Applications of Augmented Reality for Middle Ear and Lateral Skull Base Surgery

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No Disclosures
Outline:

- What is Augmented Reality
- Early examples of Augmented Reality
- Current methods for AR – advancements and limitations
- Future applications of AR – is there a possibility of widespread use?
What is Augmented Reality?

- Augmented Reality (AR) combines real-world environments with virtual objects.

- Using any computer, tablet, or smartphone, 3D models are superimposed into a live camera view.

- Coordinates for objects can be marker-based and cloud-based.

- Models using medical imaging data could visualize surgical anatomy in 3D
Augmented Reality Systems for Medical Applications

Improving Surgical Procedures by Enhancing the Surgeon’s “View” of the Patient

“Using an AR system, the user’s view of the real world is enhanced [...] in the form of labels, 3D rendered models [...]

“Using rigid transformations relating each coordinate system with reference to a world coordinate system, the object-of-interest in the real world can be registered spatially with the computer generated object.”

Augmented reality systems for medical applications.
Tang SL, Kwoh CK, Teo MY, Sing NW, Ling KV.

1 School of Mechanical and Production Engineering, Nanyang Technological University, Singapore.
Brief History of Medical Applications of AR

A head-mounted three dimensional display*

by IVAN E. SUTHERLAND**

The University of Utah
Salt Lake City, Utah

Published in AFIPS Fall Joint Computing Conference
1968
Brief History of Medical Applications of AR

Augmented Reality in Surgery
Jeffrey H. Shuhaiber, MD

WHAT DOES THE FUTURE HOLD FOR AR?

- “Despite the basic function of AR systems as ‘x-ray vision’ for surgical planning, the system extends to robots and simulation.”

- “Very experienced surgeons can benefit from such systems by extending the limit of a safe area to allow for more complete and radical operative therapy, while less experienced surgeons may at least benefit by being oriented to critical anatomic landmarks.”

- “Advancing AR to become user-friendly has rekindled interest in real-time surgical anatomy.”

Accepted for publication July 12, 2003.
Current methods for AR


Applications of Augmented Reality in Otolaryngology: A Systematic Review.

Wong K¹, Yee HM², Xavier BA³, Grillone GA².

23 articles representing 18 AR platforms

<table>
<thead>
<tr>
<th>Specialties</th>
<th>Applications</th>
<th>Visual Input</th>
<th>Tracking/Registration</th>
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<tbody>
<tr>
<td>Rhinology (52.2%)</td>
<td>Intraoperative Navigation (54.5%)</td>
<td>Endoscopic (50%)</td>
<td>Optical Trackers (38.9%)</td>
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<td>Head and Neck (30.4%)</td>
<td>Surgical Planning (24.2%)</td>
<td>Eyewear (22.2%)</td>
<td>Fiducial Markers (44.4%)</td>
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<tr>
<td>Neurotology (26%)</td>
<td>Procedural Simulations (9.1%)</td>
<td>Microscopes (4.5%)</td>
<td></td>
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Cadaveric feasibility study of da Vinci Si-assisted cochlear implant with augmented visual navigation for otologic surgery.

Liu WP¹, Azizian M², Sorger J², Taylor RH³, Reilly BK⁴, Cleary K⁵, Preciado D⁴.

Figure 3. Augmented Reality on Surgical Field of View
A Cautionary Tale

- Users endorsed visual fatigue
- On average, participants made errors of up to 5.9 mm in length (versus 2.8 mm during the naked eye tasks) with gaps up to 5.8 mm
- Depth of focus makes accommodation difficult between real and virtual objects

(Condino 2019)
Future Applications of AR for EES

- Heads up Display VS Augmented Glasses / Headset

- Registration: Fiducial-based VS Surface-based VS Point Cloud
Future Applications of AR for EES

- New, additional equipment VS utilize existing systems
Future Applications of AR for EES

- Pre-operative Planning vs Intraoperative Navigation

Barber 2018
Future Applications of AR for EES
- Pre-operative Planning vs Intraoperative Navigation

Barber 2019
References