http://jmscr.igmpublication.org/home/
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v12i03.08

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Use of Fibular Strut Graft for Reconstruction of Bone Defects

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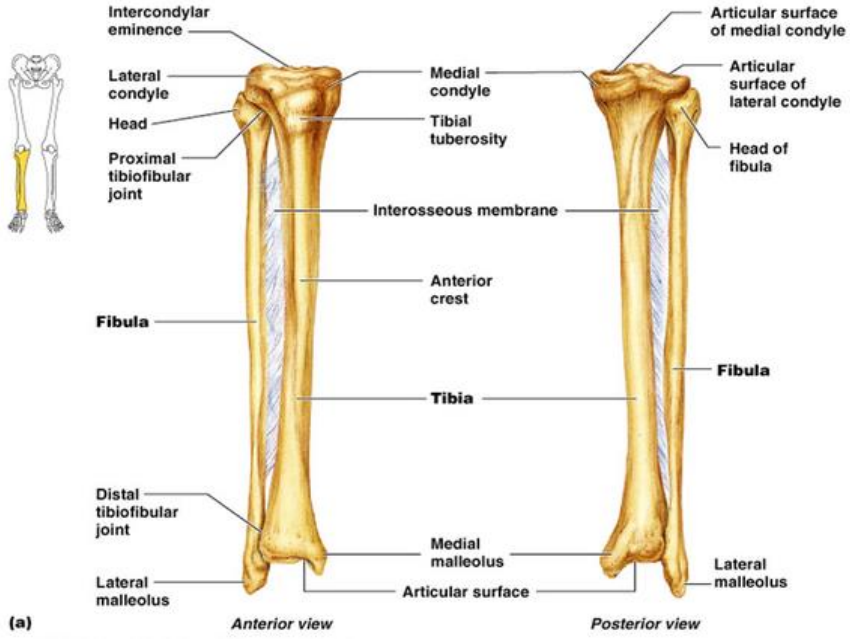
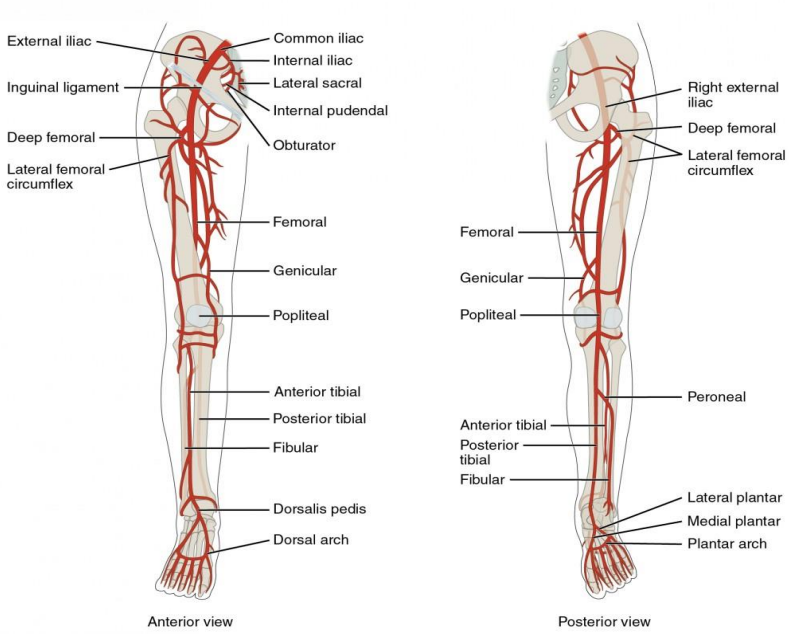
Introduction

- Bone recalcitrant nonunion and bone defects usually follow trauma, resection of a malignant tumor of the musculoskeletal system and osteomyelitis.
- Instead of amputation, which was used in the past, limb salvage surgeries, including non-vascularized or vascularized autografts and allografts, bone transport and replacement with prostheses are performed.
- Among the above methods, non-vascularized autogenous bone graft use is an important treatment strategy that has been performed for over a hundred years.
- The fibula is a tubular bone that has a suitable length, geometrical shape and mechanical strength and is considered to be the best donor bone for large bone defects.
- Free vascularized fibular grafts achieve higher union rate than non-vascularized fibular grafts in the reconstruction of long bone defects.
- In this study, 6 patients with bone defects treated by non-vascularized fibular grafts .We intended to assess the clinical outcomes of graft union, functional outcome.





Purpose of study

To assess the clinical outcome of graft union and to see the effectiveness of fibular strut graft for filling the bony defects.

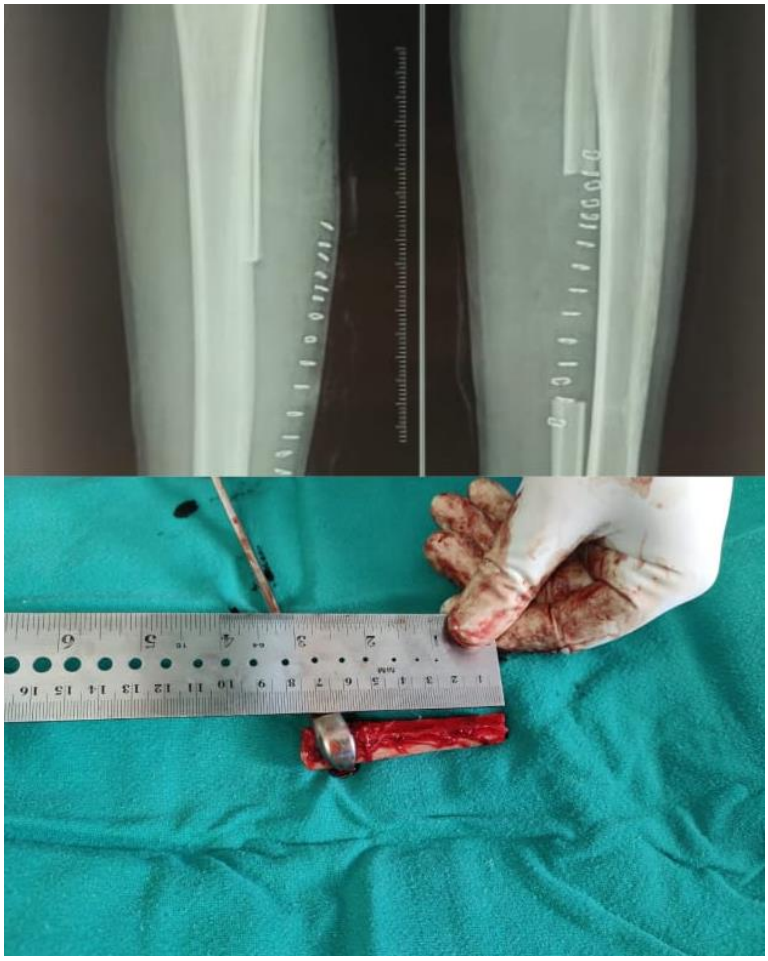
Patients and Method

- There were 5 male and 1 female patient with a mean age of 25 years. The mean follow- up was 3-6 months.
- The mean time interval between the accident and the fibular graft was 3 weeks, the initial management was debridement and external fixation or temporary immobilization.
- Radiographs were made at the time of the most recent follow-up examination.
- Tibial bone defects were encountered in 2 cases, forearm defects in 2 cases, while the

humerus was affected in another 1 case and femur in 1 case. The length of the bone defect ranged from 4 to 10 cms. The bone loss was the result of the initial injury in all cases.

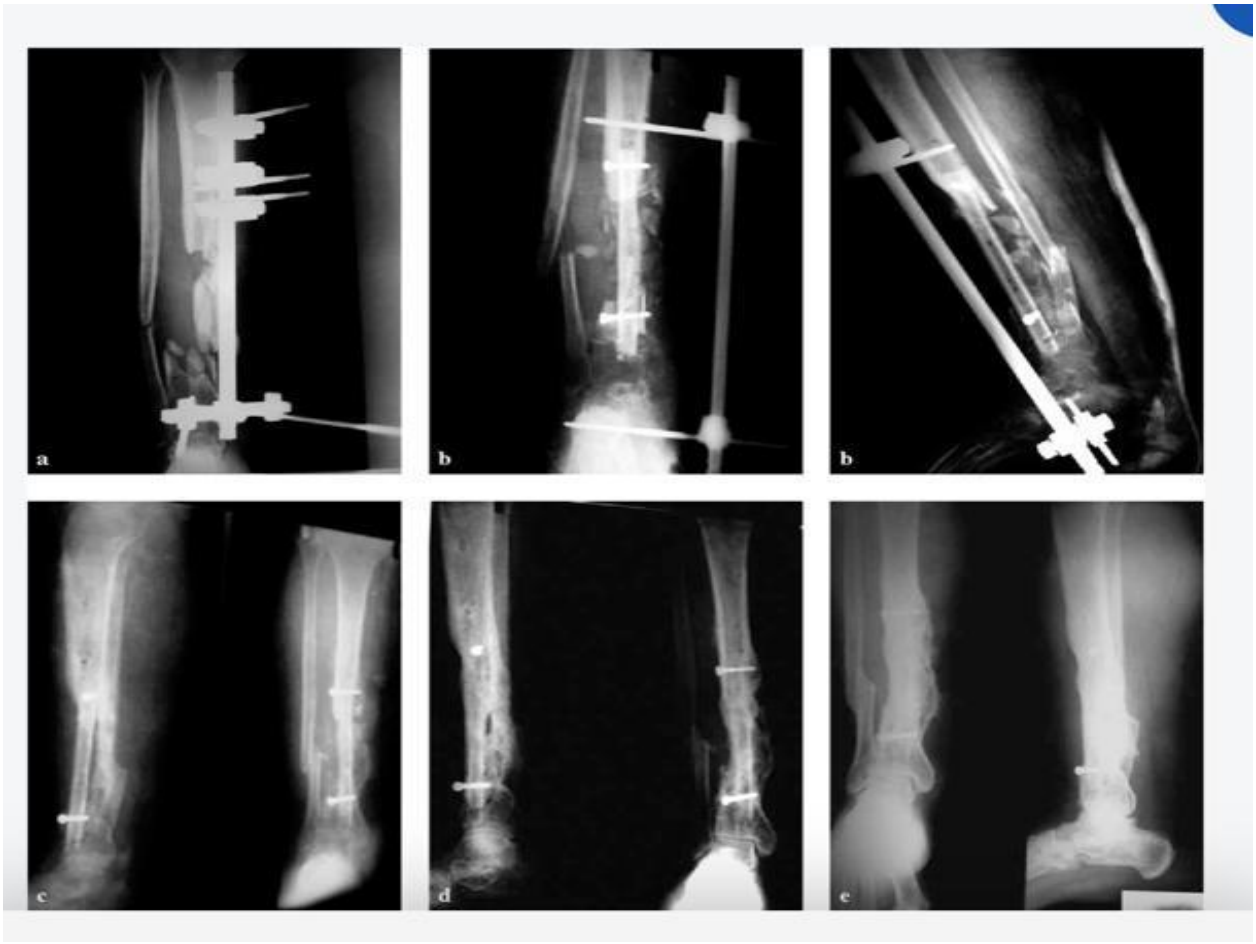
Operative Technique

- Under tourniquet the proposed portion of the fibula, leaving 6 cm at least from the distal end, was exposed and the fibula was dissected subperiosteally then it was osteotomized proximally and distally with a by pneumatic or Gigli saw.
- The fibular graft length was measured about 5 cm longer than the bone defect. After preparation of the bone ends of the gap and soft tissue bed, the medullary cavity of both ends was opened and the fibular strut graft was inserted into the medullary cavity proximally and distally, then fixed by one screw at each end holding the fibular graft to the recipient bone.
- Mechanical protection was achieved using an external fixator in tibial defects and a reconstruction plate and screws in upper limb defects.
- The fibular grafts were augmented, along their whole length, by cortico- cancellous bone graft in tibial defects of adult patients. The forearm was protected with an above-elbow splint. Immobilization was discontinued when there was radiographic evidence of union. The donor limb was supported in a posterior splint until the wound had healed.

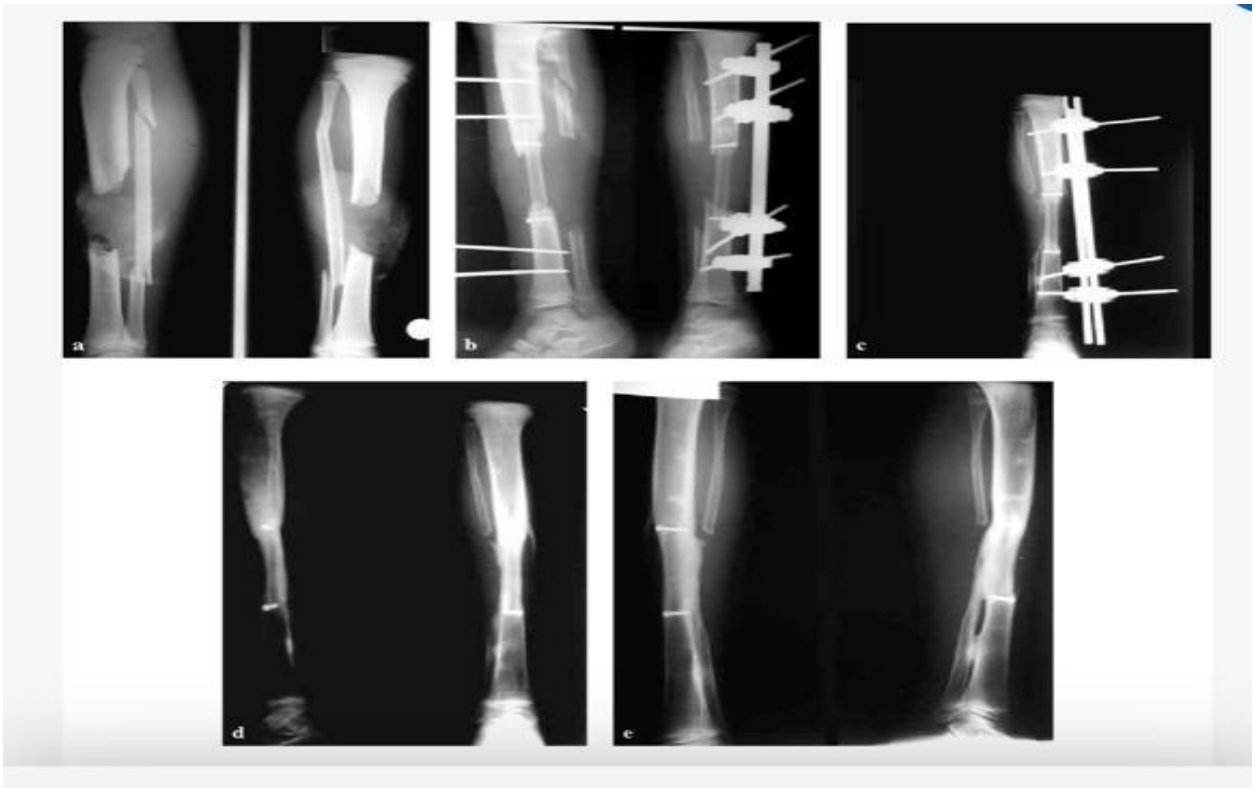


Fibula strut graft

Case 1

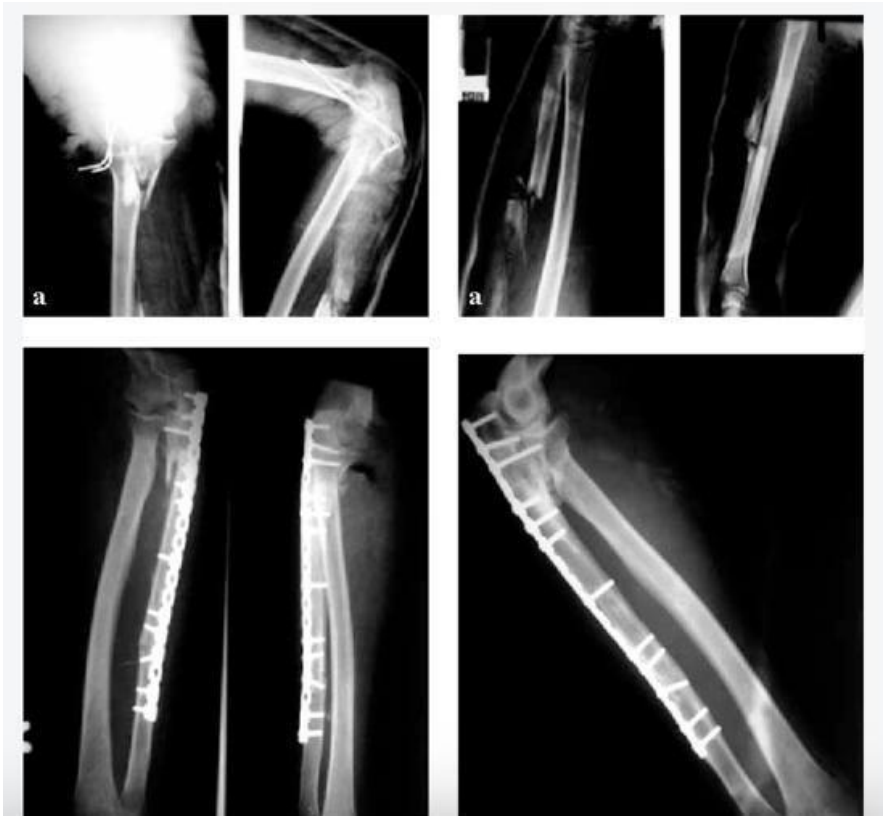


Case 2



Case 3

Case 4



Case 5

SITE OF DEFECT	LENGTH OF DEFECT	FINAL UNION	FUNCTIONAL RESULT	NO. OF CASES
Tibia	6 cms	All cases	v. Good	2
Forearm	5 cms	All cases	Good	2
Humerus, Femur	5 cms	one case	Good(1) Poor(1)	1+1

Result

- The patients were followed for an average of 3 to 6 months after the reconstructive procedure. No patient presented any symptoms suggestive of infection.
- Within an average of 4 months, all but one of the patients had radiographic evidence of bony union, at both the proximal and the distal graft-host bone junction. The remaining patient had a non-union.
- The bone healing results were rated as excellent in 5 cases. The functional results were rated as excellent in both tibial cases. None of the fibular autogenous grafts fractured, and no patient had radio-graphic evidence of osseous resorption . No patient had pain or functional disability involving the donor leg at the time of the most recent follow-up examination, although all patients noted discomfort with exertion for some time after the operative procedure.
- The two forearm cases graded as excellent results. The average pronation of the reconstructed forearm was 60° and the average supination was 40°.

- In the lower limb, there was no leg length discrepancy, with good range of knee and ankle motion . Final follow-up radiographs showed good union and healthy acceptance of the graft.

Discussion

- In 1877 Albert first proposed the use of the fibula as a substitute for the tibia. He obtained fusion between the fibula and the femur in a patient with congenital absence of the proximal tibia. Since then, the fibula has been used as a substitute for a missing segment of tibia or to reinforce a weakened section.
- Sacrifice of the fibula does not appear to have any detectable functional disadvantage.
- Several studies have shown that vascularized grafts are significantly stronger than conventional non-vascularized grafts. While a high incidence of stress fractures has been reported with non-vascularized grafts, they have also been shown to occur with free vascularized grafts.
- In our study, there was no instance of fracture of the graft . In many studies comparing non-vascularized with vascularized grafts, union of the fractures with non-vascularized grafts was found to be a major problem. However, in our study, bony union of a large non-vascularized segment occurred by twelve weeks. Even when the periosteum of the segment was absent or the medullary canal was blocked, bony union still occurred, although it was slightly delayed .
- In our study, we had a success rate of approx. 80% among 5 cases treated in a simple and effective way to bridge an average bone gap of 6 cm.
- Similar results were achieved by al-Zahrani et al who had primary union in 92% of 27 patients treated by a non-vascularized single fibular strut graft augmented with cortico-cancellous bone graft along its whole length ; the indications were varied and included infection, fracture with bone loss, non-union, bone tumour, bone cyst and congenital pseudoarthrosis.
- In our cases, we noted no donor site ankle instability, presumably because we made a point of pre- serving at least 6-8 cm of the residual fibular length distally, as recommended by Pacelli et al after their biomechanical analysis study.
- At the forearm, fibular grafts allow the use of a segment of diaphyseal bone which is structurally similar to the radius and ulna and of sufficient length to reconstruct most skeletal defects affecting these bones. Using a free non-vascularized fibular graft, we achieved excellent results in two cases (100%) of segmental ulnar defect with an average length of 5 cm.
- Our results confirm what had been found by Falder, who noted that long term behavior of the non-vascularized fibular graft, which responds physiologically to biomechanical loading, resulted in complete ‘tibialization’ of the fibula.
- In our opinion, non-vascularized fibular graft is a simple procedure that is still a valid option to successfully bridge bone defects in selected cases with good vascular bed and soft tissue coverage.

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