Commentary on: Gaudio D, Olivieri L, De Angelis D, Poppa P, Galassi A, Cattaneo C. Reliability of craniofacial superimposition using three-dimension skull model. J Forensic Sci 2016; 61(1): 5–11

Sir,

In a recent attempt to evaluate the reliability of the superimposition method using 3D laser scans of skulls and scanned face images, Gaudio et al. (1) reported 40 and 44.4% false positives for landmark and morphological methods, respectively, and concluded that their "study presents the validity of a different method of manipulation of the 3D model of the skull so that it can be more efficiently aligned with a 2D image." The methods used by these authors include the placement of targets to indicate the landmarks in the skull and face images on screen and adjusting the transparency, size, and orientation of the images "to match orientation landmarks (i.e., right and left ectocanthion, subnasal point and nasion)" (1). The authors (1) have also tabulated the definition of the orientation and other landmarks used.

This letter brings out two critical issues in the research reported by Gaudio et al. (1): reliance on cranial landmarks that are inappropriately defined and located in the skull image and also inconsistently related to the soft tissue landmarks in the face image and (2) orientating the 3D image of the skull relying merely on the landmarks located on the frontal plane of the face. Additional issues such as the hazards in relying on "mix"-type images at less than "life size" are also indicated.

Inappropriate Definitions of Cranial Landmarks

Gaudio et al. (1) have relied on the ectocanthion as an orientation landmark and have, in addition, employed dacryon while

obtaining the match between the skull and face images. These landmarks have also been defined by Gaudio et al. (1) as follows: "Ectocanthion (Ec)," as "The point located on the frontozygomatic suture, on the lateral orbital margin" (Row 1 in Table 2 in Gaudio et al. [1]) and "Dacryon (D)," as "The point on the medial wall of the orbit, at the intersection of frontal, nasal, and maxillary bones" (Row 5 in Table 2 in Gaudio et al. [1]). The above definition and the consequent location of both the landmarks "Ectocanthion (Ec)" and "Dacryon (D)" by Gaudio et al. (1) are not supported by standard literature in anthropometry, which define these landmarks differently: "ectoconchion" as a "point on the lateral margin of the orbit marking the greatest breadth measured either from maxillofrontale or dacryon," and "dacryon" as a "point marking junction of sutures between lacrimal, maxillary, and frontal bones" (2,3). Thus, the definition of the cranial landmarks that were relied on by Gaudio et al. (1) as "orientation landmarks" and employed for overlaying and matching the superimposing the skull and face images as well as for evaluating the match as "positive" appears to be inappropriate.

Incorrect Attributions of the Cranial Landmarks to Soft Tissue Facial Landmarks

The assumption by Gaudio et al. (1) that the "ectocanthion" that they locate at the fronto-zygomatic suture in the skull image is related to the soft tissue facial landmark "on the lateral canthus (right and left), where the upper and lower eyelids meet" in the face image (Row 1 in Table 2 and Fig. 2 in Gaudio et al. [1]) is not consistent with the well-established bone–soft tissue relationships in anatomy and anthropology that affirm that the outer

angle of the eye (exocanthus or ectocanthus) is related, by way muscular connection, to the Whitnall's tubercle in the orbit which lies as much as 9–10 mm below the fronto-zygomatic suture (4–12). Similarly, the assumption by Gaudio et al. (1) that the medial angle of the eye is related to their "Dacryon (D)" which they locate "at the intersection of frontal, nasal, and maxillary bones" [Row 5 in Table 2 in Gaudio et al. (1)] is also unacceptable because scholarly reports (6,8,11–13) affirm that the medial canthus (endocanthus) is connected to the posterior lacrimal crest which is located well below and lateral to the intersection of frontal, nasal, and maxillary bones. The disparity between the descriptions by Gaudio et al. (1) and those in the standard literature in anthropology and anatomy (6,8,11–13) is illustrated in Figs 1 and 2. If one were to follow the bone–soft tissue standards accepted in anatomy and anthropology and superimpose the skull and face images in Fig. 2 of Gaudio et al. (1), by aligning the "ectocanthus" in the face image with "Whitnall's tubercle" in the skull image, the face image would be