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3D Printed Liver Models as a Tool to Improve Pre-Surgical Consultation and Enhance Patient Consent

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SI/DES ABSTRACT

Project Title: 3D Printed Liver Models as a Tool to Improve Pre-Surgical Consultation and Enhance Patient Consent

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Background: 3D printing has recently emerged as an effective, cost-efficient tool for healthcare innovation. We propose the fabrication of 3D printed, patient-specific liver models as a pre-surgical planning and communication tool for liver resection surgery.

Methods: Creation of the model began with the segmentation of the patient's abdominal CT scan, where specific sections of their anatomy, including the blood vessels (portal and hepatic systems), gallbladder, and tumor (when applicable), were digitally segmented. Each structure was then printed in a unique color using polylactic acid (PLA) plastic filament on an Ultimaker 5s printer. Once printed the components were arranged anatomically and placed in clear silicone representing the liver parenchyma. The model was presented to the surgical team pre-operatively, as well as given to the patient during their pre-operative consultation.

Results: Two models were successfully printed from patient scans, both providing an accurate full-scale representation validated by the surgical team. The 3D printing time totaled 51 hours and was completed in two consecutive days with the utilization of three printers. The complete fabrication process, including the silicone curing, was accomplished in four days. The cost of materials to produce each liver was estimated at 113USD.

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Conclusions: Our results show 3D printed models are promising emerging technologies for improving aspects of surgical care. Although limited in scale, our work suggests custom anatomic models are feasible and cost-efficient within the timeframe of liver resection surgery. Moreover, anecdotally, the surgical team and patient valued the model as a teaching and communication asset. Further studies will be needed to better quantify the effects of 3D printed models on pre-surgical utility, patient satisfaction, and, more broadly, on their health outcomes.

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