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Title: Reconstruction of Oncologic Bony Defects of the Distal Radius

Authors: Stephanie Malliaris MD, Peter Cordeiro MD, Edward A. Athanasian MD

Institutions: Hospital for Special Surgery, New York, NY and Memorial Sloan Kettering Cancer Center, New York, NY.

Background:
Resection of primary bone tumors of the distal radius can be entirely extra-articular, leaving defects that extend into the joint and include carpus, distal radius, and distal ulna (Figure 1). There are many described techniques for reconstruction, including arthrodesis (vascularized, non-vascularized, and allograft) and arthroplasty (alloprosthetic, allograft, and vascularized fibular head). The variability of tumors and the resulting bony defects after resection make choosing a method of reconstruction complex. With such large defects, reconstruction with motion preserving procedures may not be possible, and limb salvage can be attempted with arthrodesis.
Historically, vascularized fibula is used for long bone defects longer than 6cm. In previous series, spanning plates were not used, and complications including secondary bone grafting, fracture, and graft failure. Non-vascularized fibula autograft is also used for arthrodesis, and is a less invasive procedure with shorter operative time. This is historically used for defects shorter than 6cm.

Questions/Purposes:
What are the rates of union following reconstruction of the distal radius after wide excision of tumor using vascularized or non-vascularized fibula grafts?
What length of bony defect is successfully reconstructed?
Is there a difference in complications using vascularized vs non-vascularized fibula bone graft?

Patients and Methods: A prospectively collected database was queried for patients undergoing wide resection of a tumor of the distal radius followed by reconstruction by any method. The group was narrowed to include patients reconstructed with either vascularized or non-vascularized fibula autograft, and these two groups were compared. A retrospective chart review was performed. The extent of resection, length of bony defect, soft tissue defect, need for radiation/chemotherapy, method of reconstruction, tumor recurrence, bony union, complications, survival and functional outcome (based on MSTS score) were analyzed.

Results:
Fourteen patients were identified (eight male patients and six female patients). The average tumor size was 5.8cm in greatest length (range 3 to 9cm), and tumor type included giant cell tumor of bone (n = 9), sarcoma (n = 2), malignant fibrous histiocytoma (n = 1), and desmoid tumor (n = 1). One patient underwent preoperative radiation. Two giant cell tumors were recurrent. The average age of the patients was 34 years at time of surgery (range 7 to 59). In the first group, ten patients were reconstructed with a vascularized fibula. The average length of defect was 12cm (range 8.2 to 18.7cm), and 6 of these patients underwent primary local bone grafting at the index procedure. Four patients underwent non-vascularized fibula autograft reconstruction, with average length of defect 8cm (range 7.2 to 9.7cm). 3 of these 4 patients underwent primary bone grafting at the index surgery. Bony union was achieved in all patients, with overall average time to union of 4.8 months (median 4.5 months). For the non-vascularized group, average time to union was 5.7 months, and for the vascularized group, 4.5 months ($p < 0.05$). Follow up ranged from 1 to 10 years (median 3.5 years). The available MSTS scores ranged from 24 – 28, with no significant difference between groups. Major complications included one recurrent tumor, one postoperative hematoma, one failed tendon transfer with tendon exposure, significant scarring requiring extensor tenolysis, and two fractures. One fracture occurred in a patient with a 7.2 cm non-vascularized fibula graft – the plate was removed 2 years after the index operation, and

then 1 year later, he fell and fractured through the fibula graft. He was treated with iliac crest bone grafting and ORIF. A patient with a vascularized fibula graft sustained a third metacarpal fracture at the end of the plate after a fall 4 years postoperatively. He was successfully treated with immobilization.

Conclusions: Bony union can be achieved using either type of graft, by using rigid internal fixation, with or without local bone grafting. We found that non-vascularized fibula grafts can work in defects up to 10 cm, and vascularized fibula grafts can work in defects up to 18.7 cm. The historical criteria of 6 cm should not be the determining factor of whether to use a non-vascularized graft. It remains a multifactorial decision, taking into account age, health, defect size, need for coverage, potential need to remove hardware in the future, and need for chemotherapy or radiation. Regardless of length, rigid internal fixation should be used. The maximum length of a non-vascularized fibula in this setting is unknown, but durable reconstruction with 100% primary bony union rate and a good functional outcome can be achieved.

Figure 1. Radiograph of a resected specimen including carpus, distal radius, and distal ulna.

Selected References:

Clarkson PW, et al. Functional results following vascularized versus nonvascularized bone grafts for wrist arthrodesis following excision of giant cell tumors. J Hand Surg Am. 2013 May;38(5):935-940.e1
Han CS et al. Vascularized Bone Transfer. J Bone J Surg. 1992 Dec;74-A(10):1441-1449.

Weiland AJ, Moore JR, Daniel RK. Vascularized bone autografts. Experience with 41 cases. Clin Orthop Relat Res. 1983 Apr;(174):87-95.