G45 A 3D Analysis of Bitemarks: A Validation Study Using an Intraoral Scanner

Géromine Fournier, DDS, Faculty of Odontology, Toulouse 31400, FRANCE; Frederic Savall, Service de Médecine Légale, Toulouse Cedex 9 31059, FRANCE; Norbert Telmon, PhD, MD, Service Medico-Judiciare, Toulouse F-31054, FRANCE; Delphine Maret, PhD, Faculty of Odontology, Toulouse 31400, FRANCE*

Learning Overview: After attending this presentation, attendees will have learned a new 3D approach to human bitemark analysis using an intraoral scanner. With this approach, the feasibility, reproducibility, and reliability of comparisons were established.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by illustrating how a 3D analysis optimizes and facilitates bitemark analysis.

Purpose: Conservation of the 3D aspect of bitemarks improves their analysis. In clinical dentistry, intraoral scanners are used as an alternative to conventional dental impressions for prosthetic design. Digital impressions are accurate, editable, and stable. In forensic odontology, an intraoral scanner could be used to record the bitemarks and a suspect's dentition. Then a 3D point processing software could compare these two objects.

The goal of this presentation is to assess the feasibility, the reproducibility, and the reliability of this new approach to bitemark analysis.

Materials: Twenty-seven volunteers bit into four materials: a triple thickness of dental wax, a hard cheese (Gouda or similar), a bar of milk chocolate, and an apple. The intraoral digital scanner PlanMeca® Emerald scanned dentitions and bitemarks. The scans obtained were exported into the mesh comparison software CloudCompare®, which can generate overlays automatically. For this purpose, dentitions were aligned and compared with the indentations. Meshing and non-meshing were visualized using a colorimetric scale.

Methods: First, the same blinded observer analyzed 256 comparisons for each material in order to compare the bitten supports. Second, 50 comparisons of bitemarks from wax were analyzed in a randomized blinded study involving four observers (dentist, dental student, forensic scientist, and police officer). None of the observers were trained before making these comparisons. Descriptive statistics, such as predictive value analysis and Cohen's kappa coefficient, were carried out in order to study the reproducibility of comparisons.

Results: For all materials, the rate of correct classifications was higher than 90%, and misclassification was rare. After calculation of predictive values, the wax support obtained the best result (positive predictive value: 87.1%, negative predictive value: 100%) and the apple the worst (positive predictive value: 57.1%, negative value predictive: 98.6%). Moreover, for each observer, negative predictive value was near 100%. Positive predictive values were more variable but higher than 70%. Cohen's Kappa coefficients showed a better concordance (almost perfect agreement) between the two observers whose training included odontology. For the other observers, the coefficient was substantial or agreement was perfect. Positive predictive values were better for the dentist and dental student than for the forensic scientist and police officer. Thus, the work clearly highlighted the importance of experience in odontology.

Conclusion: The 3D aspect of bitemarks was preserved, which facilitated analysis and reduced bias. Thus, 3D analysis was more objective than a photographic method. Dentitions not implicated by bitemarks could be excluded with certainty. Moreover, dental experience was fundamental to obtaining the best values.

Bitemarks, 3D Analysis, Predictive Value

*Presenting Author