

Current Concepts and Advances of Three-Dimensional Printing in Reconstructive Musculoskeletal Oncology: A Systematic Review

INTRODUCTION: Three-dimensional (3D) printing has revolutionized surgical practice, by way of anatomic and pathologic structure analysis and customized implant manufacturing. Potential applications for this technology include preoperative planning, prosthesis customization, and bioprinting. This review evaluates the current trends, applications, and outcomes of 3D printing in orthopaedic oncology.

METHODS: A comprehensive literature review of PubMed, Embase, Cochrane, Scopus, and Web of Science databases was conducted to extract all studies adopting 3D printing in the operative management of primary and metastatic musculoskeletal tumors.

RESULTS: A total of 73 articles reporting on 449 patients were deemed eligible for analysis. Volumetric 3D models were utilized in 110 (24.5%) individuals, combined with either customized prostheses or specific surgical guides and jigs in 50 (11.1%) and 43 (9.6%) patients, respectively. Indications of 3D printing use consisted mainly of challenging tumor locations and proximity to neighboring neurovascular structures (232 [51.7%] patients) or anticipated high complication rates (142 [31.6%] patients). Operative time and follow-up averaged 240 minutes (4 hours) and 25.8 months, respectively. The majority of patients (327 [72.8%] of 449) in whom 3D printing technology was used did not exhibit any complication or adverse event during or after their surgery, and most (354 [97.3%] of 364) subjects achieved convenient functional (enhanced autonomy, range of motion, ambulation, and pain) and oncological (improved tumor-free surgical margins and operative time) outcomes at last follow-up.

DISCUSSION: The implementation of 3D printing technology in the treatment of bone and soft-tissue tumors is safe and efficient, as evidenced by the satisfactory functional and oncological outcomes with decreases in operative time and complication rates. With recent innovations, 3D printing has become well-fitted for application in orthopaedic oncology.