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Case Report

Osteosarcoma of the Distal Radius Treated by Wide Resection and Reconstruction With a Vascularized Fibular Graft: A Case Report

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ABSTRACT

Background: Osteosarcoma is the most common primary malignant bone tumor; however, involvement of the distal radius is rare, accounting for less than 1% of cases. Reconstruction following wide resection in this anatomical region is technically challenging because of limited soft tissue coverage, complex wrist biomechanics, and the need to preserve upper limb function. Free vascularized fibular grafting has emerged as a reliable option for biological reconstruction of large skeletal defects.

Case Presentation: We reported the case of a 20-year-old male who presented with progressive pain, swelling, and deformity of the right wrist. Imaging studies revealed a destructive lesion of the distal radius with soft tissue extension. Core needle biopsy confirmed the diagnosis of osteosarcoma. After receiving neoadjuvant chemotherapy, the patient underwent wide tumor resection followed by reconstruction using a free vascularized fibular graft. Microvascular anastomosis was performed to recipient vessels at the wrist, and the graft was stabilized with internal fixation. Histopathological examination confirmed tumor-free surgical margins. Radiographic union was achieved during follow-up, and the patient regained satisfactory wrist stability and functional use of the hand. No evidence of local recurrence, infection, or distant metastasis was observed at the latest follow-up.

Conclusion: Free vascularized fibular grafting represents a reliable biological reconstruction technique for distal radius osteosarcoma, providing durable structural support and acceptable functional outcomes following oncologic resection.

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Introduction

The present study discussed the use of vascularized fibular grafts in reconstructing skeletal defects after the excision of bone tumors. Osteosarcoma is the most common primary malignant bone tumor with unclear origin, typically presenting in the second decade of life [1]. While the distal radius is a relatively common area for primary bone tumors, osteosarcoma in this location is uncommon; fewer than 1% of osteosarcomas arise in the distal radius [2]. Tumors of the distal radius present challenges because of their anatomy, histological type, tumor size, and potential mechanical dysfunction of the elbow or hand joint [3]. Described procedures include arthrodesis ulnar translocation, osteoarticular allograft, using bulk autograft, reconstruction with vascularized or non-vascularized fibular grafts, and prosthetic replacement [2-4]. Free vascularized fibular transfer can aid in rapid autograft incorporation in limbs affected by radiation or adjuvant chemotherapy [5]. Free vascularized fibular transfer offers the potential for rapid autograft incorporation in limbs affected by adjuvant chemotherapy or radiation. In the upper extremity, the fibula's tubular shape and easy access to recipient vessels render it one of the most promising areas for free fibular transfer. The fibula's size and contour closely resemble the radius and ulna diaphyses, making it an appropriate donor for reconstruction of substantial forearm bone loss. Such similarities mostly enable vascularized fibula reconstruction to produce a stable wrist and forearm [6-8]. Vascularized bone grafts (VBGs) have facilitated reconstruction of upper-extremity defects by offering superior regenerative capacity compared with non-vascularized grafts, the ability to repair large bone defects, and multiple donor-site options. VBGs can be used as pedicled or free transfers and may enable composite tissue transfers when both bone and soft tissue reconstruction are required [5]. This article reviews the use of vascularized fibular grafts in skeletal reconstruction, emphasizing long-term outcomes and improvements in patients' quality of life.

Case Presentation

Medical history

A 20-year-old male farmer with no significant medical history presented with progressive pain, swelling, and deformity of the right wrist. Physical examination revealed a hard, irregular mass on the dorsal and volar aspects of the distal radius, severe tenderness, reduced wrist range of motion, and decreased hand grip strength. Initial radiographs demonstrated a lytic lesion with indistinct margins and a permeative pattern extending beyond the bone (Figures 1 and 2). Magnetic resonance imaging (MRI) showed a hypointense lesion on T1-weighted images and a hyperintense lesion on T2-weighted and fat-suppressed images, with soft tissue extension (Figures 3, 4, 5 and 6). Technetium-99 m scintigraphy revealed increased uptake within the lesion, whereas chest CT scan showed no evidence of metastasis. Laboratory investigations, including blood counts, C-reactive protein (CRP), sedimentation rate (ESR), and alkaline phosphatase, were within normal limits. Core needle biopsy confirmed osteosarcoma. The patient underwent five cycles of neoadjuvant chemotherapy at three-week intervals before definitive wide resection and reconstruction with a vascularized fibular graft.

Operative technique

The patient was placed under general anesthesia, and the surgical site was prepared and disinfected. A longitudinal dorsal incision at the radiocarpal joint was made to approach the distal radius, and an elliptical excision was performed at the previous biopsy site. The tumor, involving both radius and ulna, was resected with wide margins, and the involved nerves were sacrificed.

Simultaneously, a vascularized fibular graft was harvested in a bloodless field, preserving a muscle cuff and the peroneal vessels up to their trifurcation. To minimize ischemic time, vessels were not divided until the recipient site was prepared. The graft was fixed proximally with a plate and distally to the metacarpal with a pin, and the ulna was stabilized intramedullary. End-to-end microvascular anastomoses were performed between graft and recipient vessels. The wound was closed in layers, and the limb was immobilized in a splint. Surgical margins were sent for histopathological evaluation. The incision healed without complications.

Postoperative care

Histopathological examination of the resected specimens confirmed tumor-free surgical margins. Two weeks after surgery, the patient received six cycles of adjuvant chemotherapy at three-week intervals, following the same regimen as preoperative therapy, and tolerated the treatment well. Informed consent for surgery and postoperative care was obtained from the patient and his family.

Results and follow-up

Postoperative radiographs (Figures 7, 8, and 9) demonstrated satisfactory graft placement and evidence of callus formation at the graft-host junction. The patient's

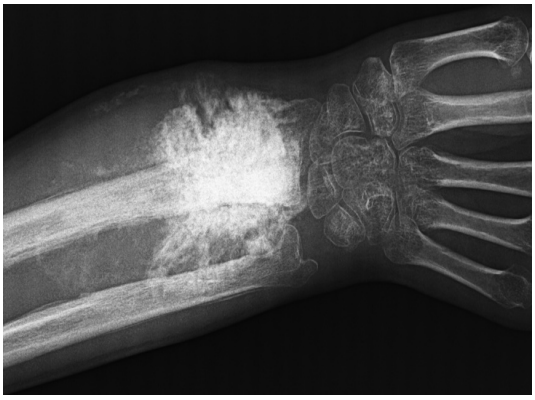

Figure 1. Initial anteroposterior radiograph of the patient at presentation

wrist and fingers were initially immobilized in a splint, with gentle mobilization exercises started to prevent stiffness. Physiotherapy was continued to restore hand grip strength and functional use. At one-month follow-up, there was no wrist deformity, instability, metastasis, or local recurrence. Pronation and supination were slightly limited due to injury to the posterior interosseous nerve (PIN); movements in the PIN innervation zone were lost. Despite this, the patient performed daily activities independently and reported satisfaction with functional outcomes. At final evaluation, complete bone graft union was confirmed, with no signs of infection or tumor recurrence. Vascularized bone grafts demonstrated robust healing and functional recovery, consistent with their ability to tolerate mechanical stress, even in patients receiving chemotherapy or radiotherapy.

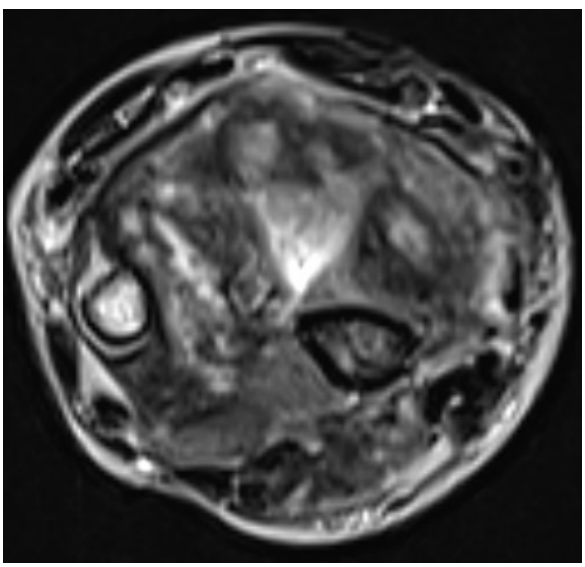

Figure 3. Axial view of the wrist region on T1-weighted MRI shows hypointense changes in the area with soft tissue involvement

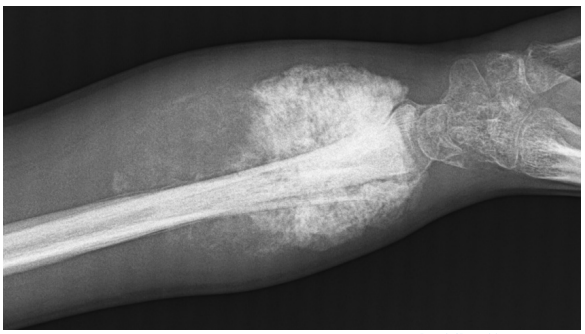

Figure 2. Initial lateral radiograph of the patient at presentation

Discussion

Osteosarcoma of the distal radius is extremely rare, and reconstruction following wide resection is technically demanding given limited soft tissue and complex biomechanics. Previous reports have documented various options, such as prosthesis, allografts, non-vascularized and vascularized fibular grafts for distal radius reconstruction after tumor excision, but very few specifically report osteosarcoma in this location [2]. Free vascularized fibular grafting offers viable biological reconstruction with living osteocytes and osteoblasts that facilitate primary healing and structural stability in large defects of the forearm and upper extremity [9]. Published studies have shown high union rates for free vascularized fibular grafts in forearm reconstruction, with many se-

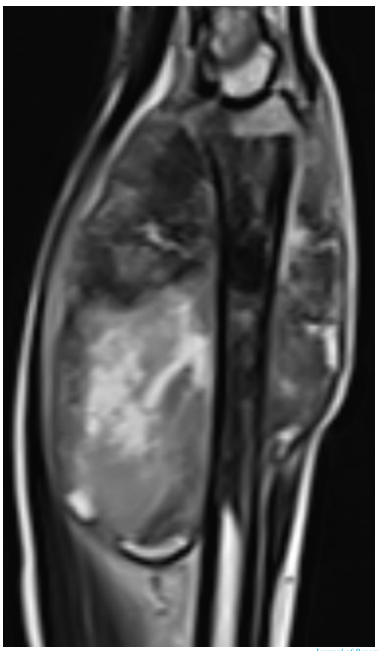

Figure 4. Sagittal view of the wrist region on T2-weighted MRI shows a soft tissue mass with medullary involvement of the radius

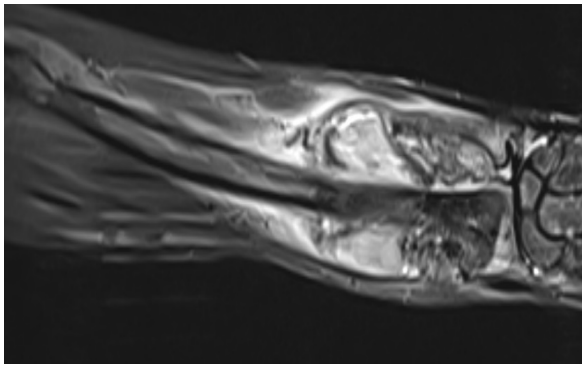

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Figure 5. Coronal view of the wrist region on T2-weighted MRI shows soft tissue edema, which overestimates tumor size

ries reporting reliable graft consolidation and functional outcomes [9]. Comparisons in the literature further demonstrate improved union and reduced complications with vascularized grafts compared with non-vascularized techniques for major skeletal reconstructions [10]. In extremity osteosarcoma reconstructions, vascularized fibular grafts have been applied successfully with satisfactory healing and functional outcomes across multiple sites [11]. In our case, the patient achieved complete graft union and was able to perform daily activities independently despite adjuvant chemotherapy, which corroborates the growing evidence that vascularized fibular grafts are a reliable option in complex oncologic reconstructions.

Conclusion

Free vascularized fibular grafting represents a reliable biological reconstruction technique for large skeletal defects following distal radius osteosarcoma resection. In this case, the procedure resulted in complete graft union, preserved wrist stability, and satisfactory functional recovery despite adjuvant chemotherapy. Vascularized

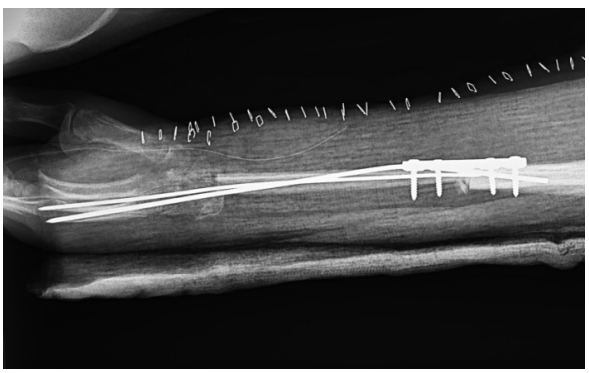

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Figure 7. First postoperative latral radiograph of the patient

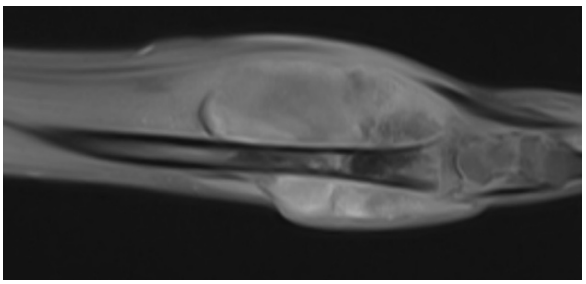

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Figure 6. Sagittal view of the wrist region on fat-suppressed MRI shows hyperintense changes in the soft tissue and hypointense changes in bone involvement

fibular grafts provide durable structural support and acceptable functional outcomes, making them a valuable limb-salvage option in complex oncologic reconstructions of the upper extremity.

Ethical Considerations

Compliance with ethical guidelines

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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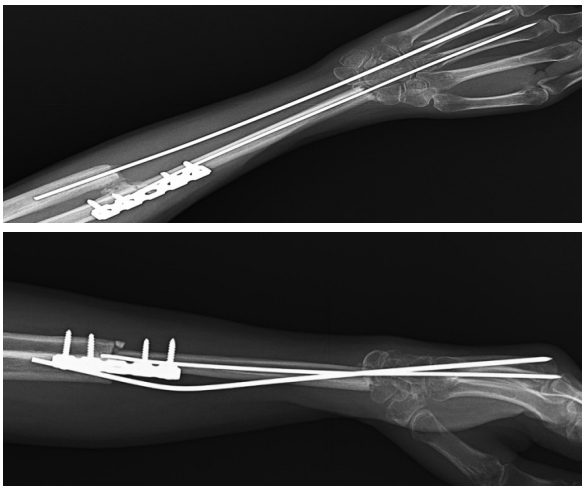

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Figure 8. Postoperative follow-up anteroposterior and lateral radiographs of the patient

Figure 9. Patient range of motion one year after operation

Authors' contributions

Study design: Khalil Kargar Shuraki, Sami Sam Hajialiloo, Babak Roshanravan and Alireza Moazen; Surgery and data collection: Amin Hamidzadeh Khiavi, Yousef Barati; Data analysis: Khalil Kargar Shuraki and Sami Sam Hajialiloo; Writing the original draft: Amin Hamidzadeh Khiavi, Yousef Barati, Khalil Kargar Shuraki and Sami Sam Hajialiloo; Supervision, review and editing: Babak Roshanravan and Alireza Moazen.

Conflict of interest

The authors declared no conflict of interest.

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