G9 A Measurement of Morphological Features of Maxillary First Molar Crowns for Human Dental Identification

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Learning Overview: After attending this presentation, attendees will be aware of the potential to include specific measurements of maxillary first molar crowns in human dental identification protocols.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by describing a method for the ranking of quantified uniqueness of specific measurements of maxillary first molar crowns and a proposition of its inclusion in protocols for human dental identification.

Improvements in oral health and the trend for minimally invasive, computer-aided dentistry makes classical protocols for human identification redundant. Morphological comparison, using 2D or 3D imaging and registration techniques, is becoming an important identification tool. This research aims to measure specific morphologic features of maxillary first molars, registered on 3D images, and to quantify their identifying power, separately and in combination.

One hundred sixty-four upper first molars were isolated from 3D digitally scanned, dental cast models and standardized dimension measurements were registered using the 3D modelling software 3-Matic Medical. Fifteen measurements were classified in four groups: tooth depth (n=1), measurement between the cusps (n=6), measurement between the cusps and the core of the tooth (n=4), and angles between cusps (n=4). All measurements were registered by the first examiner (n=2,460). After a month, a subset (n=600) was re-analyzed by the first examiner and by a second examiner. The distance between each subject in the subset and the subjects in the sample was quantified for each measurement to establish a Mean Potential Set (MPS) of candidate matches. The MPS, expressed as the amount of possible matches that would not exclude the correct subject in the sample, was determinant in the quantification of uniqueness of each specific measurement (univariate) and measurement combinations (multivariate). Intra-class Correlation Coefficient (ICC) was calculated to quantify inter- and intra-observer reliability. Differences and agreement between right and left measurements were evaluated.

The most unique measurement was tooth depth (ICC=0.879, MPS=17.1%), followed by the measurement between distal cusps and the measurement between the core of the tooth and the disto-palatinal cusp (ICC=0.855, MPS=19.9% and ICC=0.840, MPS=20.9%, respectively). The measurement between the mesio-buccal and disto-palatinal cusps (ICC=0.524, MPS=32.3%) was the least unique. The angles between cusps (n=4) was the most unique measurement combination (MPS=3.911%). The intra- and inter-observer ICC (over all measures) were 0.75 and 0.78, respectively. The measurement between the mesio-palatinal and disto-buccal cusps was the only measurement revealing a statistically significant difference between the right and left side (mean difference -0.25, p=0.0008). For this measurement, there is a clinically unimportant average discrepancy with narrow limits between the right and the left measurement. All other measurements showed a variable degree of right/left agreement.

Digital measurements of morphological features of maxillary first molars present a useful tool to integrate in human identification protocols. However, validation in forensic practice is required.

Forensic Odontology, Human Dental Identification, 3D Morphometrics

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