A118 Elliptical Fourier Analysis of the Human Nasal Aperture

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After attending this presentation, attendees will appreciate the various biological and environmental factors that contribute to normal variation in human nasal aperture shape. The goals of this presentation are: (1) to discuss how age, sex, ancestry, and geography differentially contribute to the overall shape and size of the human nasal aperture; and, (2) to discuss how this information could be applied to modern forensic investigations.

This presentation will impact the forensic science community by quantifying and describing differences in shape of the nasal aperture across different population groups. Previous studies have focused on the nasal aperture as a qualitative trait. By quantifying the shape of the aperture, more rigorous statistical analyses can be applied to the data.

In the analysis of human skeletal remains, the nasal aperture is often used in discrete, non-metric analyses, especially in regard to ancestry assessment. The shape itself is complex, so the final assessment of the shape has traditionally been based largely on the subjective judgment of the observer. This means the final decision of the qualities of that shape are subject to the Gestalt of the observer, and do not necessarily accurately describe actual shape. Elliptical Fourier analysis can transform the complex shape of the nasal aperture into a numeric variable. Once transformed, not only can the complex shape be consistently and precisely recreated, but it can be quickly and easily compared against data from other nasal apertures.

A sample of 868 individuals from the Pretoria Bone Collection and the W.M. Bass Donated Skeletal Collection were utilized in this study. Data was collected only on individuals with a known age, sex, and ancestry. This study utilized both males and females, with ages ranging from 18 to 100 years, but only collected data on individuals identified as White or Black. Individuals were not included in the sample if there was any damage to the contour of the nasal aperture. Data was collected by photographing the nasal aperture on a standardized plane at a focal length of 55mm with the camera set to aperture priority with an f-stop of eight. All photos were taken from a distance of 30cm directly above nasion. After photography, all images were uploaded into Adobe® Photoshop® v 11. The outline of the nasal aperture was traced along the internal margin using the Magic Wand Tool. The shape was then filled using the Paint Bucket Tool. Traced and filled images were resized to 500 x 332 pixels and saved as a 24-bitmap file. Those files were subsequently uploaded into SHAPE v. 1.3 for elliptical Fourier analysis. Four principal components were identified using the SHAPE program. Univariate analyses were performed to evaluate which variables (age, sex, and/or ancestry) were contributing the most to the shape differences. An Analysis of Variance (ANOVA) test was performed to test for significant differences between group means. Even though four principal components were identified, only the first two significantly contributed to the overall shape of the nasal aperture. In this study, ancestry was the most powerful contributor to the overall shape and was found to be significant in Principle Component Analysis 1 (PCA1) (height-to-width ratio, p=.000) and PCA2 (inferior margin contour, I=.004). Sex contributed significantly to PCA1 (height-to-width ratio, p=.001) but also appeared to exhibit significant interaction with ancestry, which may confound significance. The biggest difference between the sexes is overall size, but the differences in the actual shape are minimal. Age did not contribute significantly to any principal component, suggesting that it does not systematically affect the shape of the nasal aperture.

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Elliptical Fourier analysis was instrumental in quantifying a complex shape, which allowed this study to focus on statistical comparisons instead of qualitative descriptions. These results reify that ancestry is the strongest contributor to the shape of the nasal aperture. Although age and sex somewhat contribute to the differences in aperture shape, their effects are not systematic and therefore do not influence the overall mean.

Nasal Aperture, Elliptical Fourier Analysis, Shape Analysis

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