

## A novel approach to the assessment of anatomical uniqueness of ears: application of 3D-3D surface registration

Daniele Gibelli, Valentina Pucciarelli, Giulia Fornarelli, Alice Loviglio, Claudia Dolci, Chiarella Sforza

LAFAS, Laboratorio di Anatomia Funzionale dell'Apparato Stomatognatico  
Department of Biomedical Sciences for Health  
Università degli Studi di Milano

Uniqueness of body structures can be defined as the anatomical property consisting in the development of a unique and individual shape. From this point of view, the ear has always represented a field of particular interest for anatomy, especially for its individuality and the large variability in size and shape: however, its uniqueness has been assessed so far only through morphological methods, with limitations in quantifying the probability of finding the same shape within the sample [1,2].

The introduction of modern devices for 3D image acquisition and 3D models elaboration may provide additional data, especially through the 3D-3D registration of surfaces and calculation of respective distances.

Ten adults were recruited for the study. The right and left ear from each individual was acquired twice by stereophotogrammetry at the distance of few seconds. The ear surface obtained from the first acquisition was then superimposed onto the same structure derived from the second acquisition of the same subject (group of matches) and onto the ear surface from the second acquisition of all the other subjects taking part to the project (group of mismatches). In all the cases registration was reached according to the least point-to-point distance between the two 3D models. Point-to-point RMS (root mean square) distance was then calculated between the two surfaces. Possible statistically significant differences according to side and group were assessed by two-way ANOVA test ( $p < 0.01$ ).

A total 200 superimpositions were performed. On average point-to-point RMS distance in cases of matches was 0.31 mm (SD: 0.13 mm), in cases of mismatches 1.43 mm (SD: 0.31 mm): differences were statistically significant ( $p < 0.01$ ). No statistically significant differences were found according to side ( $p > 0.01$ ).

Results provided a novel contribution to the assessment of anatomical uniqueness of ear morphology, with a quantification of differences based on anatomy of auricles.

### References

- [1] Rubio et al. (2015) Anthropological study of ear tubercles in a Spanish sample. *HOMO* 66:343-56
- [2] Singh and Purkait (2009) Observations of external ear – an Indian study. *HOMO* 60:461-72

### Keywords

Facial anatomy, ear, stereophotogrammetry