G11 Selecting the Dental Morphological Identifiers With the Strongest Potential for Human Identification on Panoramic Radiographs

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Learning Overview: After attending this presentation, attendees will understand how dental morphological features on panoramic radiographs can be used effectively for human identification by applying a three-step cascade (univariate and multivariate) with the strongest identifying capacity.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by quantifying the capacity of dental morphological features on panoramic radiographs for identification and by providing a three-step cascade that can be implemented immediately in high (univariate) or low (multivariate) caseload assignments.

Background: Dental identification relies on comparing dental treatment features, odontogenic morphological features, or a combination of both. Treatment features are usually the first line of assessment used.[1,2] However, factors such as incomplete dental records and the ongoing decline in the number of dental restorations have increased the importance of morphological features.[3-5] Unfortunately, to date, there is no conclusive evidence that the human dentition is indeed unique, which is the basis in being able to use morphological dental features for identification. Therefore, the current study aimed to select the best dental morphological identifiers for human identification.[6]

Material and Methods: Sixty-two digital panoramic radiographs from 31 females and 31 males (age ranged from 13 to 56 years old) were collected retrospectively from a private dental clinic in Belgium. Since the mandibular teeth are often more clearly depicted on panoramic radiographs than the maxillary teeth, the focus of this pilot study was on all seven mandibular left permanent teeth (excluding third molars), in which six measurements were performed: Tooth Length (TL), Crown Length (CL), Root Length (RL), Crown Width (CW), Cervical Width (CEJW), and Root Width (RW). Nine length-width ratios were then calculated for each tooth, using these measurements. To determine and quantify the identifying capacity, three groups of statistics were considered: (1) inter-observer agreement quantified by Intra-Class Correlation (ICC) and Within-Subject Coefficient of Variation (WSCV); (2) mean "potential set," which represents the percentage of subjects in the antemortem reference dataset one needs to at least consider in order to detect the target (i.e., the unknown subject in the antemortem reference dataset); and (3) Spearman correlation between parameters. Based on those statistics, a selection of parameters was conducted to establish a step-by-step approach that can be put into practice immediately. Forensic odontologists can choose a cascade of steps to narrow potential matches (high caseload [e.g., mass disaster, univariate plan]) or choose one step to be applied to their specific case (low caseload [e.g., domestic fire, multivariate plan]).

Results: In the univariate setting, the following parameters proved to have the best identifying capacity: TL/CW for tooth 36 (ICC 0.82; WSCV 5.1; mean potential set 14%), TL/CEJW for tooth 35 (ICC 0.87; WSCV 3.9; mean potential set 15%), and TL/RW for tooth 32 (ICC 0.89; WSCV 4.2; mean potential set 16%). The correlations between these three parameters ranged from 0.24 to 0.47, indicating they provide complementary rather than overlapping identifying information. Compared to single parameters, combining parameters substantially improved the identifying capacity. In the multivariate setting, the following parameters proved to have the best identifying capacity: all parameters combined for tooth 31 (mean potential set 8%), for tooth 35 (mean potential set 12%), and for tooth 32 (mean potential set 16%).

Conclusion: Three-step cascades were provided to select the parameters with the best identifying capacity in mandibular permanent teeth. In high caseload assignments, a single parameter in a specific tooth narrows the set of potential matches, but the mean potential set remains relatively large. In low caseload assignments, it is recommended to combine all parameters of a specific tooth to increase the certainty of the match. In particular, tooth 31 proved to be the strongest identifier.

Reference(s):

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