

Treatment of Radial Nonunion with Corticocancellous Bone Graft and Fascia of Anterolateral Thigh Free Flap: The Wrap Technique

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Summary: The management of nonunion of the forearm bones is a challenging task. Multiple factors have been associated with the establishment of forearm nonunion, such as the fracture position and complexity, general condition of the patient, and the previously utilized surgical technique. The optimal surgical treatment of a bone gap remains a subject of discussion. Autogenous corticocancellous bone grafts and vascularized bone flaps have been used with differing results. The authors describe a technique for the treatment of posttraumatic nonunion of the radius with a 5-cm bone gap using the free anterolateral thigh fascial flap wrapped around a tricortical iliac bone graft. The fracture healed after 5 weeks. The use of a vascularized tissue wrapped around the bone graft resulted in a well-healed bone and no signs of resorption after 2 years of follow-up. A bone graft wrapped by a fascial flap could magnify the restorative effect on the bone defect because of its dual role of constructing vascularization and inducing tissue regeneration. (*Plast Reconstr Surg Glob Open* 2016;4:e1149; doi: 10.1097/GOX.0000000000001149; Published online 14 December 2016.)

Management of the nonunion of forearm bones is a challenging task. Multiple factors have been linked to the establishment of forearm nonunion, such as the fracture position and complexity, general condition of the patient, and the previously utilized surgical technique.¹ Most forearm nonunions are atrophic and may have an associated bony defect. The authors describe a new technique for the treatment of posttraumatic nonunion of the radius using the free anterolateral thigh fascial flap wrapped around a tricortical iliac bone graft.

CASE REPORT

A 36-year-old man with nonunion of the mediolateral region of the left radius was admitted to our department in February 2014. There was a history of untreated lower brachial plexus injury in the left arm and an ulnar and

a radial fracture 18 months previously. This fracture had been treated by reduction and fixation with an angular stability plate. At the time of admission, there was deformity of the forearm with pathologic movement in the middle third. Radiography revealed a segment of atrophic nonunion below the plate associated with a bone gap (Fig. 1). Reconstruction with a free fibula flap was proposed, but the patient refused consent to avoid morbidity of the lower limb. The iliac crest free flap was rejected because it was a bulky flap to introduce in the forearm of a patient affected by partial brachial plexus palsy, with a consequent very slim forearm. We planned removal of the old plate, debridement of the fibrous pathologic tissue, and a new fixation with a tricortical iliac bone graft wrapped by an ALT fascial flap. Consent concerning the unusual technique planned was obtained from the patient. Initially, the necrotic bone segment and fibrous interposed tissue were removed with the previously implanted plate. The intramedullary canal was opened on both sides with a small drill reaching healthy and bleeding bone. The bone defect was 5 cm long. The tricortical iliac crest bone was taken from the left iliac crest. On the

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Fig. 1. Radiographs revealed a segment of atrophic nonunion below the plate associated with a bone gap.

right lateral thigh, an ALT fascial flap, about twice the size of the graft, was harvested. A skin island was harvested with the flap for postoperative monitoring (Fig. 2). The fascial donor defect was closed using a single layer of acellular dermal matrix (Strattice, Lifecell, N.J.). The fascial component was then wrapped around the bone graft and fixed in the receiving site using LCP Dia-Meta Volar Distal Radius Plates (Synthes, Zuchwil, Switzerland; Fig. 3) (See video, Supplemental Digital Content 1, which displays the “wrap technique.” The fascial flap before the vascular anastomosis is wrapped around the bone graft and bone stumps, <http://links.lww.com/PRSGO/A303>). End-to-lateral anastomosis was performed on the ulnar artery and end-to-end anastomosis on 2 comitant veins to maintain the 2 main vessels of the hand. At the end of the procedure, a cast was positioned. The cast was removed 4 weeks after surgery. One- and 2-month follow-up radiographs showed no sign of resorption of the graft. Complete bone healing had been achieved by 5 weeks. Two years after surgery, imaging showed complete integration of the graft (Fig. 4) and appropriate soft tissue reconstruction. The patient refused any subsequent esthetic revision surgery.

DISCUSSION

Low complication and nonunion rates below 5% have been reported in numerous studies for radial fractures.^{1,2}

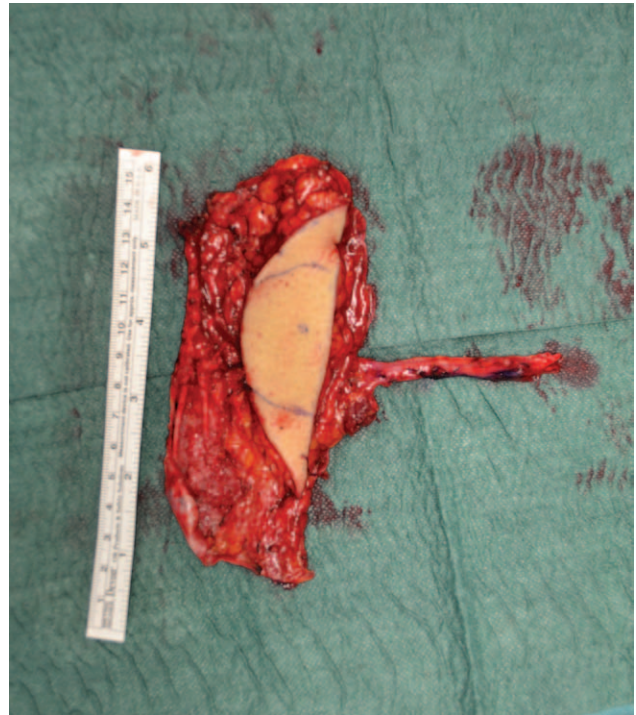


Fig. 2. The fascial anterolateral thigh flap after harvesting from the contralateral thigh.

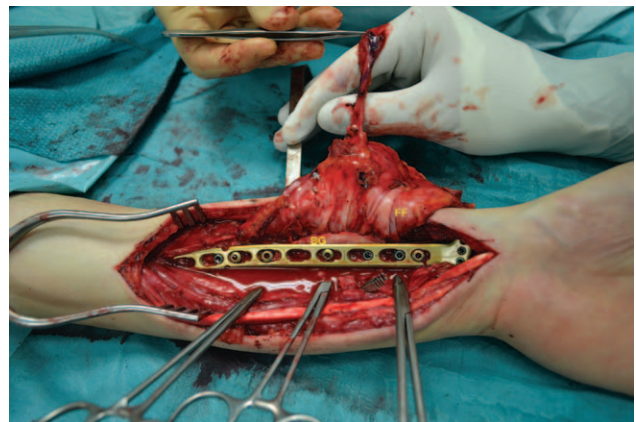


Fig. 3. The “wrap technique”: the fascial flap is wrapped around the bone graft. BG, bone graft; FF, anterolateral thigh fascial flap.

Modern compression plate-and-screw fixation is a relatively straightforward procedure in adults. Because of this new device, malunion and nonunion, once frequent complications of radial fractures, are currently uncommon. Nonunion is often associated with technical shortcomings (a short or weak plate) or injury severity (bone loss, poor soft tissue cover, infection, or contamination).³ The choice of bone graft is a continuous topic of debate in the literature and in practice in the clinic; autogenous cancellous bone graft, autogenous corticocancellous bone graft, and vascularized bone flaps have all been suggested. Usually, for defects up to 3 to 4 cm, the most common choice is autologous morselized cancellous bone.^{1,4} Other authors have preferred the use of bone blocks.⁵ For defects



Video Graphic 1. See video, Supplemental Digital Content 1, which displays the “wrap technique.” The fascial flap before the vascular anastomosis is wrapped around the bone graft and bone stumps, <http://links.lww.com/PRSGO/A303>.

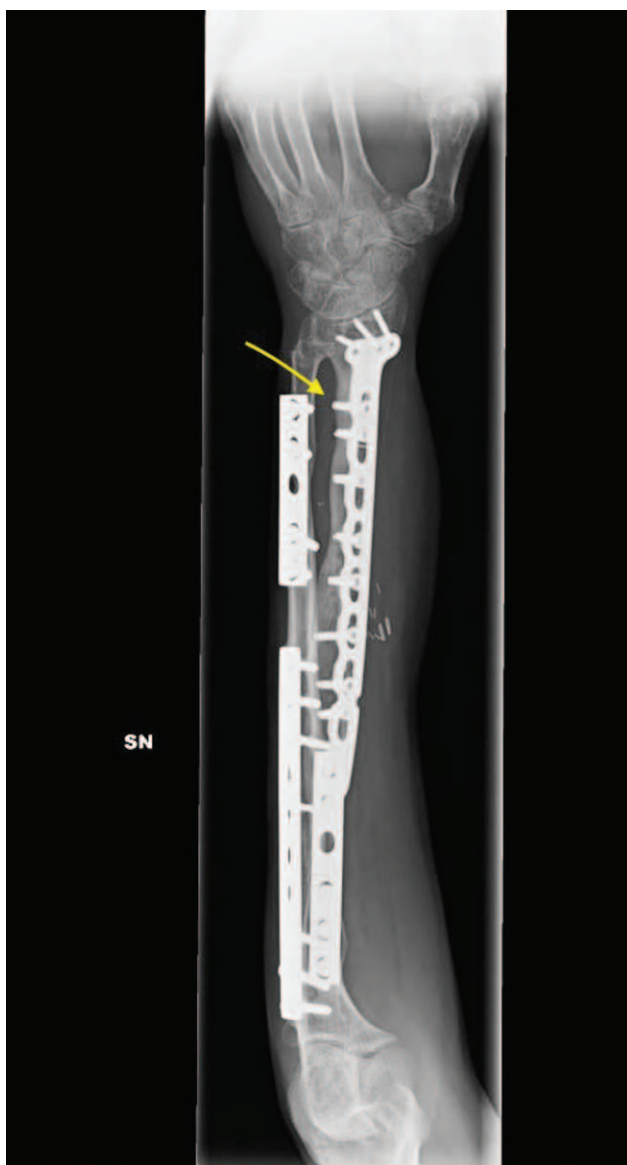


Fig. 4. Long-term follow-up shows complete integration of the graft. The arrow shows the lack of reabsorption of the graft.

between 4 and 10.5 cm, the choice of bone graft is more controversial.⁶ In more complex cases with a substantial bone defect and concomitant poorly vascularized soft tissue, the use of an osteocutaneous free flap is a viable alternative. Although this requires microsurgical experience, it can create a suitable soft tissue environment, in addition to bony continuity.⁷ We usually utilize a free fibula flap because of its low donor-site morbidity. However, in highly active people, a fibula flap can cause morbidity. In this present report, a new technique of a bone graft wrapped by a fascial flap is described. In 2009, Yang et al,⁸ in a rabbit experimental model, used autologous tissue-engineered bone wrapped by a pedicled fascial flap inside a radial defect.⁸ The authors demonstrated how this technique was superior to the use of autologous-engineered bone alone in terms of growth of blood vessels into the implant, quantity, and speed of the bone trabecula and cartilage tissue formation, development of mature bone structure, remodeling of shaft structure, and absorbance and degradation of the implant. Furthermore, the vascular regenerative area of the junctional zone was superior in the experimental group. In our opinion, this can be considered a “modified 1-step Masquelet technique.”⁹ We performed a 5-cm tricortical bone graft, surrounded by hypervascular tissue. The fascial flap could play the role of a new periosteum, preventing infection and excessive bone resorption and increasing the speed of bone healing. A similar reconstructive technique has been described for palatal reconstruction using a fascial and bone combined flap, but nothing similar has been described for upper limb reconstruction until now.¹⁰

CONCLUSIONS

A fascial flap wrapping a bone graft could magnify the restorative effect on the bone defect because of its dual role of constructing vascularization and inducing tissue regeneration. Further clinical and experimental studies are necessary to point out any differences in osteointegration between free bone flaps and this new technique.

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