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**Case Report**

# Free vascularized fibular graft in patient with skeletal defect after neurofibroma surgical excision of forearm

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## ABSTRACT

The free vascularized fibular graft has been successfully applied as a reconstruction option in patient with large secondary skeletal defects result from excision of pathologic tissue after neurofibroma surgical excision. It provides a strong cortical strut for reconstruction of defects, so that the free vascularized fibular graft is ideal for ulna reconstruction. A 22-year-old male with lump in his right forearm for 3 months previously which become bigger and more painful. There was also sings of ulnar nerve disfunction. From the CPC result, we diagnosed forearm neurofibroma. We performed wide excision and reconstruction using free vascularized fibular graft. On the last follow up, the active and passive ranges of motion (ROM) of 4$^{th}$ and 5$^{th}$ metacarpal was measured with the help of a goniometer. The ulnar neurological state was tested by manual testing and graded on the Medical research council (MRC) scale. Four weeks after surgery, the operation wound at the right forearm and right lower leg was good and no infection signs. The graft viability was good with compromised vascularity. The post-operative passive and active ROM of the 4$^{th}$ and 5$^{th}$ metacarpal able did full extend. The post-operative sensoris level of the ulnar area improved from pre-operative sensoris level.
Post-operative follow-up, in the early period (up to 6 weeks) we monitor the graft viability. Our case reported good result in the operation wound, the graft viability, the passive and active ROM of the 4$^{th}$ and 5$^{th}$ metacarpal and the sensoris level of the ulnar area.

**Keywords:** Free vascularized fibular graft, Secondary skeletal defect, Neurofibroma

## INTRODUCTION

Bony defects caused by trauma, tumors, infection or congenital anomalies present a significant clinical challenge and can often result in significant patient disability or limb amputation. The same could be said of failed spinal fusions, complex arthrodeses and femoral-head avascular necrosis (AVN). Free vascularized fibular bone grafts (FVFGs) are extremely effective in managing all these conditions.[1,2] Bone grafts can broadly be divided into non-vascularized (conventional) and vascularized grafts.[1,3,4]

The key to the success of conventional bone grafting lies with the blood supply of the recipient bone and surrounding tissues. Without an adequate blood supply, non-vascularized grafts are incapable of remodeling, and the transplanted bone can fail to unite with the recipient bone, only very few live osteocytes are able to survive

beneath the periosteum, and most are subject to necrosis.[3,4]

Nourished by the peroneal vessels, the free vascularized fibular graft has been successfully applied as a reconstruction option in patient with large secondary skeletal defects result from excision of pathologic tissue after neurofibroma surgical excision. The free vascularized fibular graft provides a strong cortical strut for reconstruction of defects because the size and straight configuration of the fibula match the forearm bones, so that the free vascularized fibular graft is ideal for ulna reconstruction.[5,6]

Indications for FVFGs can be used in the management of bony defects (such as salvage after trauma, infection or tumor), in the treatment of congenital anomalies, for AVN, in arthrodeses and in special situations (such as an epiphyseal FVFG for pediatric pathology).[7] The complications of acute, subacute and delayed complications can occur at both the donor and recipient sites. Early complications include uncontrolled bleeding at the site of a technically poorly performed microvascular anastomosis or following failure of adequate hemostasis. Thrombosis of the anastomosis can also result from poor surgical technique, poor choice of recipient vessels (restricted arterial flow and/or slow venous drainage), inadequate peroneal pedicle length and torsion of the vascular pedicle. Subacute vessel thrombosis can also occur at the recipient site for the same reasons, and the donor site can suffer compartment syndrome following poor hemostasis or if the deep fascia is closed too tightly (particularly with osteocutaneous flaps).[8]

## CASE REPORT

A 22-year-old male was admited to the hospital due to lump in his right forearm for 3 months previously which become bigger and more painful. The patient does not have the same history of complaints in the family regarding his current complaint. On examination of neurological function there was also sings of ulnar nerve disfunction. CPC orthopedic department with pathological and radiological department concluded the diagnose is forearm neurofibroma. Authors performed wide excision and leaving extensive defects in the bone. Reconstruction done by using free vascularized fibular graft because vascularized graft offers a viable blood supply for osteoblasts to remain alive and to preserve bone remodeling, thus making the graft capable to integrate and hypertrophy. Furthermore, its applicability in managing diaphyseal defects in the femur using a single- or double-barrel technique with allograft can be efficient. For the 15cm bone defect resulted from the wide excision, authors reconstructed by free vascularized fibular graft by bridging the defect by plate fixation, stabilizing the fibula to the recipient bone, and revascularizing the graft.

The free vascularized fibular graft is particularly suited for reconstruction of large forearm defects because the fibula matches the radius and ulna in size and shape. On the last follow up, the operation wound was good. the active and passive ranges of motion (ROM) of 4$^{th}$ and 5$^{th}$ metacarpal was measured with the help of a goniometer. The ulnar neurological state was tested by manual testing and graded on the Medical research council (MRC) scale. There is no need for hypertrophy, and the patient can resume full use of the upper extremity when the graft heals.

## RESULTS

Authors are reporting a case of forearm neurofibroma in adult treated by wide excision and reconstruction using free vascularized fibular graft.

Four weeks after surgery, patient recovered well without any complication. The operation wound at the right forearm and right lower leg was good and no infection signs. The graft viability was good with compromised vascularity. The post-operative passive and active ROM of the 4$^{th}$ and 5$^{th}$ metacarpal able did full extend. The post-operative sensoris level of the ulnar area improved from pre-operative sensoris level.

## DISCUSSION

Limb salvage after tumor resection in the extremities is preferable to amputation, provided that safe margins are left after all pathologic tissue is removed. The free vascularized fibular graft is particularly suited for reconstruction of large forearm defects because the fibula matches the radius and ulna in size and shape. There is no need for hypertrophy, and the patient can resume full use of the upper extremity when the graft heals. Because neurofibroma is a benign with relaps character tumor, authors performed wide excision. For the 15cm bone defect resulted from the wide excision, authors reconstructed by free vascularized fibular graft by bridging the defect by plate fixation, stabilizing the fibula to the recipient bone, and revascularizing the graft.[9,10]

Post-operative follow-up, in the early period (up to 6 weeks) authors monitor the graft viability. Recipient site complications include compromised vascularity, infection, nonunion of the graft-host junction sites, and fatigue fracture of the graft. Our case reported good result in the operation wound, the graft viability, the passive and active ROM of the 4$^{th}$ and 5$^{th}$ metacarpal and the sensoris level of the ulnar area. Long term follows up will be evaluate for then future result.[11]

Fibula is an ideal graft, its gross morphological characteristics that can be modified to reconstruct long bone defects. Being long and straight along with its dual blood supply, the fibula has a vast dimension of fitting into medullary canals of the larger long bones (e.g., humerus, femur, and tibia) to fill in defects up to

26cm.[7,12] The composition of the graft may vary to include skin, fascia, muscle, and growth plate depending on the defect.[12] As opposed to a Neovascularized graft, a vascularized graft offers a viable blood supply for osteoblasts to remain alive and to preserve bone remodeling, thus making the graft capable to integrate and hypertrophy.[8] The advantage the FVFG has over other vascularized grafts, such as the iliac crest and the rib, is its durability, strength, versatility, and the ability to undergo various osteotomies.[8] Its applicability in managing diaphyseal defects in the femur using a single- or double-barrel technique with allograft can be efficient. Furthermore, following failed total knee arthroplasty, the FVFG in the knee can be useful in arthrodesis. Other desirable sites for FVFG include defects in the clavicle, humerus, ulna, mandible, tibia, ankle, and cervical and lumbar vertebrae.[13]

The use of a neovascularized bone graft, as originally described by Phemister et al, has had variable success in the treatment of osteonecrosis.[14] Marcus et al, reported satisfactory clinical results in seven of eleven hips at the time of short-term follow-up (range, two to four years).[15] Dunn and Grow et al, reported only four good results in twenty-three patients treated with neovascularized bone-grafting.[16] Nelson and Clark et al, treated fifty two hips with Phemister bone-grafting and concluded that the technique is not eftective once collapse has occurred.[17] Boettcher et al, reported success in twenty-seven (71%) of thirty-eight hips six years after neovascularized tibial strut grafting.[18] However, in longer-term evaluation (performed at a mean of fourteen years postoperatively) that included the original thirty-eight hips in the study by Boettcher et al.[18] Smith et al, found that only sixteen (29%) of fifty-six hips still had a good result.[19]

Taylor et al, reported the first successful microvascular free fibula transfer in humans in 1975.[20] The procedure was performed for limb salvage in the setting of severe trauma and extensive bone and soft-tissue loss. In 1977, Weiland et al, were the first to report the use of a vascularized fibula for long bone reconstruction following resection of a bone tumor in an adult.[21] The microvascular technique involving transfer and anastomosis of the peroneal artery along with the fibula became well established over the following decade; indications have since come to include bone loss from extensive chronic infection, pseudarthrosis, and osteonecrosis of the femoral head.[21-23] Innocenti et al, were the first to report proximal fibula transfer with an active viable growth plate in children.[24]

The biologic advantages of a vascular bone graft are numerous. The standard allograft incorporation sequence involving necrosis of the graft, resorption, and new bone formation is completely bypassed. Instead, the graft maintains its structural integrity and hypertrophies in response to mechanical loads.[25,26] The diaphyseal graft provides viable tissue and blood flow to incorporate at the graft-host junction by active osteogenesis. When longitudinal growth is desired, the transferred physis provides this benefit at a predictive rate in addition to maintaining viability and hypertrophy.[22] With preservation of the epiphysis, the osteoarticular segment of the proximal fibular graft is able to actively remodel at the joint surface to maximize congruity.[23-24] Finally, the blood supply to the graft contributes to the vascularity of the surrounding tissue.

The technical feasibility of a vascularized growth plate transfer with expectation of longitudinal growth in the transplanted bone was first established in canine and rat models.[27-28] The application of this concept to the proximal fibula in humans was explored through anatomic studies by Taylor et al.[29] The anterior tibial artery supplies both the epiphysis and the diaphysis of the fibula so that there is no need to provide a double pedicle to the proximal fibular graft, whereas the peroneal artery supplies the middle third of the fibula.

## CONCLUSION

The free vascularized fibular graft was effectively applied as a reconstruction option in patient with large secondary skeletal defects result from excision of pathologic tissue after neurofibroma surgical excision.

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