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Research Abstracts

Three-Dimensional Printing in Surgical Education: An Updated Systematic Review of the Literature

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Introduction: Three-dimensional printing (3DP) is being integrated into surgical practice at an impressive pace, from preprocedural planning to procedure simulation. 3DP is especially useful in surgical education, where printed models are highly accurate and customizable. The aim of this study is to evaluate how 3DP is being integrated most recently into surgical residency training.

Methods: We performed a structured literature search of the OVID/MEDLINE, EMBASE, and PUBMED databases in adherence to PRISMA guidelines. Articles that met predefined inclusion and exclusion criteria spanning June 2016 to June 2023 were appraised for the key objectives of the review. Data extracted included surgical subspecialty using 3DP, application of 3DP, and trainee-reported satisfaction measures. Statistical analysis was performed with Microsoft 365 Suite software.

Results: Our search yielded 192 titles for screening which was narrowed to 90 articles after full text review. Across all extracted studies, 14 surgical disciplines were represented. ENT/otolaryngology represented the specialty with the highest recorded use of 3DP models for residents and medical students (23.15%), followed by neurosurgery (12.63%) and urology (10.52%). Plastic and reconstructive surgery represented only 5.26% of specialties using 3DP. 3DP models were created most frequently to model soft tissue (37.77%), bone (24.44%), vessel (13.33%), mixed (14.44%), or whole organ (6.66%) (Fig.1). Feedback from trainees was overwhelmingly positive regarding fidelity of the models and their support for integration into their training programs.

Conclusions: There is wide variation in the surgical specialties utilizing 3DP models in training. These models are effective in increasing trainee comfort with both common and rare scenarios and are associated with a high degree of resident support. Objective evaluations of their pedagogic effects on residents are areas of future research. The growing assimilation of 3DP models, particularly in subspecialties where their use is not yet widespread, has the potential to strengthen future surgical curricula.

Represented Surgical Specialties

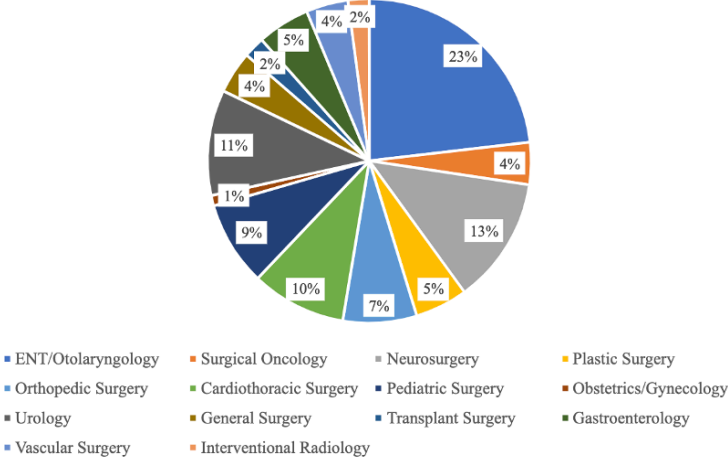


Figure 1: Represented surgical subspecialties with published reports of three-dimensional printing models utilized for surgical education among residents or medical students. Values listed as percentages, rounded to the nearest whole integer.