C15 A Morphometric Analysis of Ears in Twins: An Aid to Forensic Personal Identification

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Learning Overview: After attending this presentation, attendees will better understand the uniqueness of morphological and biometric features of ears from one individual to another and in the same subject.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by illustrating the importance of evaluating morphological characteristics and dimensions of the auricle as a tool for forensic identification of living or deceased individuals.

The idea of using ears for identification purposes dates back to the late 19th century when Bertillon included it as one of 11 anthropometric measurements in his manual system for identifying individuals.[1] In fact, although the primary function of the pinna is to collect sound waves and transmit them to ear drum through the external auditory meatus, the ear is an under-recognized defining feature of the physiognomy of the face.[2]

Since the morphological characteristics of the external ear stay fixed in the same person after completion in development until death, while they vary from one individual to another according to age, sex, and ethnicity, comparative analysis of ear biometrics represents a useful tool in forensics for positive identification of living or deceased people.[2,3] As the morphology of ears tends to be hereditary, the present twin study was undertaken to determine morphological and biometric variations of both ears within pairs for individualization purposes.[4]

The study was conducted on four pairs of homozygotic twins: two males and six females, aged 18 to 45 years. Each pair underwent facial 3D laser scanning using a Head and Face Color 3D Scanner, with the subjects' heads in Frankfurt Horizontal plane. Acquired facial surface reconstructions were obtained through Cyberware Echo software. Reference vertical (Y, midline through glabella) and horizontal (X, through right and left endocanthion) planes were constructed on the models. For each patient, the following standardized measurements of both ears were recorded twice by a single investigator using landmark points defined by Farkas and colleagues: Total Ear Length (TEL), Ear Breadth (EB), Distance Preaurale-Glabella (P-G), Preaurale-Subnasion (P-Se), Preaurale-Exocanthion (P-Ex), and Preaurale-Pogonion (P-Pg).[5] The Ear Index (TEL/EB X100) was calculated for both ears. Morphological ear shapes and lobule attachment were also noted. Intra-individual and intra-pair comparisons of those parameters were conducted. Data were analyzed using an Excel® statistical analysis program.

When comparing both sides in the same individual, complete symmetry was noted regarding the shape of the auricles and lobule attachment, with 100% intra-pair concordance. Triangular shape was the most common (50%), followed by the oval (25%) and round ones (25%). The lobule was attached in 25% of individuals, while it was free in 75% of individuals.

The mean value of TEL was 60.8±9.4mm (right ear R: 61.14±9.31mm; left ear L: 60.46±10.13mm). An average Intra-Individual Discrepancy (IID) of 2±1.72mm was found comparing R and L. A mean Intra-Pair Discrepancy (IPD) of 2.19±1.85mm for R and of 1.59±1.63mm for L was noted. The mean value EB was 33.79±4.35mm (R: 34.28±4.43mm; L: 33.3±4.51mm). The mean IID of breadth was 1.32±0.63mm and IPD of 0,85±0.63mm in R and of 0.96±1.03mm in L was noted. The mean total Ear index was 55.57% (R: 56.08% and L: 55.08%) with a mean IPD of 2.97% and a mean IID of 0.63% and of 2.73% for R and L, respectively. All ear anthropometric dimensions were found to be significantly higher in males. TEL and P-Ex distance were the only two parameters showing higher values on L. As far as EB and P-Pg distance were concerned, there seemed to be a higher variability when comparing the two ears of the same individual than when considering the auricles on the same side of the twins in each pair. On the other hand, TEL, P-G, and P-Se showed higher IPDs, especially when considering the right ears. P-Ex was the only parameter showing comparable IID and IPD.

The results of this pilot study on variations of ears morphology between homozygous twins can be used as supportive evidence that ear biometrics could represent a helpful tool in forensic issues since auricles showed measurable variations even between individuals sharing the same genetic heritage.

Reference(s):

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