



Original Research Article

Effect of reverse hammering on fracture union in transverse fracture of long bone nailing

Raghvendra Choubey^{1,*}, Gaurav Agarwal¹, Rajesh Kumar Jain¹¹Dept. of Orthopaedics, Bundelkhand Medical College, Sagar, Madhya Pradesh, India

ARTICLE INFO

Article history:

Received 11-02-2022

Accepted 17-02-2022

Available online 31-07-2023

Keywords:

Intramedullary nailing

Fracture gap

Reverse hammering technique

ABSTRACT

Introduction: Reverse hammering is the method applied during nailing of transverse long bone fracture to decrease the gap between fracture ends to ensure healing. This study aims to assess the effectiveness of reverse hammering on fracture union in transverse fracture of long bone nailing as well as possible complications of this method.

Materials and Methods: Seventy six patients with transverse fracture of long bone (femur, tibia, & humerus) treated with close reduction and internal fixation with interlocking nailing were enrolled in a prospective study conducted at the department of orthopaedics, BMC Sagar from Dec. 2012 to March 2021. Union grading was done to assess union as per Hammer criteria.

Results: Mean time to achieve bony union was 4.5 months. In our study seven out of seventy six patient at the end of three month were having radiological grade three or less union which at the end of nine month only two patient out of seventy six patient were having nonunion.

Discussion & Conclusion: Our results have been encouraging. The operation is technically demanding but provides an excellent method to achieve union in intramedullary nailing of long bones. This method to reduce fracture gap should be considered for patients requiring a faster return to function after the injury.

This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

Intramedullary nailing is the standard or ideal treatment option for fracture shaft of long bones like femur and tibia. After fixation of fracture amount of gap present in between fracture ends determines the future of union. Large residual gap at fracture site can lead to delayed union or nonunion.¹ Non union is the challenging problem to orthopedic surgeon as it requires multiple procedures thereby increasing treatment cost and patient morbidity. Various methods have been proposed to decrease fracture gap intraoperatively like avoiding too much traction, releasing traction before locking the nail, reverse hammering technique, forward striking technique etc.² During nailing intraoperatively, the

AO trauma association recommends the reverse/backstroke technique immediately after distal interlocking. But on searching English literature, when and how to use or the therapeutic effect of the technique hardly been referred. Hence this study aims to assess the effectiveness of reverse hammering on fracture union in transverse fracture of long bone nailing as well as possible complications of this method

2. Materials and Methods

We studied Seventy six patients with transverse fracture of long bone (femur, tibia, & humerus) treated with close reduction and internal fixation with interlocking nailing were enrolled in a prospective study conducted at the department of orthopaedics, BMC Sagar from Dec. 2012 to

* Corresponding author.

E-mail address: dr_raghvendra2006@yahoo.co.in (R. Choubey).

March 2021 who fulfilled the inclusion criteria.

2.1. Inclusion criteria

Adults patients; (age>18yrs and less than 50yrs), Displaced fracture of a shaft of femur, tibia, or humerus, Fractures less than two weeks old.

2.2. Exclusion criteria

Patients unfit for anesthesia, skeletally immature patients, pathological fractures, compound fractures, polytrauma patients, patients with known alcohol or drug dependency, those who knew that they would be unable to participate, those participating in other clinical trials of a drug or device were also excluded, neuromuscular disorder & Inflammatory arthritis. The mean age of 40 male and 36 females was 36.86 years (Range 18 to 50years). The most common mechanism of injury was road traffic accident, then trauma by fall. Most of cases were operated within seven days of the injury. (range 0-10days).

2.3. Surgical procedure

After obtaining written consent, patients fulfilling the inclusion criteria were taken up for close reduction and internal fixation with intramedullary locking nail. All lower limb fracture patient were done under regional anaesthesia. Out of the 11 humerus fracture patients, 4 of them underwent general anesthesia and the rest 7 underwent ultrasound-guided brachial plexus block. Using standard technique for close reduction and interlocking intraedullary nail was done after reaming the canal. Nail which was one size less than the biggest size reamer used to ream the canal was put intramedullary and placement was confirmed with intraoperative C Arm machine. During operation fracture gap was assessed and after locking distal screw reverse or back hammering was done till fracture gap was closed subjectively, then only both static as well as dynamic proximal locking was done. Bone-grafting not done. Post-operatively, Sitting up in the bed was encouraged once the blockade effects were over as well as advised to do active and passive finger/toe as well as nearby joint motion exercises. On the 2nd postoperative, 1st check dressing was done & a radiograph was taken. On the 5th postoperative day, the 2nd check dressing was done, and the patient was discharged from the hospital if everything is fine. After splint removal patients were started on nearby joint range of motion exercises active as well as in passive form. Heavy weight lifting or weight bearing was not allowed for 12 weeks after surgery. All patients were followed up on the 11th day postoperative for stitch removal, 1month, 3 months, 6 months, and at the end of 9month post-operatively. At the time of follow-up, anteroposterior and lateral view radiographs of affected bone was taken for assessment of reduction and bony union. Range of motion

was evaluated at each visit as well as scoring was done to asses union as per Hammer criteria as shown in Table 1.³

3. Results

At the end of three month and nine month grade of union no of case wise was as shown in Table 2.

Mean time to achieve bony union was 4.5 months

In our study seven out of seventy six patient at the end of three month were having radiological grade three or less union which at the end of nine month only two patient out of seventy six patient were having nonunion.

One patient from femur interlocking developed hypertrophic type nonunion at the end of nine months he was revised with exchanged nailing after nine month One patient of tibial interlock developed superficial skin infection on 5th postoperative day he was immediately taken to operation theatre and thorough wound wash was given after opening sutures which was controlled around 10th postoperative day, then secondary closure was done and rest of the period was unremarkable. One patient from humerus interlock developed iatrogenic fracture during reverse hammering which is gone into nonunion at the end of nine months. After study period is over she was revised with plating and bone grafting. So overall complication was reported in three patients. There were no supraspinatus tendon irritation or rupture, implant failure, or nerve palsy.

So at the end of nine month followup period two cases gone into nonunion out of seventy six patients

4. Discussion

For closed displaced fractures of long bones diaphysis preferred method of treatment is closed reduction and intramedullary nailing.^{1,2} After fixation of fracture amount of gap present in between fracture ends is the major factor in determination of union.^{4,5} Various methods have been proposed to decrease fracture gap intraoperatively like avoiding too much traction, releasing traction before locking the nail, reverse hammering/backstroke technique, forward striking technique etc.^{2,4} Drosos GI said that after fixation of fracture if gap is more than 3mm in tibial diaphysis then chances of non union are there.⁶ Ferrara F et al did a study over remaining fracture gap in humerus diaphysis fracture and observed less callus formation in distracted fracture ends.⁷ We evaluated backward hammering technique to reduce the fracture gap and possible complications. It avoids the need of dynamization thus risk of second surgery around 8-12 weeks. In our study seven out of seventy six patient at the end of three month were having radiological grade three or less union which at the end of nine month only two patient out of seventy-six patient were having nonunion one may be because of complication of iatrogenic fracture during reverse hammering. As compared to Lim SJ forward striking technique where they achieved bony union in all

Table 1: Radiological classification of fracture healing according to Hammer et al

Grade	Callus formation	Fracture line	Stages of Union
1	Homogenous bone struture	Obliterated	Achieved
2	Massive. Bone trabeculae crossing fracture line	Barely Discernible	Achieved
3	Apparent. Bridging of fracture line	Discernible	Uncertain
4	Trace. No bridging of fracture line	Distinct	Not Achieved
5	No callus formation	Distinct	Not Achieved

Table 2:

Bone	Grade 1 union		Grade 2 union		Grade 3 union		Grade 4 union		Grade 5 union		Total no. of Cases	
	At 3 months	At 9 months	At 3 months	At 9 months	At 3 months	At 9 months	At 3 months	At 9 months	At 3 months	At 9 months	At 3 months	At 9 months
Femur	14	27	17	5	1	0	0	0	1	1	33	33
Tibia	10	23	20	9	1	0	1	0	0	0	32	32
Humerus	3	6	5	4	1	0	1	0	1	1	11	11
Total	27	56	42	18	3	0	2	0	2	2	76	76

twenty cases, with a mean time of 5.7 months which is quite higher than our study here we achieved in mean time of 4.5 months, there sample size is less as compared to our study.⁸ Probably because of after reducing the gap and fixing nail in static mode provides better fixation, rotational control over the fixed bone fracture as well as fracture surfaces are in contact with axial loading and get a better chance of union. Weakness of studies were involving three long bones in study rather than involving single long bone, reaming in all cases which may promote union as reaming has local bone graft effect as well as increase inner wall and nail contact area leads to increased mechanical stability.

5. Conclusion

Our results have been encouraging. The operation is technically demanding but provides an excellent method to achieve union in intramedullary nailing of long bones. Reduction is maintained in due course of time. Early return to functional activity can occur with vigorous physiotherapy. Based on our results, we opine that reverse hammering method to reduce long bone diaphyseal transverse type fracture gap should be considered for patients requiring a faster return to function after the injury with due care of iatrogenic fracture. However, role of reverse hammering in long oblique or spiral long bone diaphyseal fracture is inconclusive and needs further studies to prove or disprove its role.

6. Conflict of Interest

None.

7. Source of Funding

None.

References

1. Ma YG, Hu W, Hu F. Surgical factors contributing to nonunion in femoral shaft fracture following intramedullary nailing. *Chin J Traumatol.* 2016;19(2):109–12.
2. Rommens PM, Hessmann MH. Intramedullary Nailing: A Comprehensive Guide. London: Springer Verlag; 2015.
3. Hammer RR, Hammerby S, Lindholm B. Accuracy of radiologic assessment of tibial shaft fracture union in humans. *Clin Orthop Relat Res.* 1985;(199):233–8.
4. Lee Q, Zeng B, Luo CF, Wang JW, Lu NJ. Backstroke technique: an effective way to improve the healing of tibia fracture. *Int Orthop.* 2006;30(5):329–32.
5. Bhandari M, Guyatt GH, Swiontkowski MF. Surgeon's preferences for the operative treatment of fractures of the tibial shaft. *J Bone Joint Surg [Am].* 2001;83(11):1746–52. doi:10.2106/00004623-200111000-00020.
6. Drosos GI, Bishay M, Karnezis IA, Alegakis AK. Factors affecting fracture healing after intramedullary nailing of the tibial diaphysis for closed and grade I open fractures. *J Bone Joint Surg Br.* 2006;88(2):227–31. doi:10.1302/0301-620X.88B2.16456.
7. Ferrara F, Biancardi E, Touloupakis G, Bibiano L, Ghirardelli S, Antonini G, et al. Residual interfragmentary gap after intramedullary nailing of fragility fractures of the humeral diaphysis: short and midterm term results. *Acta Biomed.* 2019;90(4):432–8. doi:10.23750/abm.v90i4.7315.
8. Lim SJ, So SY, Yoon YC, Cho WT, Oh JK. A forward-striking technique for reducing fracture gaps during intramedullary nailing: A technical note with clinical results. *Injury.* 2015;46(12):2507–11. doi:10.1016/j.injury.2015.08.024.

Author biography

Raghvendra Choubey, Associate Professor  <https://orcid.org/0000-0002-6596-608X>

Gaurav Agarwal, Assistant Professor  <https://orcid.org/0000-0002-0302-7597>

Rajesh Kumar Jain, Professor  <https://orcid.org/0000-0001-5902-5382>

Cite this article: Choubey R, Agarwal G, Jain RK. Effect of reverse hammering on fracture union in transverse fracture of long bone nailing. *Panacea J Med Sci* 2023;13(2):501–503.