ISLS INTERNATIONAL SOCIETY OF LIVER SURGEONS

ISLS STS 2024 Seoul

INTERNATIONAL SOCIETY OF LIVER SURGEONS
SINGLE TOPIC SYMPOSIUM

March 18 (Mon) - 19 (Tue), 2024 | Grand Walkerhill Seoul, Seoul, Korea

LS-1111

Metaverse-integrated XR technology for conveying optimal techniques and spatial maneuvers in robotic and laparoscopic hepatobiliary pancreatic surgery

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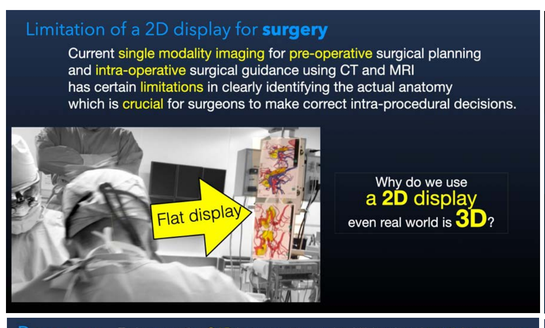
Keywords: VR, AR, MR, XR, Extended Reality, Metaverse, Surgical Training, Skill Acquisition.

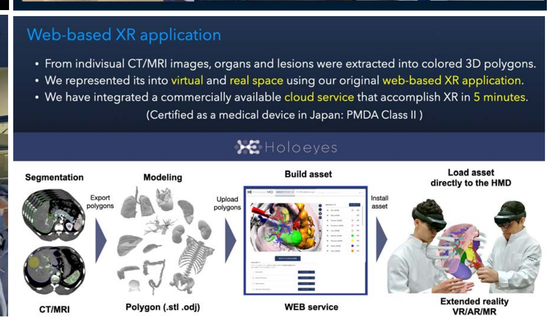
INTRODUCTION

In hepatobiliary and pancreatic procedures involving traditional robotic and laparoscopic surgeries, challenges often arise in spatial orientation. Surgical success hinges on the effective communication of optimal techniques and spatial maneuvers.

This study investigates the use of metaverse and extended reality (XR) technology to improve spatial awareness and to create an innovative training method for the acquisition of surgical skills.

It aims to evaluate the effect of an XR-enhanced surgical support system, combined with metaverse capabilities, on enhancing spatial visualization, surgical precision, and training efficiency in both robotic and laparoscopic hepatobiliary pancreatic surgeries.

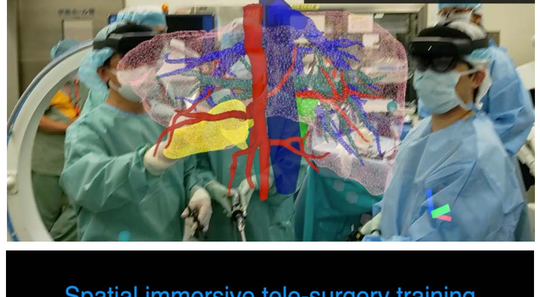


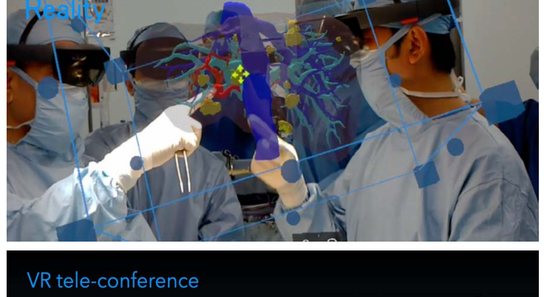


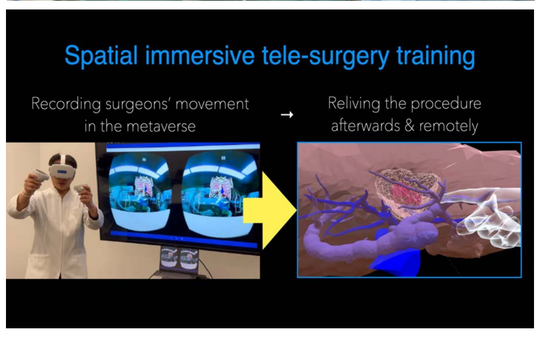
METHOD

This study encompassed 20 hepatobiliary pancreatic surgeries conducted within an XR-supported environment. Surgeons' hand movements were spatially and temporally recorded within the metaverse, facilitating postoperative re-experience and analysis.

This immersive method, enhanced by patient-specific 3D-CT holographic projections, aimed to diminish the learning curve associated with complex surgical maneuvers.



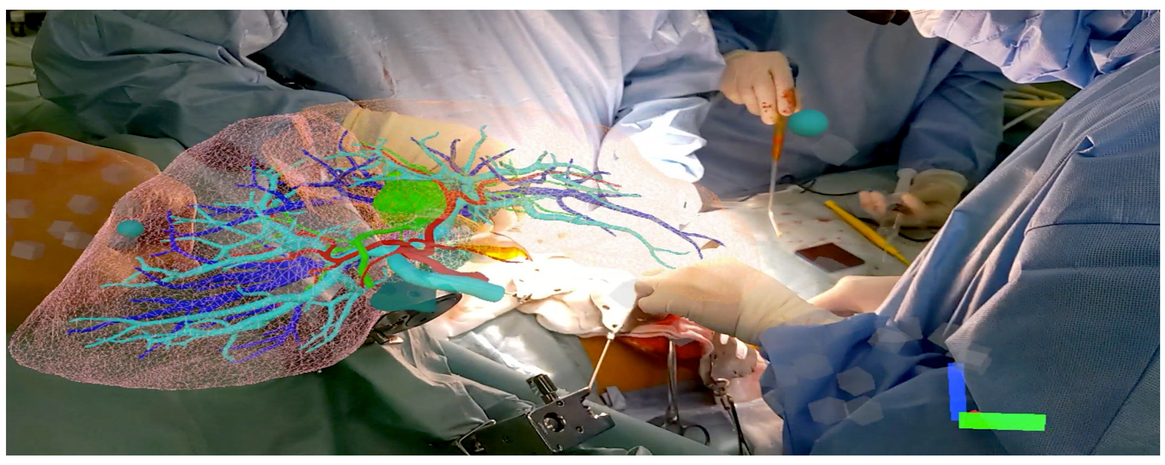


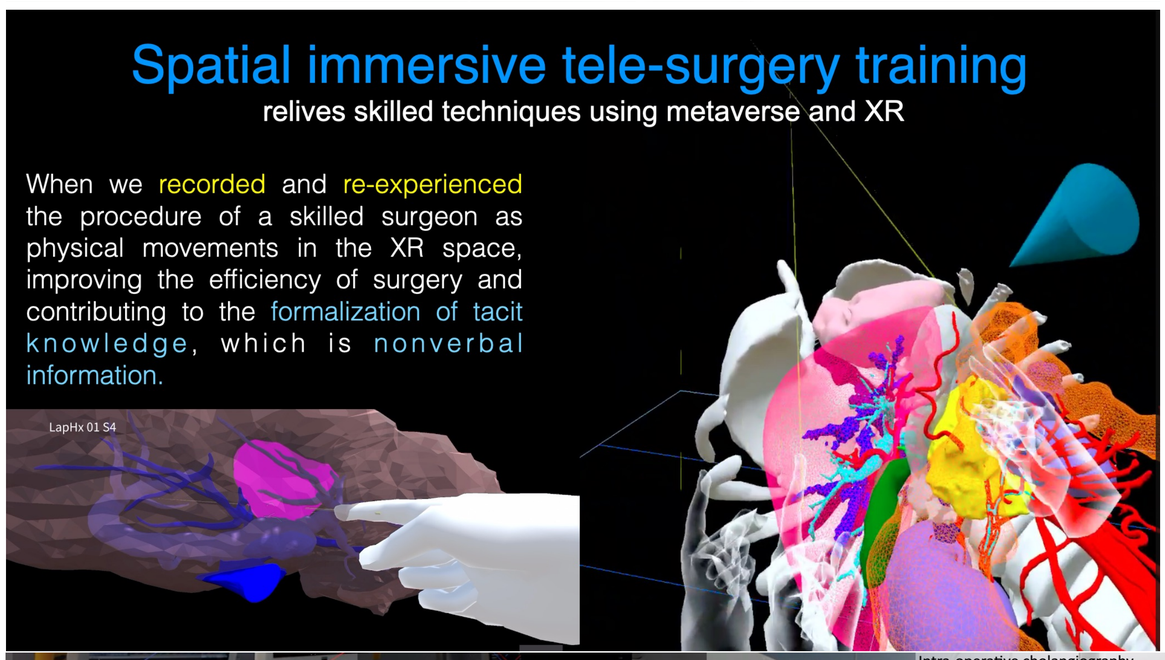


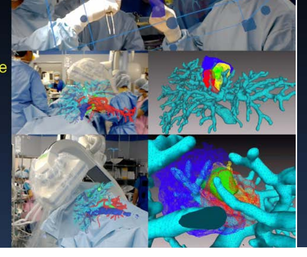
RESULTS

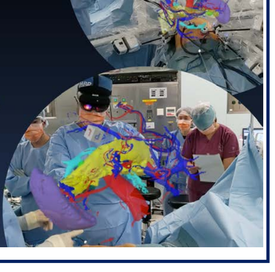
The metaverse-XR system effectively captured and replayed surgeons' movements, introducing a novel training approach whereby implicit surgical techniques could be physically internalized. This strategy decreased the time needed to acquire mastery in surgical skills.

The system proved to be efficient in both robotic and laparoscopic procedures, ensuring precise holographic representations of the liver, biliary tract, and pancreas, and aiding in collaborative planning. The setup time averaged 5 minutes without leading to an increase in postoperative complications.









Discussion

- This has illustrative benefits in surgical planning, simulation, training, and education.
- The spatial surgical image-guided simulation provided better anatomical reference tool as a tailor made guidance
- in MIS surgeries, and contribute to medical safety and accuracy, less-invasiveness and improvement of the medical education.
- This was also useful for recording surgical procedures in VR space and for handing down surgical skills to the next generation.

Conclusions

Our cross-platform XR collaboration App enabled holographic telepresence through augmented reality, turning any operation rooms into a 3D workspace.

With our system, users connect remotely and express ideas seamlessly using avatars, unlocking a new level of computing that is not confined by space, no matter what device they are using.

CONCLUSIONS

Integrating metaverse and XR technologies into robotic and laparoscopic hepatobiliary pancreatic surgeries introduces a groundbreaking training paradigm.

It not only enhances spatial awareness and precision during surgeries but also offers a potent tool for skill acquisition and mastery, setting the stage for the development of advanced surgical training methods.

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