Case Report
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# Successful Management of Midshaft Ulna Non-union Using Vascularized Fibula Grafting Following Failed Internal Fixation: A Case Report

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**Learning Point of the Article:**

Vascularized fibula grafting provides both structural stability and biological support, making it an effective means of healing resistant atrophic non-union following failed conventional fixation procedures.

## Abstract

**Introduction:** Atrophic non-union of forearm fractures following repeated failed fixation remains a difficult problem in orthopedic surgery because of compromised biology and mechanical instability. Vascularized fibular grafting offers structural support along with enhanced osteogenic potential in resistant cases.

**Case Report:** A 45-year-old male presented with painful atrophic non-union of the midshaft ulna following failed intramedullary Kirschner wire fixation and subsequent failed revision plating with cancellous bone grafting. Persistent pain, instability, and functional limitation necessitated further intervention. Revision open reduction and internal fixation combined with vascularized fibular grafting was performed. Serial follow-up radiographs demonstrated progressive graft incorporation and fracture healing. Complete radiological union with satisfactory functional recovery was achieved at 1-year follow-up.

**Conclusion:** Vascularized fibular grafting is an effective salvage procedure for resistant ulna non-union after failed fixation, providing reliable biological augmentation and structural stability in complex cases.

**Keywords:** Ulna non-union, vascularized fibular graft, forearm fracture, failed fixation, biological reconstruction.

## Introduction

Diaphyseal fractures of the ulna are common injuries and usually unite satisfactorily following stable fixation in the form of compression plating. However, non-union remains a challenging complication that may result in persistent pain, instability, deformity, and significant impairment of upper limb function. Forearm fractures fixed with intramedullary fixation in the form of Kirschner wire are likely to undergo non-union in adult patients. This is partly attributed also to the mechanism of bone healing in forearm fractures, which is by a cutting cone mechanism and not by callus formation. Successful treatment of non-union requires restoration of both mechanical stability and biological healing potential [1].

Atrophic non-union following repeated surgical intervention presents a particularly difficult clinical problem because of compromised vascularity and poor osteogenic activity at the fracture site [2]. Compression plating combined with autologous cancellous bone grafting is generally considered the standard treatment modality because it provides rotational stability and allows bone healing by the cutting cone mechanism [2,3]. Nevertheless, resistant cases may fail to unite despite adequate fixation and conventional grafting techniques such as

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*Author's Photo Gallery*

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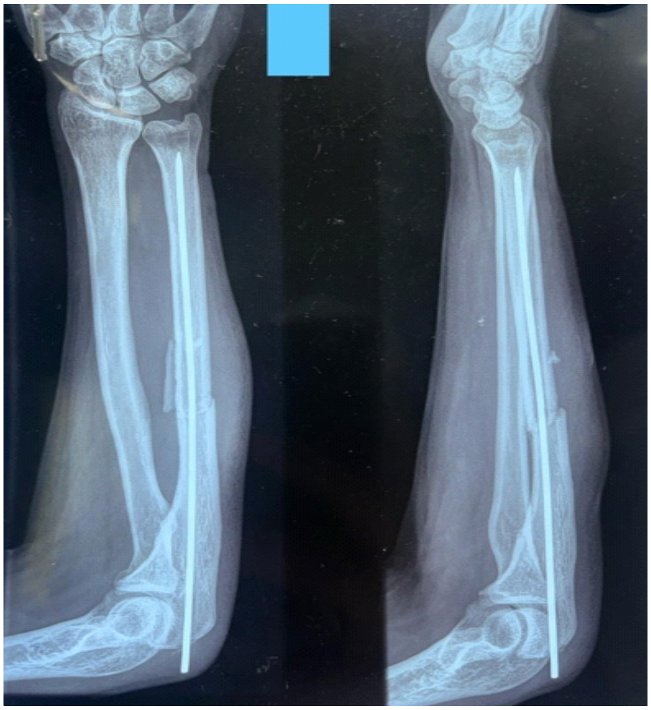

**Figure 1:** Initial radiograph showing Kirschner wire fixation for midshaft ulna fracture. The fracture is likely to undergo non-union in adult patients, particularly in forearm fractures, where compression and rotational stability at the fracture site are not provided.

iliac crest bone grafting.

Vascularized fibular grafting has emerged as a valuable reconstructive option in complex non-unions because it provides both structural cortical support and intrinsic vascularity, thereby enhancing osteogenesis and graft incorporation [2,3,4]. We report a case of resistant midshaft ulna non-union successfully managed with vascularized fibular grafting after failure of two previous fixation procedures.

## Case Report

A 43-year-old male presented with persistent pain and restricted function of the left forearm following treatment for a midshaft ulna fracture sustained after a fall. Initial management had been performed elsewhere using intramedullary Kirschner wire fixation. Serial radiographs demonstrated non-union associated with pain and reduced function.(Fig.1 ).

The patient subsequently underwent revision surgery in the same hospital with implant removal, fixation using a limited contact dynamic compression plate, and autologous cancellous iliac crest bone grafting. Although intraoperative stability was satisfactory, follow-up radiographs failed to demonstrate progression toward union over the ensuing months. Clinically, the patient continued to experience pain, instability, and difficulty performing activities of daily living.

The patient had a history of smoking. No history of diabetes mellitus, alcohol abuse, or metabolic bone disease. Clinical examination revealed localized tenderness over the ulna and painful restriction of forearm pronation and supination. Radiographs demonstrated persistent atrophic non-union of the midshaft ulna with sclerosis of fracture ends and absence of bridging callus.(Fig. 2).

Considering the repeated surgical failures and biologically compromised non-union, revision open reduction and internal fixation with vascularized fibular grafting was planned with the plastic surgery team of the hospital.

The incision of the previous surgery was used, and the ulna was exposed. Intraoperatively, fibrous tissue and sclerotic bone ends were excised until healthy bleeding bone surfaces were obtained. The gap was measured with a surgical scale to give us a guide for the length of fibula needed to be interposed between the fracture ends. (FIg. 3).

A vascularized fibular graft was harvested. Time is a constraint after the graft has been harvested, so the ulna should be ready for

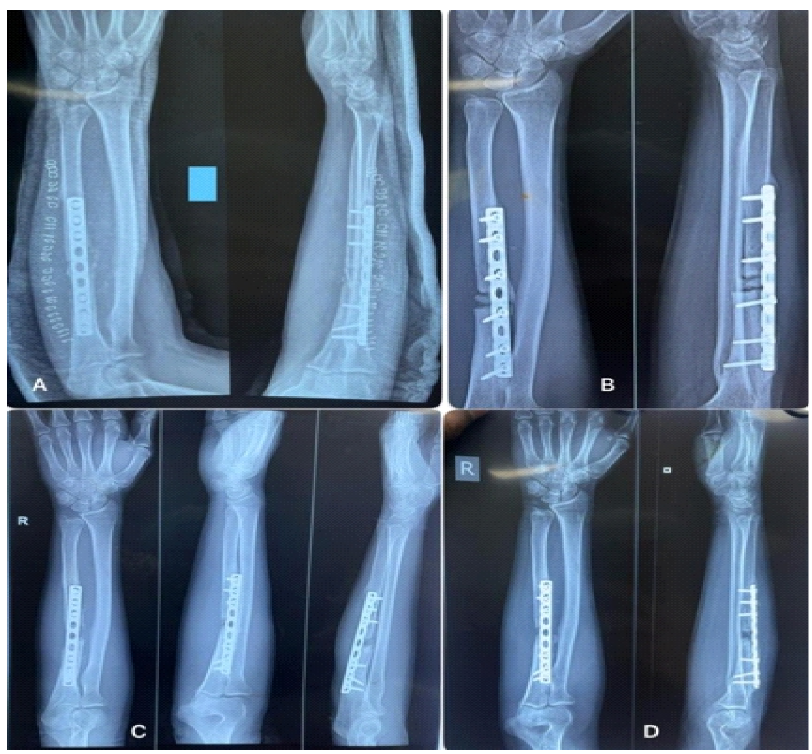


**Figure 2:** Serial radiographs (a, b, c, d) of the patient subsequent to the second surgery after K-wire removal and compression plating. The fracture did not have compression, and the cancellous graft subsequently was resorbed. The construct failed because the forearm fractures heal by a cutting cone mechanism, and contact and compression of the two ends of the fracture are prerequisites for the same.

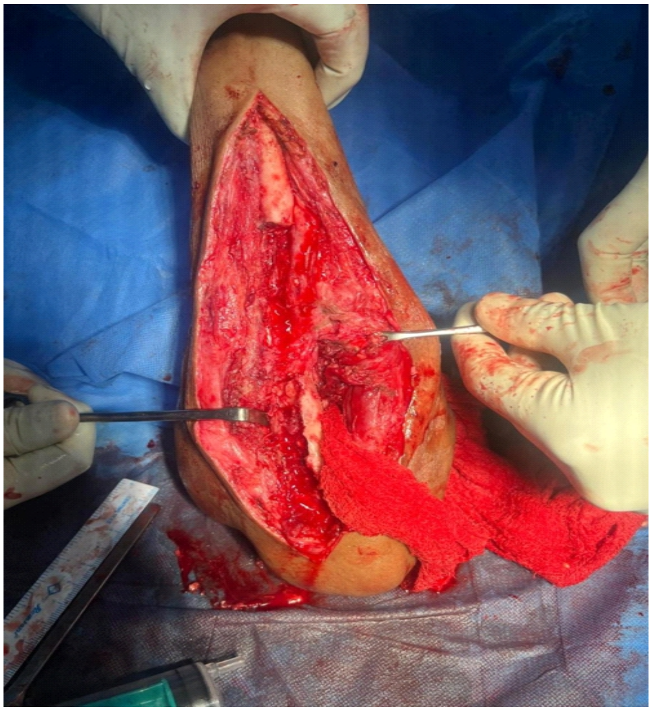

**Figure 3:** Intraoperative photographs. Exposure of the ulna fracture ends after the removal of fibrous tissues and sclerotic bone ends, till the fresh bleeding appears. It is vital to prepare the bed for the fibula graft ready, as time is a constraint after harvesting the vascularized graft.

fixation after the graft preparation. (Fig. 4).

The fibula, along with its vasculature, was interposed between the prepared ulnar ends and reduced. Stable fixation was achieved using a long compression plate spanning the ulna and graft construct. (Fig. 5).

Subsequently, anastomosis of the fibular artery to the ulnar artery was performed in an end-to-side fashion. Due to previous infection and scarring, deep veins were not reliable, and we could find one deep vein and preserve one superficial vein for venous anastomosis and closure was done in layers.

Postoperatively, the limb was immobilized, elevated, and a compression dressing was provided to allow the swelling to subside. It is important to be watchful of the wound and look for swelling. Suture removal was done after 2 weeks. Gradual rehabilitation with supervised range-of-motion exercises was started. Serial radiographs demonstrated progressive graft incorporation and signs of union. At 6 months postoperatively, substantial radiological healing with a significant reduction in pain was observed. At follow-up after 1-year, complete radiological union was achieved with satisfactory forearm function and return to normal daily activities. (Fig. 6).

## Discussion

Forearm non-union remains a difficult complication in orthopedic trauma surgery because restoration of forearm anatomy and rotational mechanics is essential for optimal upper limb function [5,6]. The ulna is particularly susceptible to impaired healing because of limited soft-tissue coverage and compromised vascularity in certain fracture patterns.

Several factors contribute to non-union, including inadequate fixation, biological insufficiency, infection, bone loss, repeated surgical intervention and, added to these, the presence of high-risk factors such as smoking. Intramedullary Kirschner wire fixation may not provide sufficient rotational stability in diaphyseal forearm fractures, thereby predisposing to non-union [7]. Although compression plating with cancellous bone grafting remains the gold standard treatment for atrophic non-union, biologically compromised cases may continue to fail despite apparently adequate fixation.

Vascularized fibular grafting offers significant advantages in resistant non-union cases. In addition to providing strong cortical structural support, preservation of the intrinsic vascularity of the fibula enhances osteogenesis, accelerates graft incorporation, and improves healing in scarred or avascular environments. This technique is particularly beneficial in cases involving repeated failed fixation, segmental defects, extensive fibrosis, or poor local biology [7,8].


**Figure 4:** (a) Fibula being harvested along with its vascular supply. The length is provided after measuring the gap between the fracture ends with a surgical scale. It acts as a guide to the approximate length of graft that needs to be harvested. (b) The graft is again measured after harvesting. It is wise to obtain a little extra length of graft and then remove the extra graft on the table after measurement. The length of the graft cannot exceed the native length of the ulna, for it carries the risk of ulnar lengthening and altering the biomechanics of both the forearm and the wrist joint.

**Figure 5:** The graft was carefully interposed between the fracture ends and reduction held with bone holding forceps, and a long, limited contact dynamic compression plate was applied, spanning both the fracture ends and fixed with a stable construct. Subsequent to this vascular anastomosis is performed between the vascular pedicles of the graft and the ulnar artery branches supplying the ulna.

In vascularized free fibular graft reconstruction, recipient vessel selection should be individualized according to the defect location and the local vascular status. The choice of recipient artery is generally dictated by the bone being reconstructed, with the ulnar artery preferred for ulnar defects and the radial artery for radial defects owing to their anatomical proximity and favorable pedicle orientation. However, vessel selection can be considerably more challenging in re-operated limbs or in patients with a history of infection. Previous infection and multiple surgical interventions often result in dense fibrosis and scarring, particularly around the deep vascular structures adjacent to the affected bone, potentially compromising the deep venous system and limiting the availability of suitable venae comitantes for microvascular anastomosis [7]. Consequently, meticulous pre-operative planning and careful intraoperative dissection are essential. In our case, anticipating the possibility of compromised deep veins, a superficial vein was deliberately preserved during exposure of the ulna. Venous outflow was ultimately established using one vena comitans and the preserved superficial vein, providing reliable drainage and contributing to successful flap perfusion. This highlights the importance of preserving superficial venous options during surgical exposure, particularly in complex reconstructive cases with previous infection or multiple prior procedures.

Adani et al. demonstrated successful incorporation and functional restoration using vascularized fibular grafts in complex skeletal reconstruction procedures [4]. Similarly, Giannoudis and Harwood emphasized the importance of biological augmentation in resistant long-bone non-union management [6]. In the present case, repeated surgical procedures likely further compromised local vascularity and osteogenic potential, contributing to persistent atrophic non-union.

Successful union following vascularized fibular grafting in our patient highlights the importance of combining stable fixation with enhanced biological reconstruction in difficult non-union cases. Although technically demanding, vascularized fibular grafting remains a reliable salvage option when conventional techniques have failed [9,10].

## Conclusion

Vascularized fibular grafting is an effective salvage procedure for resistant atrophic midshaft ulna non-union following failed fixation procedures. It is imperative to realize that long bones such as the ulna have a very limited soft-tissue cover, and repeated surgeries compromise the already fragile soft-tissue

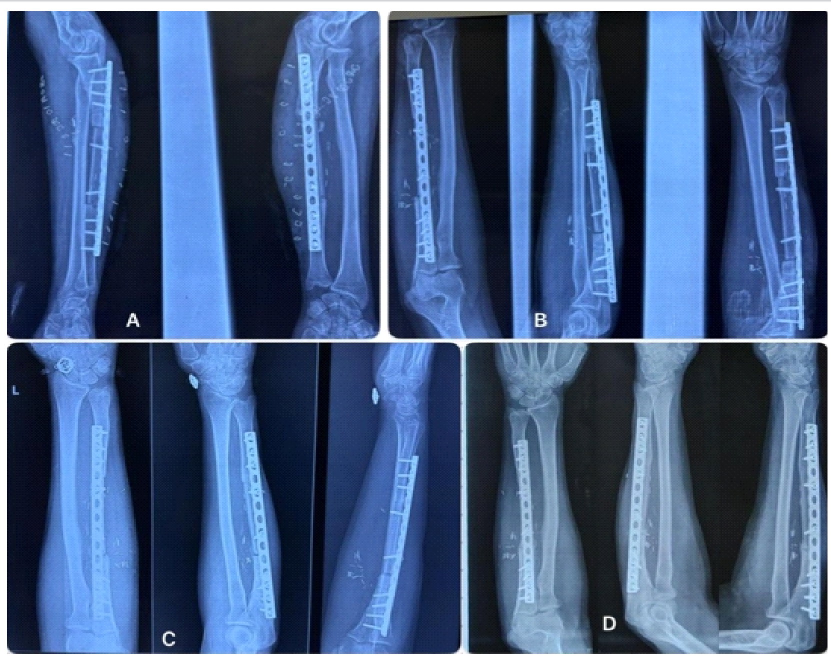


**Figure 6:** (a) Post-operative X-ray at 1 month, (b) 3 months, (c) 6 months post-operative radiograph showing progressive graft incorporation, (d) 1 year follow-up radiograph demonstrating complete union.

cover. Therefore, it is important that the surgery performed after multiple failures should provide both biological enhancement and structural stability, and have reliable union rates and satisfactory functional recovery in complex cases.

**Clinical Message**

Persistent atrophic ulna non-union after multiple failed fixation may require biological reconstruction beyond conventional plating and cancellous grafting. Vascularized fibular grafting can provide a reliable environment for long bone diaphyseal union by providing the required blood supply and structural support. It provides good functional outcomes in resistant forearm non-union cases.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Conflict of interest:** Nil **Source of support:** None

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