A167   Rare is Good, Unique is Better: Testing Maxillary Sinus Morphologies for Human Identification

Teresa M. Runge, MS*, Liverpool John Moores University, Liverpool, Merseyside L3 3AF, UNITED KINGDOM; Joel D. Irish, PhD, John Moores University, Liverpool, Merseyside L3 3AF, UNITED KINGDOM; Matteo Borrini, PhD, Liverpool John Moores University, Liverpool, AE L3 3AF, UNITED KINGDOM

Learning Overview: After attending the presentation, attendees will understand the potential of using morphological evaluations of maxillary sinuses for identification purposes. The goal of this study is to quantify morphological uniqueness of maxillary sinuses and to assess their morphology for human identification purposes.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing insights into the suitability of maxillary sinus morphologies for human identification, observed on X-ray images.

In forensic sciences, many studies are concerned with qualitative analyses of frontal sinuses and their application for identification. Approaches using measurements and volumetric assessments show promising results.[1,2] However, in view of prompt working routines in anthropological case work, utilization of maxillary sinus morphologies offers quicker results, as the features frequently appear on dental overview images. Even if dental comparisons cannot be applied due to, for example, mutilation of the remains, maxillary sinus morphologies can be extracted and compared. However, before techniques can be used to identify remains, the applicability of the procedure needs to be verified as a means of antemortem and postmortem comparison.

A total of 600 maxillary sinuses was sampled on radiographic images from nine population samples dating from Roman times to the 20th century. To simulate antemortem and postmortem situations, images were processed twice, for a total of 1,200 sinuses. Individuals were over 20 years of age and showed no pathological changes in the maxillofacial area. Image analyses were performed separately for right and left sinuses. Standardized anteroposterior radiographic images were used for evaluations. Sinus morphologies were extracted using the software SHAPE ver. 1.3, applying Elliptic Fourier Analysis.

Using Analysis of Covariance (ANOVA) statistics, morphological uniqueness between samples as well as individuals was evaluated. Analyses show statistically significant differences for both sides of sinus morphologies between all nine populations ($p<0.001$). Evaluations by individual show the same trend. Additionally, all individuals have been analyzed divided into modern ($n=6$) and historical ($n=3$) samples to exclude statistical skewing relating to potential evolutionary changes. Results show statistically significant differences for right and left sinus morphologies ($p<0.001$). Only slight differences can be assessed between the historical samples. Although p-values for the ancient samples are slightly higher, no skewing can be concluded ($p<0.05$).

To examine suitability of maxillary sinus morphologies for comparison testing, the simulated antemortem and postmortem datasets were assessed using one-way ANOVA. The results indicate total conformity between the two datasets and potentially each antemortem and postmortem morphology pair ($p=1.000$). To evaluate degrees of similarity and difference between individuals in the two datasets, neighbor joining clustering was used. Measuring Euclidean distances, the dendrograms for right and left side morphologies illustrate total morphological accordance for each antemortem and postmortem data pair. Furthermore, they verify sinus morphological uniqueness, as variability between each matching antemortem and postmortem pair is evident. To test for inter- and intra-observer reliability, 18% of the radiographs were reassessed with Kappa statistics. Statistical analysis were performed using IBM® SPSS Statistics v.26 and Past.

This research provides highly encouraging outcomes, demonstrating uniqueness of maxillary sinus morphologies in a simulated environment. Future analyses should involve real life antemortem and postmortem data to verify and further the results.

Reference(s):
1. Xavier, T.A., Dias Terada A.S.S., and Alves da Silva R.H. Forensic Application of the Frontal and Maxillary Sinuses: A Literature Review. *J Forensic Radiol. and Imaging* 3, no.2 (2015): 105-10.
2. Choi I.G.G., Duailibi-Neto E.F., Beaini T.L., da Silva R.L.B., and Chilvarquer I. The Frontal Sinus Cavity Exhibits Sexual Dimorphism in 3D Cone-Beam CT Images and Can Be Used for Sex Determination. *J Forensic Sci*. 63, no.3 (2018): 692-98.

Maxillary Sinus, Human Identification, Morphological Evaluation