

## Use Of Real-time Mixed Reality Intraoperative Navigation With Microsoft HoloLens 2 In Complex Liver Surgery

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**Background :** Mixed reality (MR) enhances the real-world environment thanks to the simultaneous integration with computer-generated images. Extending the use of MR technologies from medical teaching and training to surgical planning and intraoperatively is aimed at facilitating surgeons, especially in complex cases.

**Methods :** Virtual liver reconstructions using Synapse 3D®-Fujifilm software have been performed, creating 3D anatomical models that can be limitlessly edited in all their components including tumour nodules, vessels and solid structures, also simulating resection options and calculating remnant volumes. The models are visualised and controlled with Microsoft HoloLens 2® linked through a synchronized virtual network (VSI® software). The MR allows to have 3D models always available while not looking away from the surgical site.

**Results :** Twenty-three patients have undergone MR-guided liver resections with curative intent between 6/2021-12/2021 for hepatocellular carcinoma (7, 30.4%), cholangiocarcinoma (4, 17.4%), colorectal liver metastases (8, 34.8%) or other primary or secondary liver tumours (4, 17.4%). Six cases (26.1%) were anatomical right or left hepatectomies, 2 central hepatectomies (8.7%) and 15 of them complex, multiple, non-anatomical resections (65.2%) with tumour locations in the proximity of major liver vessels. All procedures were completed successfully and consistently with the pre-operative planning, and the workload of the surgeons has been evaluated with the NASA task load index resulting in an average weighted rating of  $65 \pm 7$ .

**Conclusions :** MR real-time navigation during complex liver resections allows to access essential and accurate information without interrupting the procedure, in order to increase accuracy in locating tumours, delineate resection planes, obtain clear margins, preserving vessels and reduce risk of damages. This preliminary series to establish feasibility of real-time intraoperative MR navigation in liver surgery showed the huge potentiality of this technology and sets the ground for further studies.

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