

G18 How the Lack of Human Dentition Uniqueness in Orthodontically Treated Patients and Twins Affects Bitemark Investigations

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After attending this presentation, attendees will be better informed regarding the research on the Uniqueness of the Human Dentition (UHD). Specifically, attendees will be aware of the most advanced pathways for investigations in the field, and will obtain scientific evidence to indicate whether or not the UHD is able to support current bitemark analyses. Finally, suggestions for undisputable bitemark analyses will be presented.

This presentation will impact the forensic science community by scientifically demonstrating the lack of UHD among orthodontically treated patients and twins. Additionally, this presentation will reveal the most advanced approach for investigations on the UHD on the level of bitemarks, encouraging the use of this methodology for further research in the field. This presentation may reinforce the fact that bitemark analyses should be performed with caution in the forensic practice, confirming that only trained professionals should become involved, and that specific case selection should be considered.

The UHD became one of the most polemic fields in forensic dentistry in the last decade. Criticism arose in the scientific community¹, especially in the interface of the UHD and bitemark analysis.¹⁻⁴ The scientific literature demonstrates a dissonant opinion concerning the existence or not of the UHD on the level of bitemarks.⁵⁻⁷ The present study proposed to investigate the UHD at the level of bitemarks in human skin, systematically modifying the amount of dental material analyzed in the anterior dentition.

The sample consisted of 445 dental casts digitalized with an automated motion device (XCAD 3D[®]) and implemented in the Geomagic Studio[®] software package. The dental casts derived from randomly selected patients ($n=22$), orthodontically treated patients ($n=59$), twins ($n=344$), and orthodontically treated twins ($n=20$). Additionally, casts ($n=20$) were collected from subjects at two different times to establish threshold values indicating whether or not two dentitions were equal. Within each group, pair-wise comparisons were performed with the Geomagic Studio[®] software, using automated superimposition. The comparisons were performed on four levels, systematically reducing the amount of dental material analyzed (level 1: 3mm of the incisal edges; level 2: 2mm of the incisal edges; level 3: 1mm of the incisal edges; level 4: a slice of 1mm not including the incisal edges of the anterior dentition). The morphological differences between dentitions were quantified separately for the maxilla and the mandible, for each group, and for each level, and expressed in four values: the maximum positive and negative deviations, the average and the standard deviation. The four quantified values were log transformed in a single mean Euclidean distance and compared with the threshold of the respective level, using the Analysis of Variance (ANOVA) test with a significance interval of 5%. A Receiver Operating Characteristics (ROC) analysis was performed to test the predictive value of the threshold group to classify unique and not unique dentitions.

In all the study levels, the mean Euclidean distances of the maxilla and the mandible of orthodontically treated patients, twins, and orthodontically treated twins remained below the threshold ($p<0.05$). The opposite was

observed with the randomly selected subjects. The resulting ROC curve was optimistic for the study levels 1, 2, and 3, reaching sensitivity and specificity rates between 70%-100%, while it decreased to 55%-80% in study level 4. Apart from that, the Area Under the Curve (AUC) remained >71% in all the study levels, suggesting a proper threshold for the classification of “unique” and “not unique” dentitions.

The lack of the UHD on bitemark levels observed in the present study was proven with advanced scientific standards; however, this finding must be carefully interpreted. Specifically, the bitemark practice must not be disregarded, but applied after careful case selection.

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