Three-Dimensional Printing-Based Custom Reconstructions for Limb Salvage in Patients with Bone Tumors: A Multi-Institutional Retrospective Case Series of 105 Patients

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INTRODUCTION:

Three-dimensional (3D) printing is an emerging technology for reconstruction of large bone defects after tumor resections or complex revision surgeries, especially in specific sites where modular prostheses are not available. Aims were 1) indications and designs of 3D-printed prostheses for complex reconstructions; 2) complications rate considering site; (3) oncologic and functional outcomes.

METHODS: This is a multi-institutional retrospective case series reviewing these novel reconstructive implants that impart mechanical stability mainly to the pelvic ring. We analyzed 105 patients (males 38%, mean age 45 years/range 10-78 years), in whom a custom-made 3D printed prosthesis was used from 2009 to 2022 in two referral centers. There were 67 primary tumors (63%), 27 metastatic lesions, and 11 non-oncologic patients. Pelvis was the most frequent site (93, 88%). Reconstruction included articular replacement (72% of the cases), whereas a combined spinopelvic implant has been used in 35 cases.

RESULTS: The 5 year-survival rate was 89% (sarcoma group) whereas mean survival in metastatic group was 2 years. Overall complication rate was 29% (31/105 patients), mainly wound related problems and infection, 4 mechanical failures, 1 hip dislocation. Recurrence occurred in 12 patients. None of the following factors (site, pathologic fracture, adjuvant treatments, primary/revision implants) significantly affect survival to complication at both univariate and multivariate analysis. Survival was related to tumor histotype, range of resection, recurrence, and time of diagnosis ($p<0.05$). Mean MSTS score at final follow up was 73% (range, 23%-100%).

DISCUSSION AND CONCLUSION:

Custom-made 3D-printed prostheses represent a good reconstructive technique, maintaining the correct indications for their use. Complication rate is acceptable, with infection and wound healing problems. Osseointegration is necessary to reduce loosening in different clinical stages.