A11 3D Models of Paranasal Sinuses to Establish Age, Sex, and Ethnicity Across Three Modern Populations

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Learning Overview: The objective of this research is to assess if the shape or size of the paranasal sinuses provide patterns that distinguish between age, sex, and ethnicity on unknown remains that may assist with victim identification in forensic reconstructions.

Impact on the Forensic Science Community: This presentation will impact the forensic science community as attendees will leave with an understanding of the production, accuracy, and utility of Three-Dimensional (3D) modeling as a primary visualization technique for 3D entities and the ability of using this method for human identification. Attendees will be introduced to the findings of preliminary research that highlights the potential of 3D modeling as a novel method for examining the paranasal sinuses to identify patterns that may assist with distinguishing between individuals and victim identification.

The identification of unknown human remains can be an essential element to a forensic investigation or crime reconstruction. Technological advances have furthered the development and understanding of trace evidence such that DNA and fingerprints have become the foundation of human identification. However, when a body undergoes extreme damage, such as in cases of arson, these methods of identification may not be possible. In conditions such as these, alternative methods of identification become critical.

Previous research has quantified the variability of the frontal sinus between individuals and has likened the distinctiveness of this structure to that of fingerprint comparison. As a result, the frontal sinus has been successfully used as a primary source for identification supported by expert testimony in the court of law. Therefore, examining the effectiveness of the paranasal sinuses in determining age, sex, and ethnicity is a valuable next step. However, the existing literature on the paranasal sinuses are targeted toward practicing physicians for medical care and not explicitly intended for human identification in a forensic context. For example, morphological patterns of the ethmoid sinus between populations has been documented solely as a precautionary guide to mitigate complications during endoscopic sinus surgery. Consequently, the ability of the paranasal sinuses to provide biological information to assist with forensic identification is under-researched. Therefore, there are no standard approaches for measuring or analyzing these structures.

This study addressed this gap by developing a new approach for human identification using 3D models of the paranasal sinuses. Models were produced from a database of modern Computed Tomography (CT) scans provided by University College London Hospital (UCLH). Elliptic Fourier and linear analysis of 30 3D models produced from the CT data demonstrated notable variations and patterns with regard to discriminating age, sex, and ethnicity across three distinct ethnic groups. The most promising classification rates ranged from 93% (p=.000) to 70% (p=005). This study also aimed to assess the correlation between these variables to determine if one particular sinus has a more successful prediction rate than others to assist with identification.

The findings from this study lay the foundations for developing the means for fast and reliable identifications to be made as a result of computer-assisted methods based from 3D reconstructions of the paranasal sinuses.

Identification, Three-Dimensional Reconstructions, Paranasal Sinuses

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