# Virtual Dog Head:
# Using 3D Models to Teach Complex Veterinary Anatomy

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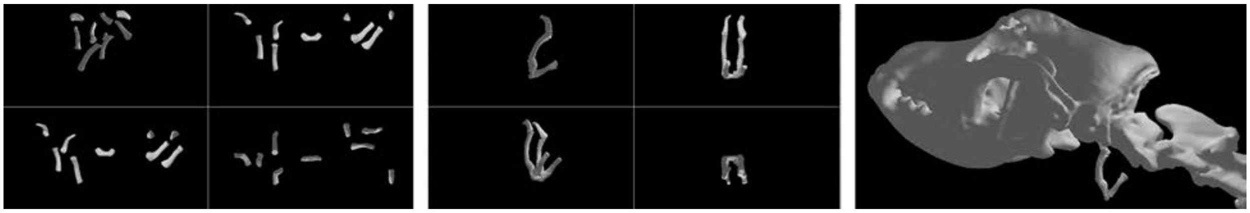

**Figure 1:** *Steps in hyoid assembly: initial starting point (left), fully assembled apparatus, properly attached to skull*

## 1 Introduction and Motivation

Oregon State University veterinary medicine faculty recently observed that fourth year veterinary medical students consistently struggled during their clinical rotations in cases that required accurate and detailed recall of the complex anatomical relationships in the head region of a dog. These structures were difficult to see and understand since they were hidden behind muscle and tissue and often destroyed or damaged during dissection.

This work presents a new method of interactive learning through the incorporation of 3D computed tomography (CT) scan-generated models of the hyoid and larynx apparatus in dogs with OpenGL and the Oculus Rift. It will also be used as a review resource for fourth year veterinary medicine students on clinical rotations.

## 2 Approach and Design

Students begin by identifying the individual structures within an apparatus. Once all structures are correctly labeled, students translate and rotate each one to build the complete apparatus. When objects are within a predefined distance and degree of rotation from connecting objects they snap into place and form a group that shares further transformations. Each step includes visual and text based cues indicating it was performed correctly. We used quaternions to measure the rotation between two objects and determine if they fall within a given tolerance. Colored wireframes indicate the current selection and its grouped structures.

## 3 Process

Data was generated using a 64-detector Toshiba Aquilion CT machine to scan a dog cadaver. Raw scans were loaded into Vitrea, an imaging and analysis software suite for handling CT data. Vitrea generated 3D polygonal surfaces for each structure that were then converted into OBJ format.

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A trainer can load any number of anatomical models. Individual models are positioned such that they form an accurate anatomical structure. The trainer then exports the correctly assembled scene.

The student program consists of a GUI control window, an interactive 3D window where models are displayed and selected, and a text window for displaying model labels and descriptive hints. The 3D window can be toggled between one and four camera views, as one would expect with modeling software such as Blender.

Added support for the Oculus Rift and various controller-based input devices enables a greater degree of immersion with a goal of further enhancing learning. These stereoscopic views allow students to better understand the 3D spatial relationships of separate and assembled structures that will translate to real world procedures.

We are conducting studies to quantify the effectiveness of the program on knowledge retention and recall using a standard monitor as well as a Rift-enabled version and various input devices versus traditional teaching materials. Future versions will be expanded to anatomical structures of additional species including the cat, cow, small ruminant, pig, and horse.

## References

CLEMENTS DN, BROADHURST H, CLARKE SP, FARRELL M, BENNETT D, MOSLEY JR, MELLANBY RJ. The Effectiveness of 3D Animations to Enhance Understanding of Cranial Cruciate Ligament Rupture. *J Vet Med Educ 2013*; 40(1):29-34.

NICHOLSON DT, CHALK C, FUNNELL WRJ, DANIEL DJ. Can virtual reality improve anatomy education? A randomised controlled study of a computer-generated three-dimensional anatomical ear model. *Medical Education 2006*; 40: 1081–1087.

SENTHIRAJAH JS, STIEGER-VANEGAS SM, NEMANIC S, BALTZER WI. 3D-Computed Tomography of the Canine Pelvis: A Technique to Evaluate Complex Fractures. *NIH-Merial Summer Symposiums*, Loveland, CO, 2012.


SIGGRAPH 2014, August 10 – 14, 2014, Vancouver, British Columbia, Canada.

ACM 978-1-4503-2958-3/14/08