

## Original Research Article

# Functional outcome of non-vascularized fibula in gap non union

Amit Kumar Yadav\*, Eknath Pawar, Prasanna Kumar G. S., Akash Mane,  
Abhishek Harssor, Vipul Shet, Sagar Bansal

Department of Orthopaedics, Grant Government Medical College, Mumbai, Maharashtra, India

**Received:** 28 October 2019

**Revised:** 17 December 2019

**Accepted:** 18 December 2019

**\*Correspondence:**

Dr. Amit Kumar Yadav,

E-mail: [amit\\_aur09@yahoo.com](mailto:amit_aur09@yahoo.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### ABSTRACT

**Background:** Gap non-union is one of the most perplexing problems facing the orthopedic surgeon today. Fibula is the preferred site of non-vascularized bone graft due to its easy accessibility to surgical resection and minimal donor site complications.

**Methods:** The study comprised 11 patients of gap non-union between 13 to 80 years (mean=34.9 years). The fibular graft was harvested from the mid shaft and cortico-cancellous bone graft taken from the iliac crest was applied at both ends of the fibular graft to aid in union.

**Results:** The average bone gap was 7 cm (4-13 cm). 64% of the patients achieved bone union after the first procedure, of the remaining 4 patients, 1 patient showed union after secondary cortico-cancellous bone grafting, while two are planned for the same. The remaining one patient has only completed 16 weeks follow-up at present and is not showing signs of union at present. Functional range of motion was achieved in both the proximal and distal joints in all cases.

**Conclusions:** Non-vascularized fibular bone grafting is a simple and effective treatment option which does not require any special skill, has a very low complication rate and has very high patient compliance.

**Keywords:** Gap non-union, Non-vascularized fibula, Bone graft

### INTRODUCTION

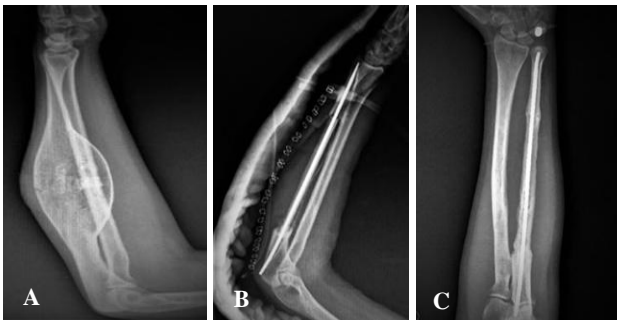
Gap non-union is one of the most perplexing problems facing the orthopedic surgeon today due to the advancements in trauma and tumor diagnosis and management. Gap non unions may be caused either by trauma, tumor excision or bone loss due to osteomyelitis. Fibular bone graft with metallic implant stabilization is one of the definitive managements in gap non unions.<sup>1-3</sup> The other effective method is Illizarov ring fixator or monorail systems, using the principle of distraction osteogenesis.<sup>4-6</sup> But compared to fibular grafting, fixators have morbidity associated with them, need expertise for application and also have low patient compliance. Fibula is the preferred site of non-vascularized bone graft due to

its easy accessibility to surgical resection and minimal donor site complications.<sup>7</sup> Fibular grafting therefore due to the above mentioned advantages is the better technique in developing countries where the necessary infrastructure and skill may not always be available and patient compliance to follow up is poor. The aim of study is to evaluate functional outcome of non-vascularized fibular graft in gap non-union.

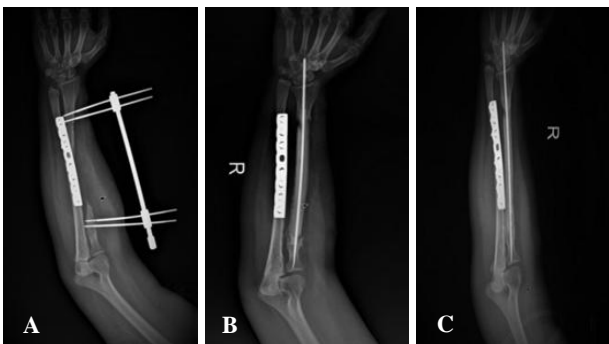
### METHODS

We conducted a retrospective study in Grant Medical College and Sir JJ group of hospitals Mumbai from August 2016 to May 2019 which included 11 patients of gap non-unions. The age of the patients ranged between

13 to 80 years (mean=34.9 years). Of the 11 patients 5 (45%) were male and 6 (55%) females. The average bone gap was 7 cm (4-13 cm). The technique involved thorough debridement and clearance of fibrotic tissue and crushed devitalized bone or tumor to create a gap. The fibular graft was harvested from the mid shaft region under tourniquet using the standard postero-lateral approach. For tibial and fibular defects, the contralateral leg was used as a donor site. The graft was fixed at the site of gap using plate and screws in 7 (64%) patients, Tens nail in 3 patients and monorail system (LRS) in one patient (Figures 1 and 2). Cancellous bone graft taken from the iliac crest was applied at both ends of the fibular graft to aid in union.



**Figure 1:** (A) A 25 year female presented with a chronic slowly growing swelling of the left forearm which on further investigations was found to be fibrous dysplasia of the ulna; (B) patient underwent complete resection of the tumor with non-vascularized fibular graft interposition with fixation with TENS nail (immediate post-op radiograph); (C) a 24 week follow up shows complete integration of the graft with union at both ends.



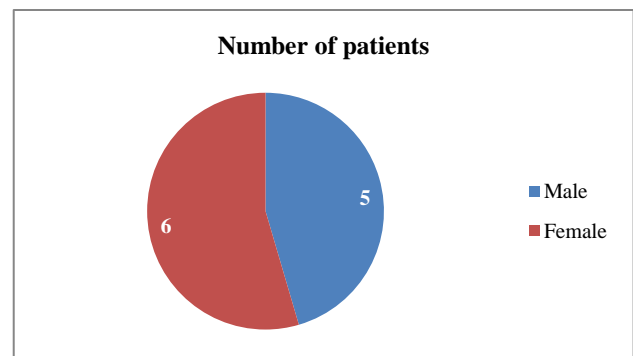
**Figure 2:** (A) 24 year female presented to us with bone loss in the radius due to osteomyelitis developed in a case of plating for radius and ulna where in the radius plate got infected and was removed along with infected bone and exfixator was done; (B) after confirming the non infective nature of the tissue by various blood parameters and local bone biopsy, we operated the patient with local debridement followed by non-vascularised fibular bone graft and fixed it with a tens nail (immediate post-op); (C) 24 weeks follow-up radiograph reveals complete union at both ends.

Postoperatively limb was immobilized for variable period's minimum being 6 weeks in appropriate slab or cast. All patients were given Intravenous antibiotics in perioperative period and continued post operatively for 48 hours to 7 days depending on surgical site condition. Post 48 hours patients were shifted on oral antibiotics for 5 days. Follow up was conducted at 1 ½ months, 3 months, 6 months, 9 months, and 12 months and later at 6 monthly intervals till the time of submission of this article. Follow up focused on identifying complications and conducting serial radiographs to assess union. In doubtful cases, a metal artifact reduction system-computed tomography scan was done to assess union.

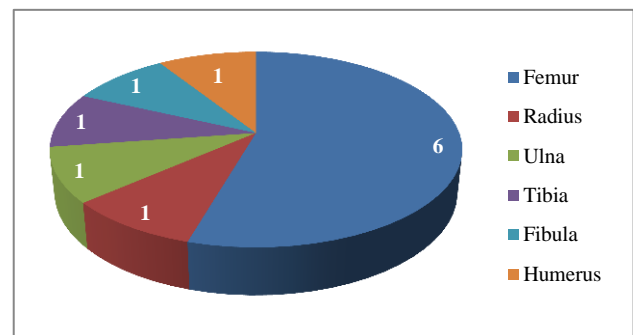
The statistical analysis was done by using SPSS-20.

**RESULTS**

Out of the 11 patients included in the study, 5 (45%) were males and 6 (55%) were females (Figure 3). Of the 11 patients with gap nonunion, 6(55%) involved the femur, 1 tibia, 1 fibula, 1 humerus, 1 radius and 1 ulna (Figure 4). Of the 11 gap non unions 7 (64%) were due to trauma, 2 were due to tumor excision, 2 were due to osteomyelitis (Figure 5).



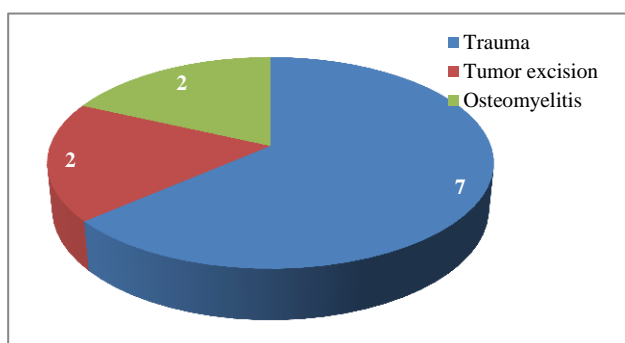
**Figure 3:** Sex distribution.



**Figure 4:** Distribution according to bone involved.

The patients were followed up for a mean period of 56 weeks (24 to 80 weeks). The average bone gap was 7 cm (4-13 cm). 64% of the patients achieved bone union after the first procedure. One of these, a case of radius shaft osteomyelitis managed with excision and fibular bone grafting with tens nail, developed a superficial infection

at the surgical incision site which was managed with five days of intravenous antibiotics followed by oral antibiotics. Patient had an uneventful course with bony union achieved at 24 weeks. Of the remaining 4 patients, one patient a case of femur shaft gap non-union managed with fibular strut graft with distal femur plating in an operated case of bipolar hemi-arthroplasty, the patient had a stress fracture at the tip of the bipolar prosthesis at 54 weeks follow-up due to weight bearing which further complicated the union process resulting in non-union till present follow up at 74 weeks. Another patient a case of femur shaft gap non-union operated with fibular strut graft with angle blade plating showed signs of graft resorption from site at around 50 weeks follow up. This was managed with multiple sittings of bone marrow aspiration and injection over the fibular graft followed by one sitting of tricortical bone graft, harvested from the iliac crest, at the resorption site. This patient achieved union at 18 weeks following the second grafting surgery. In a similar case of resorption following being operated for a similar fracture, was still found to be in non-union at present follow up of 80 weeks and is now planned for bone marrow aspiration and injection followed by bone grafting. In the latest case of tibia shaft gap non-union due to trauma, fibular bone grafting with monorail system or limb reconstruction system (LRS) was attempted with a patient. Present follow up of 16 weeks still not showing any signs of union, but this patient needs subsequent follow ups to assess the same.



**Figure 5: Cause of gap nonunion.**

The average limb shortening was 2 cm with a range of 0.5 cm to 3.5 cm. Range of motion in both the proximal and distal joint was full and free in both the proximal and distal joints in 9 out of 11 patients while the remaining 2 patients presented with a painful and stiff joint. This was corrected with extensive physiotherapy and the patient gained functional range of motion. The donor site wound healed with no complication as a rule in all patients further reinforcing the fact that fibular graft harvesting is a comparatively safe and effective procedure.

## DISCUSSION

Non-vascularised fibular grafting has been used to treat bone defect for a long time. Removal of fibula did not cause any complication in the donor leg. Non-vascularised fibular grafting is a simple procedure. The

procedure is relatively easy and has much better patient compliance when compared to other methods of treating bone defect like bone lengthening procedures using ilizarov.

Free non-vascularised fibular grafting has been used in post-traumatic bone defects. Swamy et al in their study including 20 patients, from the pediatric age group, reported a union rate of 80% following first surgery and in the remaining 4 patients union was achieved after the second procedure of bone grafting.<sup>8</sup> Patwardhan et al in their series of 26 pediatric patients of gap non-union, reported union in 24 patients (92%) with 2 patients undergoing delayed union requiring secondary procedures.<sup>9</sup> They concluded that the procedure was simple, not requiring any special skill with a very low complication rate. Lenze et al concluded that the procedure was a valuable procedure in defects less than 12 cm in length with an excellent union rate with minimum complications.<sup>10</sup>

El-Sayed et al in a study of 12 patients with post traumatic bone defects, reported union in 11 cases (union rate of 92%) in an average period of 4 months.<sup>11</sup> They used plate and screws for upper limb defects and external fixators for tibia with cortico-cancellous bone graft along the entire length of fibular graft to augment graft uptake. Morsi et al (union in 6 out of 7, 86%), Steinlechner et al (union in 7 out of 8, 88%) and Lawal et al (union in 8 out of 10, 80%) all reported excellent results in their respective studies on non-vascularised fibular grafting concluding separately that it is a comparatively simple procedure with excellent results.<sup>12-14</sup> Al Zahrani et al in his study on 27 patients with varied etiologies leading to bone gap concluded that non vascularised fibular graft is a safe and effective procedure to treat gap non-union with a union rate of 92%, stress fractures occurring in 26% with no significant graft hypertrophy.<sup>3</sup> As compared to all the above studies, we report similar outcomes in non-vascularized fibula grafting in gap non-unions secondary to trauma, osteomyelitis and tumor. Limitations of study are small sample size.

## CONCLUSION

From our results mentioned above we conclude that non vascularized fibular bone grafting is a simple and effective treatment option which does not require any special skill, has a very low complication rate and has very high patient compliance.

*Funding: No funding sources*

*Conflict of interest: None declared*

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

## REFERENCES

1. Enneking WF, Eady JL, Burchardt H. Autogenous cortical bone grafts in the reconstruction of

- segmental skeletal defects. *J Bone Joint Surg Am*. 1980;62:1039-58.
2. Yadav SS. Dual fibular grafting for massive bone gaps in the lower extremity. *J Bone Joint Surg Am*. 1990;72:486-94.
  3. Al-Zahrani S, Harding MG, Kremli M, Khan FA, Ikram A, Takroni T. Free fibular graft still has a place in the treatment of bone defects. *Injury*. 1993;24:551-4.
  4. Kocaoglu M, Eralp L, Rashid HU, Sen C, Bilsel K. Reconstruction of segmental bone defects due to chronic osteomyelitis with use of an external fixator and an intramedullary nail. *J Bone Joint Surg Am*. 2006;88:2137-45.
  5. Cattaneo R, Catagni M, Johnson EE. The treatment of infected nonunions and segmental defects of the tibia by the methods of Ilizarov. *Clin Orthop Relat Res*. 1992;280:143-52.
  6. De Pablos J, Barrios C, Alfaro C, Canadell J. Large experimental segmental bone defects treated by bone transportation with monolateral external distractors. *Clin Orthop Relat Res*. 1994;298:259-65.
  7. Eh Lee, Goh JC, Helm R, Pho RW. Donor site morbidity following resection of the fibula. *J Bone Joint Surg Br*. 1990;72:129-31.
  8. Swamy MKS., Rathi A, Gupta V. Results of non-vascularised fibular grafting in gap non-union of long bones in pediatric age group. *J Clin Orthop Trauma*. 2013;4(4):180-4.
  9. Patwardhan S, Shyam AK, Mody RA, Sancheti PK, Mehta R, Agrawat H. Reconstruction of bone defects after osteomyelitis with non vascularized fibular graft: A retrospective study in 26 children. *J Bone Joint Surg Am*. 2013;95:1-6.
  10. Lenze U, Kasal S, Hefti F, Krieg AH. Non-vascularised fibula grafts for reconstruction of segmental and hemicortical bone defects following meta/diaphyseal tumour resection at the extremities *BMC Musculoskeletal Disord*. 2017;18:289.
  11. El-Sayed M, El-Hadidi M, El AdlWael. Free non-vascularised fibular graft for treatment of post-traumatic bone defects. *Acta Orthop Belg*. 2007;73:70-6.
  12. Morsi E. Tibial reconstruction using a non-vascularised fibular transfer. *Int Orthop*. 2002;26:377-80.
  13. Steinlechner C, Wand M, Kandawire NC. Non-vascularised fibular transfer in the management of defects of long bones after sequestrectomy in children. *J Bone Joint Surg Br*. 2005;87:1259e1263.
- Lawal YZ, Garba ES, Ogirima MO, Dahiru IL, Maitama MI, Abubakar K, et al. Use of non-vascularized autologous fibula strut graft in the treatment of segmental bone loss. *Ann Afr Med*. 2011;10(1):25-8.

**Cite this article as:** Yadav AK, Pawar E, Prasanna Kumar GS, Mane A, Harsor A, Shet V, et al. Functional outcome of non-vascularized fibula in gap non union. *Int J Res Orthop* 2020;6:205-8.