

IMPROVING SURGICAL OUTCOMES IN BENIGN AND MALIGNANT FOREARM BONE TUMORS

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ABSTRACT

Forearm bone tumors pose significant challenges in orthopedic oncology due to the complex anatomy and biomechanics of the radius and ulna. This study analyzes modern surgical strategies for benign and malignant forearm tumors, focusing on limb-sparing resections, vascularized fibular grafting, and patient-specific implant technologies. Results indicate that combining radical tumor excision with advanced reconstruction reduces recurrence, improves functional outcomes (MSTS scores 80–90%), and enhances quality of life. A multidisciplinary individualized approach is essential for optimal results.

Keywords: forearm bone tumors, limb-salvage surgery, vascularized fibular graft, orthopedic oncology, surgical reconstruction, MSTS scoring, radius, ulna.

1. INTRODUCTION

Primary forearm bone neoplasms represent a clinically significant subset of musculoskeletal tumors requiring precise surgical management. The coordinated function of the radius and ulna — enabling pronation, supination, and grip — makes oncological resection particularly demanding. Over recent decades, the treatment paradigm has shifted decisively from radical amputation toward limb-preserving surgery. However, balancing oncological safety with functional preservation remains a central challenge. Advances in imaging, biomaterials, and reconstructive microsurgery have expanded the therapeutic options, yet a unified evidence-based algorithm is still needed.

2. MATERIALS AND METHODS

This systematic analytical review examined peer-reviewed literature from PubMed/MEDLINE, Scopus, and the Cochrane Library (2005–2024). Included studies addressed: (1) intralesional curettage and segmental resection for benign lesions; (2) wide en-bloc resection for malignant tumors; (3) preoperative planning using MRI, CT, and 3D virtual modeling; and (4) vascularized versus non-vascularized bone grafts. Functional outcomes were measured using the Musculoskeletal Tumor Society (MSTS) score. Studies with a minimum 24-month follow-up were prioritized.

3. RESULTS AND DISCUSSION

Wide en-bloc resection with histologically confirmed negative margins remains the oncological gold standard for malignant forearm tumors (osteosarcoma, Ewing sarcoma). Vascularized free fibular grafting demonstrated superior biological integration, with union rates of 85–94% and mean consolidation at 4–6 months, outperforming conventional allografts. Patient-specific 3D-planned implants significantly improved articular reconstruction of the radiocarpal and distal radioulnar joints, restoring rotational kinematics with greater precision.

For benign aggressive lesions (giant cell tumor, aneurysmal bone cyst), extended curettage with high-speed burring and PMMA cementation reduced local recurrence to 8–12%, compared to 25–40% with curettage alone. Neoadjuvant chemotherapy achieved tumor volume reduction in 60–75% of malignant cases, increasing eligibility for limb-salvage. Postoperative MSTS scores of 80–90% were achieved when early structured rehabilitation commenced within the first postoperative week.

4. CONCLUSION

Optimal management of forearm bone tumors requires an integrated, individualized strategy uniting oncological radicality with functional reconstruction. Vascularized

grafting, patient-specific implants, 3D preoperative planning, and early rehabilitation constitute the current evidence-based standard. Prospective multicenter studies are needed to further standardize outcome reporting and refine clinical guidelines.

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