## A141 A Method for the 3D Restoration of Fragmented Human Crania for Trauma Analysis

*Teresa V. Wilson, PhD*, Louisiana State University, 227 Howe-Russell Geoscience Complex, Baton Rouge, LA 70803*

After attending this presentation, attendees will better understand how 3D technologies can be used to reconstruct and assess traumatic skull injuries in forensic cases.

This presentation will impact the forensic science community by providing a method for visualizing trauma in skeletal material that is fragile and heavily fragmented. This presentation will demonstrate how 3D scanning and polygon manipulation can be used to assist in skeletal analysis and to communicate anthropological findings in situations ranging from the classroom to the courtroom.

When a forensic anthropologist is confronted with heavily fragmented crania, the task of reconstructing the skull for trauma analysis can be difficult. Skulls that are fragmented due to trauma are weakened and susceptible to further damage when reassembled using traditional methods of reconstruction (i.e., glue). The recent prevalence of 3D scanning technology in forensic anthropology laboratories allows for greater access to digital technology to solve problems related to the condition and fragility of remains. The goal of this project is to develop a method to digitally restore a cranium that can be 3D printed or exported as an interactive digital model.

Two crania were selected that had experienced catastrophic blunt force trauma and were heavily fragmented due to fractures and separated sutures. A FARO® Design ScanArm high-definition laser scanner was used to obtain surface scans of the individual fragments. A point cloud and polygon editing software (Geomagic® Wrap) was used to reassemble the individual fragments of each skull. Individual fragments were merged using points of commonality along suture lines and unique points along fracture lines. Both crania exhibited areas of missing bone that were not reconstructed to maintain the accuracy of the models to the source material. Selected cranial measurements that were not affected by the fragmentation were used to test the accuracy of the restored crania. The skull measurements were obtained with calipers and the models were measured using the measurement tool with the 3D software. Each of the 3D cranial measurements tested were within an acceptable error threshold (<1mm) of the caliper measurements. The results revealed a small amount of variation in measurement; however, this may be due inaccuracies and inconsistencies in measuring the crania within the editing software as opposed to traditional calipers.

Both of the test crania had experienced isolated traumatic events that only became apparent after the original manual reconstructions were completed. If this method of 3D digital restoration had been available at the time these cases were being analyzed, the restorations could have been completed with minimal disturbance to the fragments, and a 3D print could have been made. The 3D scans allowed for viewing of the model in a uniform and neutral color for distraction-free texture visualization. The locations, patterns, and behavior of the fractures were easily seen on the bone and permitted the reconstruction of the traumatic events. This technology is a valuable tool that could be used for teaching future generations of forensic anthropologists about trauma analysis as well as demonstrating complex traumatic events in the courtroom.

**3D Scanning, Trauma Analysis, Blunt Force Trauma**