G22 The Performance of Forensic Craniofacial Identification in Surgically Altered Faces

Petra Urbanová, PhD, Masaryk University, Brno 611 37, CZECH REPUBLIC; Hana Eliasova, PhD, Prague 170 89, CZECH REPUBLIC; Tatjana Dostalova, MD, PhD, Motol University Hospital, Prague 150 06, CZECH REPUBLIC*

Learning Overview: After attending this presentation, attendees will be acquainted with the basic principles of forensic craniofacial identification and its technical and methodological shortcomings when applied to persons whose craniofacial region was altered in the course of a maxillofacial surgical treatment. Attendees will be presented with performance rates acquired using a sizeable study sample.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing an insight into state-of-the-art forensic craniofacial identification and its pitfalls related to the processing of surgically altered faces.

Forensic craniofacial identification is a set of techniques that allows forensic practitioners to establish a person's identity by comparing morphological characteristics of facial features in an unknown person (e.g., victim, perpetrator, or witness) with the physical appearance of a target or an array of candidates. Identification can be conducted in real time or off-line, based on various visual recordings via image processing (e.g., photographs, surveillance videos, medical images, etc.). Generally, image identification requires a trained professional who examines identity-coding facial features or runs computer-aided algorithms. There are fundamental differences between expert-based and computer-based image identification procedures. However, in both cases, forensic identification is known to be highly dependent on a variety of technical factors (image quality and resolution) as well as other behavioral and biological determinants (aging, pose, facial expression, postmortem modifications). Recently, surgical facial alterations performed for esthetical or other purposes (e.g., functional, trauma-related) at lower costs have become very abundant and emerged as a new covariate of craniofacial processing. However, to date there has been little scientific evidence specifying practical consequences of such artificial interventions in forensics.

The present study explores the effect of maxillofacial surgeries in forensic craniofacial identification. The tested sample consisted of 50 individuals of European ancestry aged between 17 and 44 years (average of 22.6 years) who underwent a maxillofacial surgical procedure. For each individual, pre- and post-operative image were acquired using a Cone Beam Computed Tomography (CBCT) unit and a 3D stereophotogrammetry device (Vectra M3). In addition, a control subset (N=500) was sampled randomly from the FIDENTIS 3D Face Database (N~3,000 subjects; www.fidentis.cz).

Two basic quantitative matching techniques, landmark-based and surface-based, were employed. The landmark-based approach was based on 26 discrete facial points collected manually on 3D images, whereas the surface-based approach processed 3D meshes in their totality. For each tested individual, the post-op record was taken for a probe and superimposed, then compared in the one-to-many fashion against an array of targets composed of the individual's pre-op record and the control subset. A sum of squared distances between corresponding points (landmarks) and closest points (surfaces) were taken as the measures of dissimilarity.

The results expressed in terms of rank-1 identification rates, Receiver Operator Curves (ROCs), and likelihood ratios showed that the presence of surgical modifications raised challenges for the tested identification approaches. For the landmark approach, the accuracy rates ranged from 66% to 92%, depending on the combination of input points. The surface-based performance was likewise affected, falling to 64% of correctly matched pairs. The improvements in accuracy were observed once the mid-face and lower face regions were given a lower priority in the processing. However, in all tested instances, the acquired results fell short of the identification rates reported for similar types of face identification processing.

Similar to other scientific approaches in forensics, the primary concern for conclusions derived using craniofacial identification techniques is to be based on sound scientific principles. This requires questioning conditions, under which the employed techniques can yield accurate and reliable results. The purpose of this presentation is to raise awareness of the examined conditions to the forensic community.

Forensic Identification, Surgical Alterations, Craniofacial Region

*Presenting Author