

ROLE OF AUGMENTATION PLATING & BONE GRAFTING IN NON-UNION FEMORAL SHAFT FRACTURE AFTER NAILING

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Abstract

Background: Non-union of femur shaft fractures after intramedullary nail is rare and this study aims to evaluate the role of augmentation plating with bone grafting with retention of nail in such cases. **Materials and Methods:** 20 patients with aseptic non-union femur shaft fracture initially treated by interlocking femur nail included in this study. All patients were treated by augmentation plating with bone grafting with nail in situ. Patients were followed-up at regular interval clinically, radiologically and functionally. **Result:** All 20 patients achieved union at an average duration of 20 weeks (range 16-24 weeks) without any significant complication. All patients showed good to excellent functional results. **Conclusion:** Augmentation plating with bone grafting with femur nail in situ is an effective method of management for non-union femur shaft fractures after nailing.

INTRODUCTION

Femoral shaft fractures usually occur due to high velocity trauma. Femoral interlocking nail is the treatment of choice for these fractures. Non-union after interlocking nail is not very common in these fractures but may occur due to certain factors like soft-tissue damage, segmental fracture, diabetes, smoking, comminuted fracture, fracture distraction, nail size etc. incidence of non-union in these fractures after IMN is about 8-10%.^[1] Treatment options for management of non-union femur shaft fractures after IMN are exchange nailing with a larger diameter nail, nail removal & plating with or without bone grafting, external ring fixator. Augmentation plating & bone grafting with nail in situ is an effective method of treatment for non-union shaft femur and we evaluated the efficacy of this method by our study.

MATERIALS AND METHODS

Between 2017 to 2022, we conducted this study in our hospital and included total 20 patients of non-union femur shaft fractures with interlocking nail in situ. The study design was retrospective type and approval from institute ethical committee was taken. Informed consent from all the patients were taken. There were 12 male and 8 female patients in this study with an average age of 30 yr (range 18-45 yrs). All patient developed fracture due to high velocity trauma (RTA, fall from height). All the patients were managed by augmentation plating with bone grafting.

Patients with infected non-union shaft femur and pathological fractures were excluded from the study. The mean time from primary surgery to augmentation plating & grafting was 1 yr (range 9-15 months). The average follow-up after augmentation plating was 19 months (range 15-24 months).

Surgical technique: all the patients were treated in lateral position on a radiolucent table. Lateral incision given and TFL split. Vastus lateralis muscle elevated from lateral intermuscular septum to expose the non union site. Minimal stripping of periosteum done and non-union site freshening done. All the fibrous tissue from non-union site removed and decortication done at the non-union site. Broad dynamic compression plate applied over the non-union site and fixed with 4 proximal & 4 distal bicortical screws avoided the intramedullary nail. Bone graft taken from ipsilateral iliac crest and put at non-union site circumferentially. Wound closed in layers without surgical drain.

All the patients were allowed knee physiotherapy & partial weight bearing from next day of surgery. Patients were discharged from the hospital on 4-5 day and regular follow-up done.

RESULTS

All the patients were assessed at regular follow-up clinically, radiologically and functionally. Various parameters like age, sex, site of fracture, type of non-union, mechanism of injury, time to union, follow-up

duration, complication recorded in every patient included in this study [Table 1].

Table 1: Patients variables and observations

Patient	Age (yrs)	sex	Site of fracture	Type of nonunion	Mechanism of injury	Time to union(weeks)	Follow-up(months)	Complications
1.	32	M	Middle 1/3 rd	hypertrophic	FFH	17	21	None
2.	27	M	Upper 1/3 rd	oligotrophic	RTA	16	15	None
3.	18	F	Middle 1/3 rd	atrophic	RTA	18	24	None
4.	20	M	Distal 1/3 rd	atrophic	RTA	20	18	None
5.	22	F	Middle 1/3 rd	oligotrophic	RTA	24	19	None
6.	30	F	Distal 1/3 rd	hypertrophic	FFH	20	21	None
7.	24	M	Distal 1/3 rd	atrophic	FFH	21	23	None
8.	25	M	upper 1/3 rd	oligotrophic	RTA	16	22	None
9.	45	M	Distal 1/3 rd	atrophic	RTA	16	15	None
10.	40	F	Upper 1/3 rd	atrophic	FFH	22	24	None
11.	35	M	Distal 1/3 rd	oligotrophic	RTA	24	16	None
12.	32	M	Distal 1/3 rd	atrophic	RTA	18	17	None
13.	29	F	Middle 1/3 rd	hypertrophic	RTA	23	16	None
14.	33	F	Distal 1/3 rd	atrophic	RTA	22	15	None
15.	34	M	Distal 1/3 rd	atrophic	RTA	21	22	None
16.	29	M	Middle 1/3 rd	hypertrophic	FFH	24	18	None
17.	28	M	Upper 1/3 rd	atrophic	RTA	18	20	None
18.	26	F	Upper 1/3 rd	oligotrophic	RTA	16	17	None
19.	28	F	Distal 1/3 rd	hypertrophic	RTA	23	16	None
20.	43	M	Distal 1/3 rd	atrophic	FFH	21	21	None

*FFH= fall from height *RTA= road traffic accident



Figure 1: Non-union shaft femur with nail in situ (pt 1) (9 months after primary surgery).



Figure 2: Augmentation plating with bone grafting with retention of nail (pt 1) (6 months follow-up)



Figure 3: Non union shaft femur with nail in situ (patient 2)



Figure 4: Augmentation plating with bone grafting with retention of nail (patient 2) (8 months follow up)

All the patients achieved union in a mean time of 20 weeks (range 16-24 weeks). The average blood loss during the surgery was 250 ml (200-300 ml) & the mean operative time was 110 minutes (range 90-120 mins). Complication like infection, broken hardware, malalignment, limb length discrepancy did not occur in any patient. 5 patients had proximal 1/3rd fracture, 5 had middle 1/3rd fracture and 10 patients had distal 1/3rd fracture. Mostly patients had atrophic or oligotrophic type of non-union (75%) while 5 patients (25%) had hypertrophic non-union.

DISCUSSION

Femoral shaft fractures are usually managed by interlocking nail and have excellent results in terms of union rate. It also provides advantage of early weight bearing, less blood loss, shorter duration of hospital stay. But sometimes femur shaft fractures

managed with interlocking nail fails and land up into non-union. There are several options to manage femoral shaft non-union such as exchange reamed nailing, nail removal and plate application with bone grafting, illizarov fixator, plate augmentation with bone graft leaving the nail in situ.

Exchange nailing with larger diameter nail is a good option for non-union management and achieved high union rate. Furlong et al,^[2] conducted a study where exchange nailing was done in 25 patients for non-union femoral shaft fractures and 96% patients achieved union. In another study, D J Hak et al,^[3] concluded that exchange reamed nailing is the treatment of choice for most diaphyseal non-union and achieved union rate of 78.3%. They also observed that tobacco use appears to have an adverse effect on non-union healing after exchange nailing. Swanson et al,^[4] in their study concluded that systematic approach of exchange nailing for the treatment of aseptic femoral non unions resulted in 100% healing rate. However M J Weresh et al,^[5] in their study concluded that re-evaluation of routine exchange nailing as the recommended treatment for aseptic femoral non-union may be required because a significant number of patients require additional procedures to achieve fracture union. Hua Luo et al,^[6] in a meta-analysis of 232 pts concluded that augmentation plate is superior to exchange nailing for femoral shaft non-union. Augmentation plating had a lower non-union rate, shorter time to union, less intraoperative blood loss and shorter operative time than exchange nailing. Po-Ju Lai et al,^[7] in their study of 96 patients with femoral shaft atrophic non-union concluded that augmentation plating achieved higher union rate in comparison to exchange nailing especially for non-isthmic femoral shaft non-union. Augmentation plating with bone grafting with retention of nail has many benefits over other available methods. Advantage of this technique include shorter surgical time, no need of fracture reduction, early weight bearing, less blood loss, better & faster union rate. Chin-Jung Lin et al,^[8] in their study of 22 patients concluded that plate augmentation with autologous bone grafting with retention of nail may be an effective & reliable method of treatment for non-union femoral shaft management. All the patients achieved union and no patient developed any significant complication. Ali Yeganeh et al,^[9] conducted a study of 35 patients of femoral shaft non-union with nail in situ where all the patients were treated by plate augmentation. Patients with oligotrophic or atrophic non-union also received iliac crest bone grafting. All the patients achieved bony union. They concluded that plate augmentation is an effective and safe treatment option for non-union of femoral shaft fractures. In another study, Mohamed A. Mohamed et al,^[10] concluded plate augmentation and bone grafting is an effective and reliable method for management of non-union femoral shaft fractures. Yao-Feng Jin et al,^[11] in a meta-analysis of five RCTs with a total of 506 patients (232 pts in augmentation plating group &

256 in exchange nailing group) found that augmentation plating is superior for non-union femoral shaft fractures both intra-operatively (shorter operative time & less blood loss) and post-operatively (higher union rate, shorter union time, lower complication rate).

In our study, we did augmentation plating with bone grafting with nail retention and achieved 100% union rate. no patient developed any serious complication. We used broad DCP plate in all the patients. We achieved union rate comparable to other published literature on plate augmentation with bone graft in non-union femoral shaft fractures. [Table 2].

Table 2: comparable studies

Reference study	No of patients	Mean age (yrs)	Union rate	Mean follow-up (months)	Mean time to union (months)
Vaishya et al(2016)12	16	36	100 %	9.62	6.25
M.A. Mohamed et al(2022)10	20	32.4	100%	13	4.9
C.J.Lin et al(2012)8	22	34.3	100%	17.2	5.15
H.R. Jhunjhunwala et al13	40	35	97.5 %	12	4

There are some limitations of our study like small sample size, no control group, single centre retrospective study. Therefore a large scale prospective case-control study or meta-analysis is required to show the effectiveness of augmentation plating with bone grafting for non-union femur shaft fractures and its superiority over exchange nailing.

CONCLUSION

The current literature and our study showed that augmentation plating with bone grafting with retention of nail is an effective method for management of non-union femoral shaft fractures.

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