleterious effect on shoulder function. This can be due to impingement of proximal nail tip or proximal locking screw, due to adhesive capsulitis or due to rotator cuff tears. In most of the studies with ante grade nailing, 80 to 95% of patients regained their normal shoulder function. With Russell-Taylor ante grade nailing, Crates *et al* [17] reported 90% of patients regaining full shoulder function.

In our study 26 (86.6%) patients had excellent shoulder function with near normal range of motion in shoulder. In 3 (10%) patients, shoulder function was moderately good. One patient had severe shoulder stiffness and had significant restriction of shoulder motion.

Postoperative early mobilization of shoulder and elbow was very critical in attaining full range of movements. It was observed that the movements and functional ability of the shoulder depend upon the patient's adherence to rehabilitation programme and early intensive physiotherapy hastened the recovery of shoulder function.

Most of our findings, including period of fracture consolidation, union rates, complications and functional results are comparable with the studies where intra-medullary nailing was used to treat the humeral shaft fractures.

Closed intra-medullary nailing with an interlocking nail is a safe and reliable method of treating humeral shaft fractures. Among available surgical modalities, closed nailing is the least invasive surgical technique and has the least chance of post-operative infection. It reduces the duration of the hospital stay. Complications like nonunion can be avoided by intra-operative compression and avoiding distraction at fracture site. Certain technical aspects like burying the proximal nail end at the entry portal are essential in avoiding impingement and to gain better shoulder function.

5. Conclusion

Closed intra-medullary nailing is an excellent, least invasive surgical option available to manage humeral shaft fractures with early fracture consolidation and better union rates. It decreases the hospital stay, provides early rehabilitation and reduces the morbidity. It is ideal in patients with poly-trauma. Early intensive physiotherapy hastens the recovery of shoulder function.

Funding: No funding sources

Conflict of interest: None

Ethical approval: The study was approved by the institutional ethics committee

Table 1: Grading of functional outcome

Grade	ROM Shoulder and elbow	Subjective
Excellent	<10 ⁰ loss of ROM in direction	None
Moderate	10-30 ⁰ loss of ROM in direction	Mild
Poor	>30 ⁰ loss of ROM in direction	Moderate to severe

Table 2: Functional outcome in study population (N=30)

Grade	N (%)	
	Shoulder	Elbow
Excellent	26 (86.6)	27 (90.0)
Moderate	3 (10.0)	3 (10.0)
Poor	1 (3.3)	0 (0)

Table 3: Comparison of results of present study with other studies, using intra-medullary nail fixation for treating humeral shaft fractures

Study author	Method of treatment	No. of patients	Average time for fracture consolidation	% of fracture union	Infection	Delayed or non-union	Transient radial nerve palsy	Excellent functional results
Crates et al	Ante grade interlocking nailing by Russell-Taylor nail	71	3.2 months	97%	--	2 (2.7%)	2 (2.27%)	90%
Jinn Lin	Locked intra-medullary nailing	48	8.6 weeks	100%	--	--	--	87.5%
Potatoes et al	Ante grade interlocking nailing	37	--	92.3%	--	7.7%	--	87.2%
Kropfl et al	Undreamed Ante grade interlocking nailing	109	12.6 weeks	95.4%	--	5 (4.6%)	--	83%
Rommens et al	Retrograde interlocking nailing	39	13.7 weeks	94.9%	--	2 (5.1%)	1 (2.6%)	84.6%
Present study	Ante grade interlocking nailing	30	13 weeks	95%	1 (3.3%)	1 (3.3%)	--	86.6%



Preop xray

Post op xray

At 6 months union



Adduction & Internal rotation

Abduction

References

- Williams GR, Ramsey ML, Wiesel SW. Operative Techniques in Shoulder and Elbow Surgery. Philadelphia: Lippincott Williams and Wilkins. 2010.
- Bodner G, Buchberger W, Schocke M, Bale R, Huber B, Harpf C, *et al*. Radial nerve palsy associated with humeral shaft fracture: Evaluation with US – initial Experience. Radiology. 2001; 219:811-6.
- Shao YC, Harwood P, Grotz MR, Limb D, Giannoudis PV. Radial nerve palsy associated with fractures of the shaft of the humerus: A systematic review. J Bone Joint Surg Br. 2005; 87:1647-52.
- Sarmiento A, Zagorski JB, Zych GA, Latta LL, Capps CA. Functional bracing for the treatment of fractures of the humeral diaphysis. J Bone Joint Surg Am. 2000;

- 82:478-86.
- Niall DM, O Mahony J, McElwain JP. Plating of humeral shaft fractures – has the pendulum swung back? Injury. 2004; 35:580-6.
- Brumback RJ, Bosse MJ, Poka A, Burgess AR. Intramedullary stabilization of humeral shaft fractures in patients with multiple trauma. J Bone Joint Surg Am. 1986; 68:960-70.
- Rommens PM, Verbruggen J, Broos PL. Retrograde locked nailing of humeral shaft fractures. A review of 39 patients. J Bone Joint Surg Br. 1995; 77:84-9.
- Ingman AM, Waters DA. Locked intramedullary nailing of humeral shaft fractures. Implant design, surgical technique, and clinical results. J Bone Joint Surg Br. 1994; 76:23-9.
- Rommens PM, Kuechle R, Bord T, Lewens T, Engelmann R, Blum J. *et al* Humeral nailing revisited. Injury. 2008; 39:1319-28.
- Farragos AF, Schemitsch EH, McKee MD. Complications of intramedullary nailing for fractures of the humeral shaft: a review. J Orthop Trauma. 1999; 13:258-67.
- Lin J, Shen PW, Hou SM. Complications of locked nailing in humeral shaft fractures. J Trauma. 2003; 54(5):943-9.
- Baltov A, Mihail R, Dian E. Complications after interlocking intramedullary nailing of humeral shaft fractures. Injury (Suppl 1). 2014; 459-15.
- Spiguel AR, Steffner RJ. Humeral shaft fractures. Curr Rev Musculoskelet Med. 2012; 5(3):177-83.

14. Westrick E, Hamilton B, Too good P, Henley B, Firoozabadi R. Humeral shaft fractures: results of operative and non-operative treatment. *Int Orthop*. 2017; 41(2):385-95.
15. Kulkarni SG, Varshneya A, Jain M, Kulkarni VS, Kulkarni GS, Kulkarni MG, *et al.* ante grade interlocking nailing versus dynamic compression plating for humeral shaft fractures. *J Orthop Surg*. 2012; 20(3):288-91.
16. Cole PA, Wijdicks CA. The operative treatment of diaphyseal humeral shaft fractures. *Hand Clin*. 2007; 23(4):437-48.
17. Crates J, Whittle AP. ante grade interlocking nail of acute humeral shaft fractures. *Clin Orthop Relat Res*. 1998; 350:40-50.
18. Tings tad EM et al. Effect of immediate weight bearing on plated fractures of the humeral shaft. *J Trauma*. 2001; 49(2):278-280.
19. Bell MJ, Beauchamp CG, Kellam JK, McMurty RY. The results of plating humeral shaft fractures in patients with multiple injuries: The Sunnybrook Experience. *J Bone Joint Surg*. 1985; 67:293-296.
20. Vander Griend R, Tomasin J, Ward EF. Open reduction and Internal fixation of humeral shaft fractures: Results using AO plating techniques. *J Bone Joint Surg*. 1986; 68:430-433.
21. Dabezies EJ, Banta II CJ, Murphy CP, D' Ambrosia KD. Plate fixation of the humeral shaft for acute fracture with and without radial nerve injuries. *J Ortho Trauma*. 1992; 6:10-13.
22. Durbin RA, Gottesman MJ, Sanders KC. Hackethal stacked nailing of humeral shaft fractures: Experiences with 30 patients. *Clinical Ortho*. 1983; 179:168-174.
23. Brumback RJ, Bosse MJ, Poka A, Burgess AR. Intramedullary stabilization of humeral shaft fractures in patients with multiple trauma. *J Bone Joint Surg Am*. 1986; 68:960-70.
24. Riemer BL, Butterfield SL, Ambrosia D, Kellam R, Siedel J. intramedullary nailing of humeral diaphyseal fractures : A preliminary report. *Orthopaedics*. 1991; 14:239-246.
25. Jensen CH, Hansen D, Jorgensen U. Humeral shaft fractures treated by interlocking nailing. A preliminary report on 16 patients. *Injury*. 1992; 23(4):234-236.
26. Raja Gopal HP, Madan Mohan M, Pilar A, Tamboowalla KB. Functional outcome of ante grade interlocking intramedullary nailing for humeral shaft fractures. *Int J Res Orthop*. 2017; 3:1127-31.
27. Sahu RL, Ranjan R, Lal A. Fracture Union in Closed Interlocking Nail in Humeral Shaft Fractures. *Chin Med J*. 2015; 128:1428-32.