A115 The Applications and Practicality of Dental 3D Scanning in Forensic Anthropology

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After attending this presentation, attendees will better understand how and if consumer-grade 3D scanning of teeth can be used to aid medicolegal investigations involving skeletal remains and assist in the teaching of forensic anthropology students.

This presentation will impact the forensic science community by demonstrating the possible advantages and disadvantages of incorporating the 3D scanning of teeth into forensic anthropological analyses, research, and teaching. This presentation will provide results pertaining to the accuracy and resolution of scans, minimization of scanning anomalies and artifacts, and ways in which scans can be displayed for demonstration and teaching.

The use of 3D scanning in macroscopic analyses is becoming more affordable and attainable by researchers and practitioners in forensic anthropology. The non-destructive nature of 3D scanners allows for the scanning of fragile and important specimens; however, consumer-grade scanners can create several logistical and quality problems, including excess noise and gaps in the scans. Teeth in particular are difficult to scan because of the glossy texture of the enamel interfering with the reflective angles of the lasers employed by 3D scanners. This research focuses on dentition because of the importance of teeth in positive identification of remains as well as the analysis of age, trauma, and overall health.

Twenty modern isolated teeth, four isolated teeth from a historic population, and five mandibles (teeth: n=24; mandibles: n =5) were chosen for this study. The teeth from the modern population were selected to represent all tooth types and various states of dental health (i.e., carious lesions, amalgam fillings, resin fillings, and natural). Each specimen was scanned using a NextEngine® 3D Ultra HD scanner and processed using the NextEngine® ScanStudio™ ProScan software. Each specimen was scanned using different resolution settings, lighting conditions, and scanning techniques. Each scan was compared for measurement accuracy and the precision in which the lesions or restorations were captured. Scans using the highest resolution (16k points/inch^2) showed a grainier texture to the surface and displayed large amounts of noise that created inconsistent measurements of the teeth. Scans could not be accurately replicated at the high resolution due to the noise and textured surface. Scans at low resolution (~2k points/inch^2) proved to be accurate in dimensional measurement; however, all of the details of the tooth surface were lost. Scans at the middle resolutions (~4.2k points/inch^2) provided an acceptable balance between measurement accuracy and surface detail retention. Scan resolution and noise reduction were achieved through manipulation of the ambient light during scans and the reduction of enamel shine through the use of surface powders and sprays.

Although inexpensive consumer-grade 3D scanners are not without their difficulties, 3D scanning of dentition can be useful to forensic anthropologists in both the laboratory and the classroom. Choosing the appropriate scan resolution and noise reduction techniques is dependent on the purpose of the scan. When the goal is to preserve accurate dimensions and surface detail of the teeth for presentation during trial or continued examination of the dentition after skeletal remains have been released, choosing a mid-level resolution and controlling for all lighting problems that may affect the surface integrity is imperative. Accuracy is less important when using these scans in a classroom or training setting and lower resolutions can be used. Although it is unlikely that 3D scanning of dentition would be utilized in every forensic case, this technology can be useful in the preservation of anomalous

features (i.e., trauma, dental pathologies, and unique occlusal patterns) for use in the future or when another look at the teeth will be useful later.

3D Scanning, Dental Anthropology, Teeth