# UNIVERSITY OF MANITOBA

# Gesture-Controlled Interactive Three-Dimensional Anatomy: A Novel Teaching Tool in Head and Neck Surgery

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## Objective

- **Creation of a temporal bone gesture-controlled 3D teaching tool. Using this tool, anatomy can be manipulated with the use of hand gestures, in the absence of mouse or keyboard.**

## Introduction

- Head and neck anatomy has proven to be an ongoing challenge in medical education
- Complex soft tissue structures are situated throughout the temporal bone
- Learning places severe demands on visuo-spatial capabilities.
- Novel learning tools are needed to aid spatial learning
- 3D projections permit viewing of structures from numerous vantage points aiding understanding of spatial relationships[1-4].
- In our system, 3D data can be manipulated through both haptic and standard control techniques.
- The virtual environment facilitates scene augmentation with possible overlay of labels, DICOM data, and animations[5,6].
- Interaction with the virtual environment may enhance learning[1,2,5,6].

## Materials and Methods

- 3D models are generated from CT data by bone and soft tissue segmentation
- The segmented model is exported in a polygonal mesh format to a in-house developed 3D graphics engine
- A Microsoft Kinect™ detects body motions generating inputs based on scene depth, colour, and joint locations (displayed as an avatar in the scene).
- Both the left and right hand are tracked relative to the position of the user's left shoulder

## Results

- The tool successfully tracked scene depth and user joint locations, permitting gesture control.
- Stereoscopy was deemed appropriate and useful by a cross-section of experts and learners
- Images can be selected, translated, magnified and rotated with simple body motions.
- Specific anatomical structures can be selected from within the larger virtual environment.
- Voice commands employing the Kinect's™ intrinsic speech library works, yet is easily confounded by environmental noise.

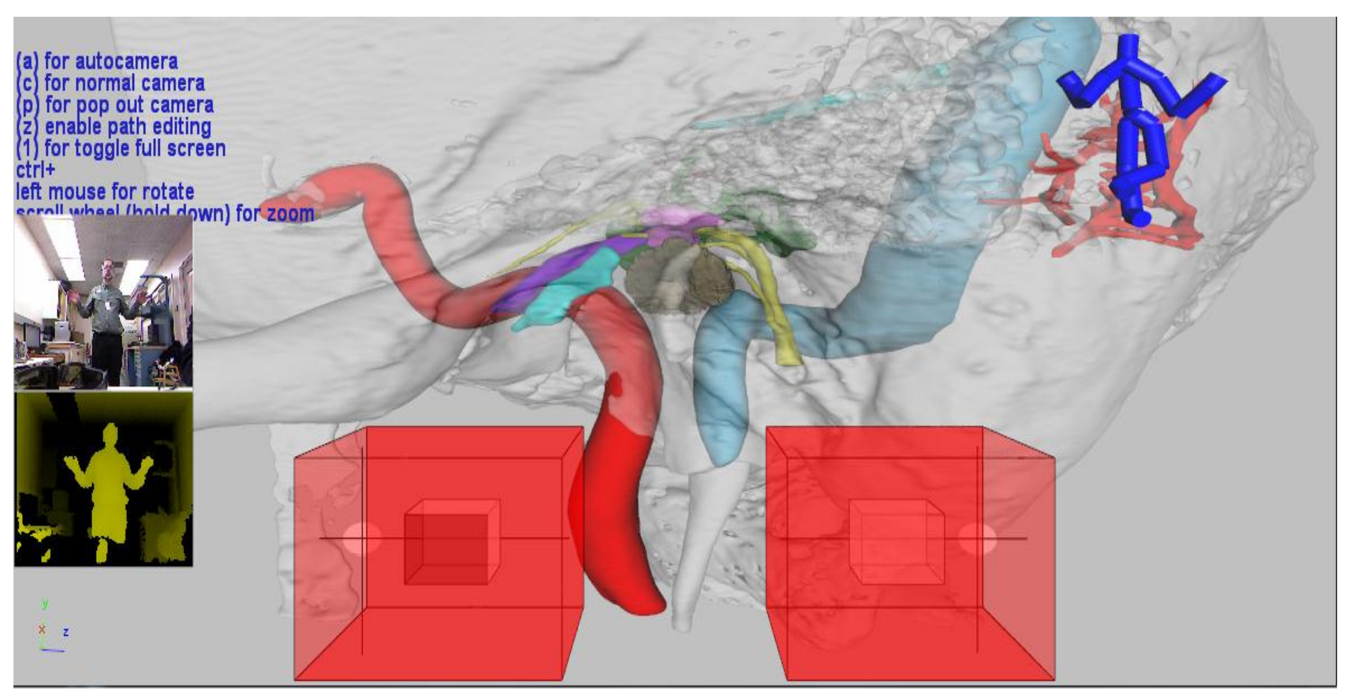

**Figure 2. Screen shot of 3D Kinect™ Gesture Controlled Demo.**
**Note the large red control cubes in the foreground. The left-hand cube controls translational movement while the right-hand cube controls rotation and orientation.**
**The user is shown in colour camera and infrared depth sensor images on the left and is represented graphically by the avatar in the top right.**

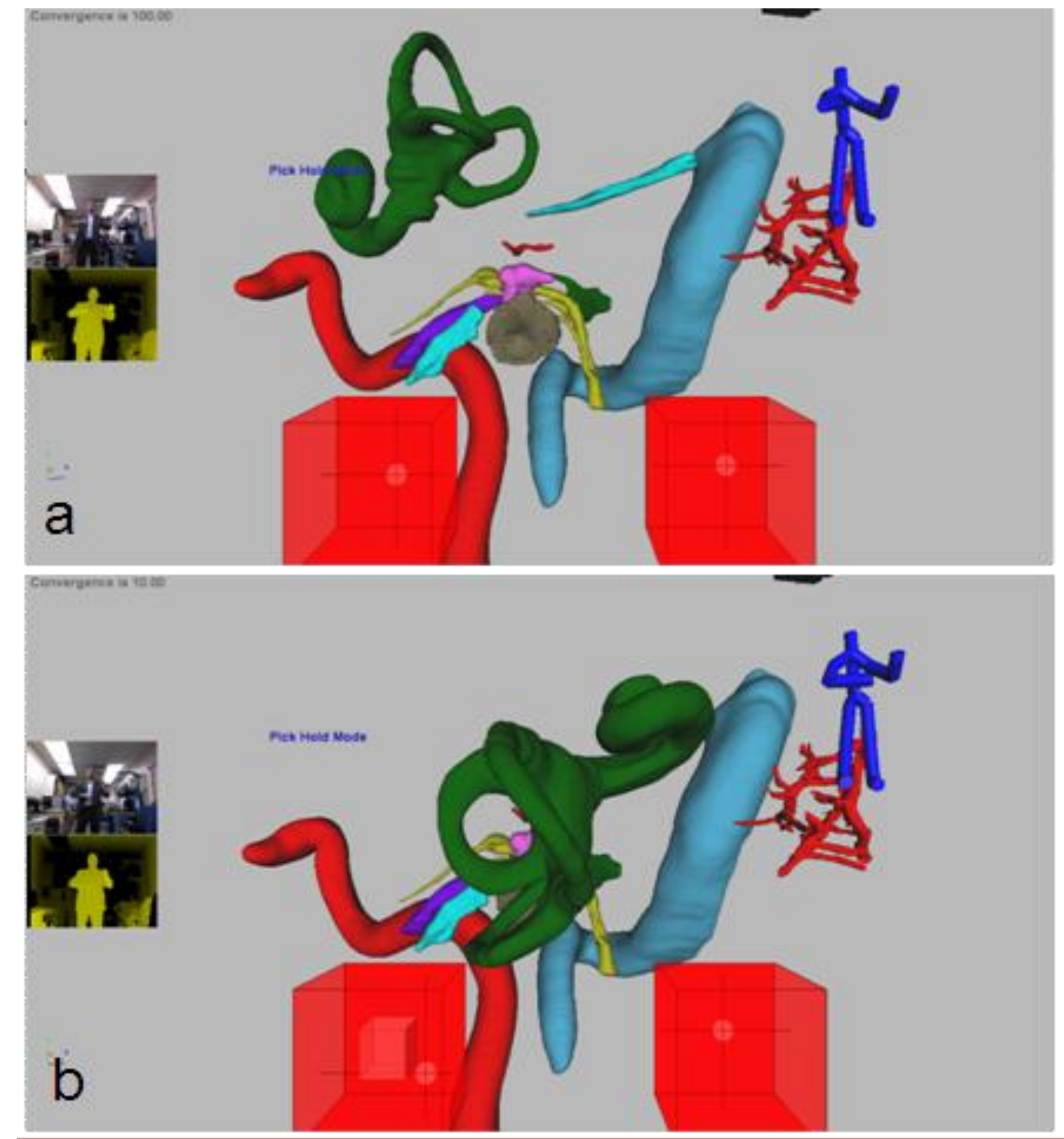

**Figure 3. 3D anatomy tool selection mode with cochleo-vestibular apparatus brought to foreground. Objects may be manipulated by both gesture and voice control.**
**(a) & (b) Selected cochleo-vestibular apparatus is in transit to the foreground. It may be translated, magnified or rotated under user control with gestures.**

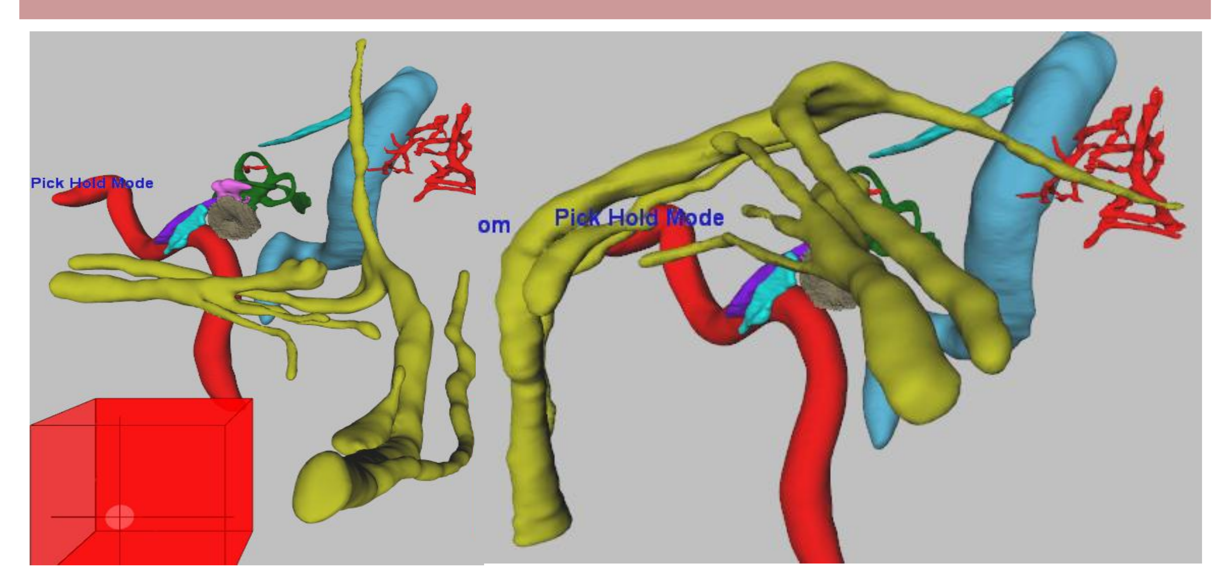

**Figure 4. 3D anatomy tool selection mode with cranial nerves VII and VIII brought to foreground in two different orientations.**

## Discussion

- Patient oriented care requires a sound anatomic basis.
- New technologies and learning modalities are meant to compliment classic learning, benefiting from collaboration of anatomists, clinicians, and engineers.
- Development of 3D models employing patient specific data may enhance spatial appreciation in complex cases.
- Interactive models may improve incentive for both early and advanced learners .
- There is a need for formal evaluation of possible educational gain.

## Conclusions

- This novel gesture-controlled interactive 3D model of temporal bone anatomy provides a stereoscopic and interactive tool to enhance complex spatial learning tasks.

## References

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Funding for this project was obtained from the Dean's Strategic Research Fund, Faculty of Medicine, University of Manitoba, and the Industrial Technology Centre, Winnipeg, Canada.

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