

## Original Research Article

# Prospective study of managing long bone fracture nonunion: is bone graft needed in every case?

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**Received:** 21 April 2018

**Revised:** 06 May 2018

**Accepted:** 08 May 2018

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## ABSTRACT

**Background:** Increased road traffic accidents lead to increased incidence of fracture of long bones. It has a tendency of non-union. Infection is very common in these cases which are an important cause of nonunion of long bone fractures. The objective of the study was to study the incidence and patterns of non-union of long bone fracture.

**Methods:** Hospital based prospective study was carried out at Department of Orthopedics, from June 2017 to March 2018. Patients admitted to wards of Department of Orthopedics with nonunion of long bones were included. During the study period a total of 20 cases were eligible for the present study as per the inclusion and exclusion criteria.

**Results:** Males were more affected than females. Most commonly affected age group was 41-50 years and 61-70 years (25% each). Most commonly affected long bone was femur in 35% of the cases. Most common type of non-union was hypertrophic (50%). Most common cause of non-union was broken implant in 35% of the cases. Maximum number of patients had union in 4-6 months in 60% of the cases after surgery of previous non-union of long bones. Only four patients developed complications like shortening of the limb or persistent non-union.

**Conclusions:** Hypertrophic non unions doesn't require bone graft, they require only stable fixation. For removal of broken implant in hypertrophic non-union if we open the fracture site, then even the gap after debridement of fracture site shows partial segmental defect it doesn't require bone grafting.

**Keywords:** Long bone, Nonunion, Hypertrophic, Atrophic

## INTRODUCTION

"A nonunion exists when repair is not complete within the period expected for a specific fracture and when cellular activity at the fracture site ceases and there are no visible progressive signs of healing for 3 months".<sup>1</sup>

Another definition is given by "American Food and Drug Administration". According to them when there are no healing signs nine months after injury for continuous 3 months. But these definitions are difficult to practice. The orthopedic surgeon will modify the actual meaning of nonunion depending upon various factors.<sup>2</sup>

The incidence of nonunion depends upon many factors. These factors can be type of fracture, bone affected, individual patient factors affect the healing of bones which can land the patient in nonunion. Other important factors like occurrence of infection, movement of the affected part by the patient against medical advice, lack of blood supply, persistent gap leads to the nonunion of fractures of bones. Pain is the predominant feature in fractures of nonunion of long bones. It is also associated with adverse functions. Patient is not able to perform his routine activities.<sup>3</sup>

Increased urbanization, increase in number of vehicles, not following traffic rules is leading to road traffic

accidents. This is the reason for increased incidence of fracture of long bones. Fracture of long bones has a tendency of nonunion. They have to undergo operations many times. Infection is very common in these cases which are an important cause of nonunion of long bone fractures.<sup>4</sup>

Present study was undertaken to study the incidence, patterns, type, causes of nonunion of fracture of long bones. At the same time against usual dictum that all atrophic type of nonunion of long bones should be operated with bone graft only, we attempted, depending upon the certain factors, not to use the bone graft in atrophic cases in certain cases and study the outcome of it.

## **METHODS**

### ***Type of study***

Hospital based prospective study.

### ***Study place***

Department of Orthopedics, RVM Medical College and Hospital.

### ***Study duration***

From June 2017 to March 2018.

### ***Study population***

Patients admitted to wards of Orthopedics department with nonunion of long bones.

### ***Ethical considerations***

Institutional Ethics Committee permission was obtained. Ethically all patients were informed that their names will not be disclosed but data will be used for presentation. They will be given complete follow up after surgery. Once the patients agreed upon, their data was included in the present study.

### ***Inclusion criteria***

Inclusion criteria were all ages; nonunion following failed internal fixation; neglected nonunions; infected non unions; deformed non unions.

### ***Exclusion criteria***

Exclusion criteria were segmental bone defects leading to nonunion >2 cm; pathological fracture non unions.

### ***Sample size***

During the study period of June 2017 to March 2018, a total of 20 cases were eligible for the present study as per

the inclusion and exclusion criteria and those who consented to put their data in the present study.

### ***Study procedure***

Only those patients with history of nonunion of long bones were included in the present study. Such patients were enquired for details like age, sex, bone affected, and other demographic details as per the pre designed, pre tested, and semi structured study questionnaire developed for the present study.

On clinical examination and investigations like x-ray, the type of nonunion and cause of nonunion was determined.

After complete surgical profile, and fitness for the surgery, the patients were operated adopting standard operative procedures. Blood loss was noted during the surgery and documented. Anesthesia- epidural is preferred. Long duration is anticipated for surgery. At least 2 units of whole blood are reserved. Counselling of the patient and the attendees regarding the procedure of the surgery and expected complications and need for multiple surgeries in future should be explained. Monitoring of pulse rate is very crucial as rise in pulse rate is early indicator of intra-operative blood loss. Mop count, Blood pressure monitoring. Neglected nonunion lead to disuse osteoporosis hence leading to fragile bones. Hence excess soft tissue release is done for good alignment and reduction. Each fragment should be released completely from the soft tissue from all the sides. Release the soft tissue before reaming the medullary canal. Fracture ends are freshened until paprika's sign is positive. Ream the medullary canal in both the fragments. Note the size of the defect after freshening of the fracture ends then depending on size of the defect bone graft is harvested. In hypertrophic nonunion, no bone graft is used. In atrophic non unions cortical and cancellous graft is used. In case of nonunion tibia only 2-3 cm fibulectomy was done. In need of cortical graft depending on length of segmental defect fibula was harvested. Broken intra medullary nails are removed by following rail road technique. If we are unable to remove the broken implants like screws or nail it doesn't matter if it doesn't interfere with current line of management. In case of failed internal fixation with hypertrophic nonunion- do not open the fracture site unless the broken implant need to be removed though the fracture site.

Patients were followed till complete union. They were asked to visit at regular intervals and follow up X-rays were taken. Outcome was noted in these patients with regard to complete union, persistent nonunion, shortening of the affected limb etc.

The data was entered in the Excel worksheet and analyzed using proportions.

## **RESULTS**

Males were more affected than females. Male to female ratio was 2.3:1. Most commonly affected age group was 41-50 years and 61-70 years (25% each). Older age group was found to be commonly affected due to increased fragility of the bones. In males 61-70 years was most commonly affected due to increased bone fragility. In females, 41-50 years was affected as it is the menopausal age group and they are susceptible to acute osteoporosis.

Most commonly affected long bone was femur in 35% of the cases followed by tibia in 30% of the cases. Humerus was found to be affected in 20% of the cases.

Most common type of nonunion of long bones in the studied cases was hypertrophic in half of the cases. This was followed by atrophic type in 40% of the cases. Oligotrophic type of nonunion is very rare and seen in only two cases in the present study.

**Table 1: Age and sex wise distribution of cases.**

Age (years)	Male		Female		Total	
	Number	%	Number	%	Number	%
10-20	02	14.3	0	0	02	10
21-30	02	14.3	0	0	02	10
31-40	03	21.4	01	16.7	04	20
41-50	02	14.3	03	50	05	25
51-60	01	7.1	01	16.7	02	10
61-70	04	28.6	01	16.7	05	25
Total	14	70	06	30	20	100

**Table 2: Bones affected in the study subjects.**

Bones affected	Number	%
Femur	7	35
Tibia	6	30
Humerus	4	20
Femur and tibia	1	5
Ulna	1	5
Both bone forearm	1	5
Total	20	100

**Table 3: Types of nonunion in the cases.**

Type of non union	Number	%
Hypertrophic	10	50
Atrophic	8	40
Oligotrophic	2	10
Total	20	100

**Table 4: Causes of nonunion in the cases.**

Causes of nonunion	Number	%
Broken implant	7	35
Infection	5	25
Broken nail	3	15
Neglected	3	15
Implant in situ	2	10
Total	20	100

Most common cause of nonunion of long bones was broken implant in 35% of the cases followed by infection in 25% of the cases. Broken nail and neglect were the causes of nonunion in 15% of the cases each. Only two cases of nonunion were found due to implant in situ.

Majority of the patients were managed with blood loss less than 1000 ml in 70% of the cases. Maximum number of patients had union in 4-6 months in 60% of the cases after surgery of previous nonunion of long bones. Only four patients i.e. 20% of the cases developed

complications like shortening of the limb or persistent non union

The patients diagnosed as having long bone nonunion in previous surgeries, were operated and outcome was studied. It was found that the outcome was good in 80% of the cases. Only in two cases each there was shortening or persistent nonunion.

Generally bone graft is not required in hypertrophic and oligotrophic cases. In the present study also we did not use bone graft in these cases. Usually all cases of atrophic nonunion require bone graft. But we did not use it in three cases and on follow up there were no complications reported in these cases. Hence we were successfully able to avoid use of bone graft in atrophic cases depending upon the patient condition without any complications.

**Table 5: Postoperative features of operated cases of long bone nonunion.**

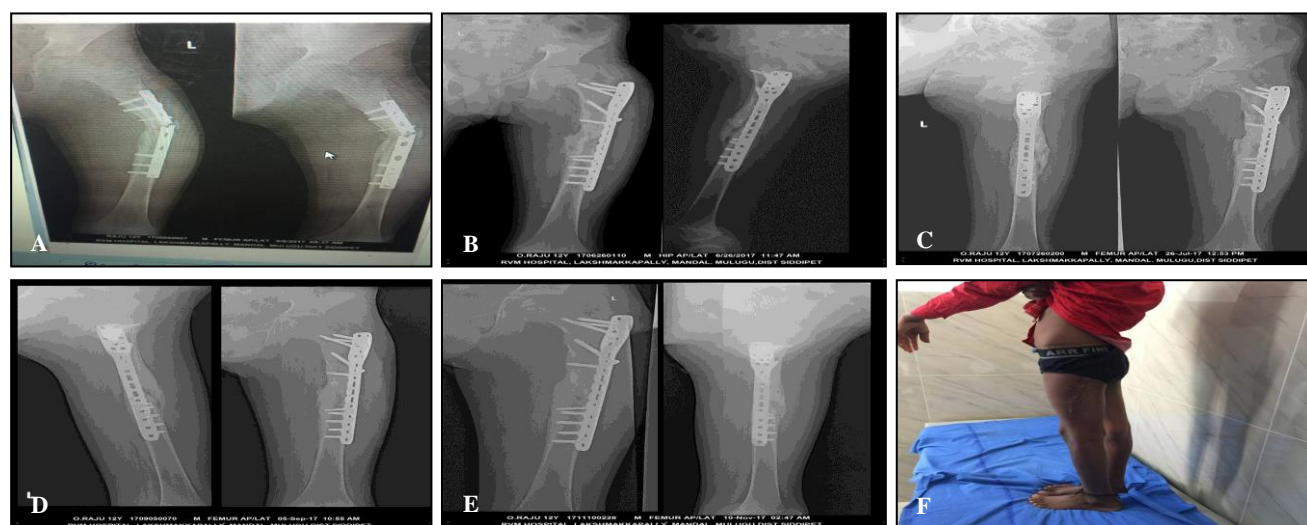
Postoperative features		Number	%
Blood loss	<1000 ml	14	70
	>1000 ml	06	30
Time taken for union after surgery	<4 months	2	10
	4-6 months	12	60
	6-9 months	6	30
Complications developed after surgery	Shortening	2	10

**Table 6: Outcome of surgery in cases of long bone nonunion.**

Outcome	Number	%
Complete union	16	80
Persistent nonunion	2	10
Shortening	2	10
Total	20	100

**Table 7: Type of nonunion and bone graft used.**

Type of nonunion	Bone graft required				Total	
	Yes		No			
	Number	%	Number	%	Number	%
Hypertrophic	0	0	10	100	10	50
Oligotrophic	0	0	2	100	2	10
Atrophic	5	62.5	3	37.5	8	40
Total	5	25	15	75	20	100



**Figure 1: Follow up X-rays of same patient. (A) pre-op X-ray; (B) post-op X-ray; (C) X-ray after 2 months; (D) X-ray after 4 months; (E) X-ray after 7 months; (F) patient was able to stand at 7 months.**

## DISCUSSION

Males were more affected than females. Male to female ratio was 2.3:1. Most commonly affected age group was 41-50 years and 61-70 years (25% each). Older age group was found to be commonly affected due to increased fragility of the bones. In males 61-70 years was most commonly affected due to increased bone fragility. In females, 41-50 years was affected as it is the menopausal age group and they are susceptible to acute osteoporosis. Most commonly affected long bone was femur in 35% of the cases followed by tibia in 30% of the cases. Humerus was found to be affected in 20% of the cases. Most common type of nonunion of long bones in the studied cases was hypertrophic in half of the cases. This was followed by atrophic type in 40% of the cases. Oligotrophic type of nonunion is very rare and seen in only two cases in the present study. Most common cause of nonunion of long bones was broken implant in 35% of the cases followed by infection in 25% of the cases. Broken nail and neglect were the causes of nonunion in 15% of the cases each. Only two cases of nonunion were found due to implant in situ. Majority of the patients were managed with blood loss less than 1000 ml in 70% of the cases. Maximum number of patients had union in 4-6 months in 60% of the cases after surgery of previous nonunion of long bones. Only four patients i.e. 20% of the cases developed complications like shortening of the limb or persistent nonunion. The patients diagnosed as having long bone nonunion in previous surgeries, were operated and outcome was studied. It was found that the outcome was good in 80% of the cases. Only in two cases each there was shortening or persistent nonunion. Generally bone graft is not required in hypertrophic and Oligotrophic cases. In the present study also we did not use bone graft in these cases. Usually all cases of atrophic nonunion require bone graft. But we did not use it in three cases and on follow up there were no complications reported in these cases. Hence we were successfully able to avoid use of bone graft in atrophic cases depending upon the patient condition without any complications.

Seenappa et al found that in the number of cases they operated for nonunion of long bone fractures the union rate was 89.28% which is comparable to the findings of the present study where we found complete union taking place in 80% of the cases.<sup>5</sup> They reported that they had poor results in 10% of the cases which is half than the findings of the present study where we found that the poor results were encountered in 20% of the cases.

Ebraheim et al reported that the union rate was only 57% which is lower than the findings of the present study where we found complete union taking place in 80% of the cases.<sup>6</sup> They used the ORIF revision in some cases.

Holzman et al reported that the complication rate in their study was 30% which is higher than the findings of the present study where we found complication rate was 20%

of the cases.<sup>7</sup> Just the findings of the present study, this study also reported a very good union rate but slightly more rate of complications.

Egol et al carried out a follow up study where they followed 80 patients.<sup>8</sup> The infection rate was 21%. The authors found that the time taken for complete union in all patients on an average was 18.7 months with a range of 12-36 months. The union rate in their study was 90% which is slightly more than the findings of the present study we found complete union taking place in 80% of the cases.

Collinge et al followed patients for two years.<sup>9</sup> In patients with acute fracture, the average time taken for union was 9.5 weeks. It was more in patients who were operated for nonunion and the mean time taken for union of such patients was 10.5 weeks. The authors stated that the functional outcomes were excellent in their study.

El Haj et al observed that the union rate was 100% in their study which is higher than the findings of the present study where we achieved a complete union rate of 80%.<sup>10</sup> The authors noted that the average time for complete union was 5.8 months with a range of two to 24 months. They have to do the repeat double plating in one case. They found that the culture positivity was 50%.

Egol et al followed 134 patients for a period of one year.<sup>11</sup> The rate of complication in their study was 11% which is slightly lower than the findings of the present study where we reported a complication rate of 20%. The authors noted that more the experienced surgeon more was the healing rate. Patients with complications were less likely to have complete union. The union was not found to be related to other factors.

## CONCLUSION

Hypertrophic non unions doesn't require bone graft, they require only stable fixation. For removal of broken implant in hypertrophic nonunion if we open the fracture site, then even the gap after debridement of fracture site shows partial segmental defect it doesn't require bone grafting. If we are unable to remove the broken implants like screws or nail it doesn't matter if it doesn't interfere with current line of management. Need to have sound knowledge in knowing the cause of nonunion. Need to wait for 6-9 months for the fracture to unite post intervention. Need to keep blood reserve 2 to 3 units whole blood before start of surgery. Long duration of surgery must be anticipated before and should be done with epidural anesthesia.

*Funding: No funding sources*

*Conflict of interest: None declared*

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



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**Cite this article as:** Balagani S. Prospective study of managing long bone fracture nonunion: is bone graft needed in every case? *Int J Res Orthop* 2018;4:556-61.