Augmented Reality in Facial Plastic & Reconstructive Surgery: A Systematic Review

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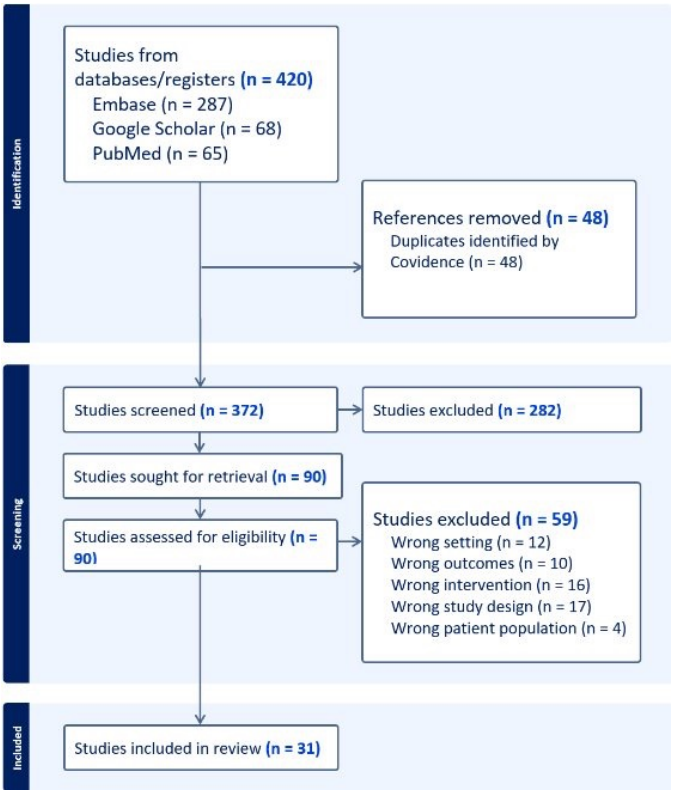
INTRODUCTION

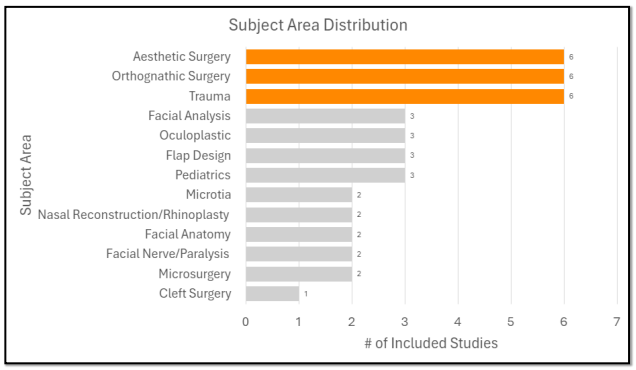
In recent years, virtual and augmented reality has taken an emerging role in expanding the educational and operational toolset in different fields, including facial plastic and reconstructive surgery (FPRS). Current literature suggests that augmented reality can increase surgical precision, reduce planning and operative times, and improve outcomes at many stages of care. This literature review aims to cover the landscape of applications for augmented reality in FPRS, its uses, limitations, and future directions.

METHODS

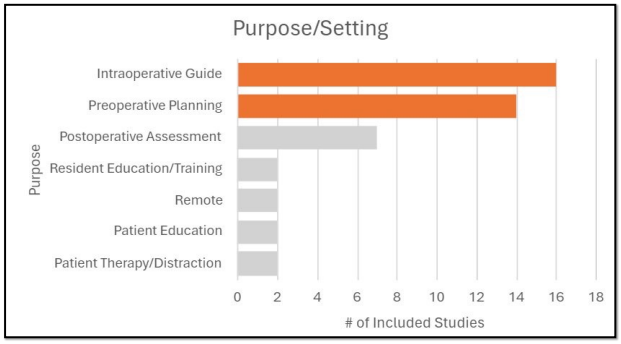
A review examining the landscape of augmented reality in facial plastic surgery was conducted using PubMed, Google Scholar, and EMBASE and was organized with Covidence. Search terms include a combination of "augmented reality," "facial plastic surgery," "oral and maxillofacial surgery," "simulation," "training", "rhinoplasty", "microtia" "cosmetic surgery", "flap" and "facial analysis". The review was conducted as displayed in the PRISMA diagram.



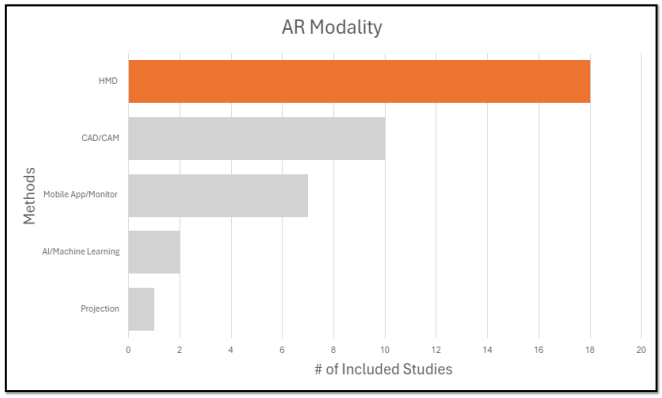
RESULTS



Note: Subject area reflects the area of application within Facial Plastic & Reconstructive Surgery. Some included studies may fall within multiple categories.



Note: This chart demonstrates the different purposes and settings AR was used in the included studies. Some included studies may fall within multiple categories.



Note: CAD: computer assisted design, CAM: computer assisted modification, HMD: head mounted display (i.e., Microsoft HoloLens 2), AI: Artificial Intelligence. Studies represented may fit into multiple categories depending on their applications.

CONCLUSIONS

This systematic review revealed multiple applications of AR within FPRS, spanning from microtia reconstruction to facial skin tension line display for flap design guidance. The most common areas of application are within hard tissue reconstructions, such as orthognathic surgery and trauma. AR has a role in both intraoperative guidance and preoperative consultation. The most common AR modality is HMD, with CAD/CAM and mobile app/monitor following closely behind.

Future Directions

- It can be more difficult to use AR on soft tissue reconstruction than hard tissue reconstruction like bone, teeth, and cartilage
- Image alignment can be more difficult when tissue has been surgically rearranged
- AR equipment can be expensive and difficult to acquire in places with low resources
- Current AR applications are in their early stages and need further research to determine their value in clinical environments
- AR technology may have a steep learning curve for some unfamiliar users slowing down immediate uptake
- Generation of dynamic image alignment could bridge the barrier between soft tissue AR use (e.g., facial analysis or soft tissue recon) and hard tissue AR use (e.g., orthognathic surgery and trauma)

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