3D-Printed vs Non-3D-Printed Endoprosthetic Reconstruction Following Surgical Removal of Pelvic Tumors: A Systematic Review and Pooled Analysis of Functional Outcomes

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INTRODUCTION: The pelvis is the most common site of primary and secondary malignant bone tumors. Pelvic tumors are historically associated with a poor prognosis due to the complex anatomy and neurovasculature of the pelvis. Resection is an ideal treatment modality, and there is high demand to identify reconstructive surgical options that allow for optimal restoration of mobility and improvements in patient quality of life. The use of 3D-printing to produce custom endoprosthetics is an active area of research and literature has suggested a favorable early safety profile. However, there has been insufficient data succinctly gathered to determine if it has demonstrated the ability to improve functional outcomes in patients who receive them. This study aims to evaluate functional outcomes in patients who underwent reconstruction with 3D-printed endoprosthesis compared to non-3D-printed endoprosthesis following pelvic tumor resection to determine if 3D-printed endoprosthesis is a favorable reconstructive option.

METHODS: A systematic review was conducted according to the PRISMA 2020 guidelines. Five online databases (Pubmed, Web Of Science, Embase, Scopus, Cochrane) were searched using MeSH key terms and Boolean operators were applied to identify studies. Included in the analysis were retrospective and prospective cohort studies which utilized 3D-printed or non-3D-printed endoprosthetics for reconstruction following pelvic, acetabular, or periacetabular tumor resection, limb salvage surgery, or internal hemipelvectomy and reported Musculoskeletal Tumor Society (MSTS-93) scores at follow-up. Case series, cadaveric studies, studies with an exclusively pediatric population, studies evaluating the use of allograft- or autograft-prosthetic reconstruction, and articles without an English translation available were excluded. 46 studies evaluating 963 total participants with a mean follow-up time of 50.62±25.37 months in the non-3D-printed group and 26.7±10.21 months in the 3D-printed group met inclusion criteria. 27 studies (545 participants) were in the non-3D-printed group and 22 studies (418 participants) were in the 3D-printed group. MSTS-93 scores, which measure overall pain, function, emotional acceptance, use of supports, walking ability, and gait, were analyzed as the primary outcome.

RESULTS: A pooled analysis with weighted averages was performed to compare functional outcomes following pelvic tumor resection and endoprosthetic reconstruction. 3D-printed endoprosthesis showed significant ($p<0.001$) and large (Cohen's $d=1.04$) treatment superiority compared to non-3D-printed endoprosthesis. The weighted average MSTS-93 score for the 3D-printed group was 22.13±3.16, while the weighted average MSTS-93 score for the non-3D-printed group was 18.81±3.22.

DISCUSSION AND CONCLUSION: In this systematic review and pooled analysis of 46 studies, it was found that the use of 3D-printed endoprosthesis for reconstruction following pelvic tumor resection resulted in significantly improved MSTS-93 scores at follow-up compared to non-3D-printed endoprosthesis.