## ACS 2025 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

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## **Research Abstracts**

## Virtual Reality Anatomical Simulation for Skull Based Surgery

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**Introduction:** There is limited literature on virtual reality (VR) simulations in skull base surgery. We aim to outline the technical development, participant evaluation, and future directions of a VR simulation for anterior skull base surgery.

**Methods:** A multidisciplinary group of physicians, computer scientists, and medical illustrators contributed to a VR surgical simulation for anterior skull base surgery. Skull and vascular anatomy from a computed tomography scan was segmented using Amira and refined in ZBrush for anatomical accuracy. Models were retopologized to reduce total polygon count and optimize for VR. A prototype VR application was created in ShapesXR, imported into Unity engine, and viewed with the Meta Quest 3 headset. Medical trainees were surveyed using the 5-point Likert scale following a skull base anatomy course utilizing VR and cadaveric dissection.

**Results:** Challenges of developing the VR simulation included reconstructing thin anatomical areas from segmented data, including skull base foramina and paranasal sinuses. Sixteen participants completed the skull base anatomy and dissection course, including 3 medical students, 12 otolaryngology and neurosurgery residents, and 1 surgical faculty. The average age of participants was 28.8 years (range: 22 - 40 years). Course surveys demonstrated 75% of participants agreed or strongly agreed that the VR/3D model was helpful in preparing for endoscopic dissection. All course participants agreed (44%) or strongly agreed (56%) that they would recommend VR/3D model training prior to endoscopic dissection and/or operative experience. The most significant barrier to using the VR simulation was the learning curve of the VR technology (56%).

**Conclusions:** High-fidelity anatomical VR simulations allow surgical trainees to learn procedures in a lowrisk environment. Our study suggests a skull base VR simulation is a helpful learning tool prior to completing complex skull base procedures in the operating room. Further work will focus on increasing anatomical fidelity and usability of the VR simulation.

Participant responses to skull base virtual reality simulation (n=16)			
The VR/3D model review was helpful in preparing for endoscopic dissection.	Neutral	4	25%
-	Agree or Strongly Agree	12	75%
The VR/3D model had high fidelity compared to endoscopic dissection.	Disagree	3	18.8%
-	Neutral	6	37.5%
-	Agree or Strongly Agree	7	43.8%
I would like more VR/3D models integrated into surgical simulation education.	Agree	7	43.8%
	Strongly Agree	9	56.2%
I would recommend VR/3D model training prior to endoscopic dissection and/or operative experience.	Agree	7	43.8%
- -	Strongly agree	9	56.2%