F35 The Use of the Incise Dental Scanner to Compare Bitemarks in Cheese With Models of the Suspects' Dentition

Mark Hector, PhD, Administration Office, Dental School, Park Pl, Dundee, UNITED KINGDOM; Peter Tomlins, PhD, and Lifong Zou, PhD, Barts and the London School of Medicine & Dentistry, Queen Mary, Univ of London, Garrod Bldg, Turner St, Whitechapel, London, UNITED KINGDOM; and Amal Al-Ali, DDS, 199 Weedon House, Du Cane Rd, London, UNITED KINGDOM*

After attending this presentation, attendees will become better aware of how digital imaging techniques can be used in the quantification and analysis of bitemarks.

This presentation will impact the forensic science community by providing insight into how the application of digital imaging technology may help in the more objective assessment of deformations caused by weapons or tools in the investigation of crimes.

This study presents a technique developed for 3D imaging and quantitative comparison of the human dentition and bitemarks created in a perishable substrate, cheese. Six adult volunteers from the biometric lab, Queen Mary, University of London, had study casts made of their dentition and also bit into 40mmx20mmx20mm blocks of cheese. Impressions of the bites were made in putty fixture (Extrude, type 0, Germany). The dental models and the corresponding bite impressions were digitized by a contact coordinate measuring machine, (Incise Dental Scanner). The digitization strategy was set as follows: 1mm-diameter probe tip of 30mm length, scanning at Y direction, 0.1mm scanning interval, and scanning speed of 500 points per minute. The dental and bite models from which the incise Dental Scanner can capture coordinate data, from these data points, produces a model of the surface, thus providing a means of obtaining objective and accurate measurements and comparison of morphology.[1] Sets of dental models and corresponding bite impressions were numbered. This technique allows pattern association comparison to be made between the 3D images of the dental models and a bitemark.

Data analysis was based on the use of a 3D image analysis software package Cloud (UCL).[2] It is a versatile tool used to reconstruct 3D coordinates (X, Y, Z) into a color digital image for visualization and to analyze a free form surface. Cloud software has several tools for digital model analysis and measurement. It provides functions of superposition, calculates the geometric shapes, and analyzes the geometric relationship of surfaces. Superposition as a method of comparison is the procedure of bringing geometric objects into appropriate alignment but is dependent on the quality of the 3D digitized images of these objects.

The biting edges are usually the only clear feature in a bitemark and, therefore, were selected as the reference frame for the comparison. Based on the mathematical least square within the common area in the registration procedure using the Iterative Closest Point (ICP) algorithm within the software, the two surfaces were superposed; at this superposed position the difference along the surface at each single digitized point then was calculated and displaced on the computer screen corresponding to the cursor position on the image.[3] Different colors present depth differences between the surfaces: zero differences represented by sea blue color; +10µm to +20µm differences presented by orange, red, and purple; black colors represent -10µm to -20µm differences. Furthermore, the Cloud software provides the absolute numerical differences between the two superposed images; these differences demonstrate the distribution of the differences in relation to every single registered point.

A pattern-associated comparison using the superposition method between the 3D digitized images of the dental models and their corresponding cheese impressions was performed demonstrating a high degree of similarity of the incisal edges outline confirmed to be produced by the corresponding model. The descriptive statistics revealed that the average differences between the dental models and their corresponding bite impressions range between 0 and 3µm and mode between ±12µm. The standard deviation and the square root of the mean were exactly the same which recorded a range between 9µm and 11µm. These findings agree with the distribution of the absolute differences between the images which was extracted from the subtracted image and plotted using bar graph; the data was in bimodal shape with the peaks falls around ±10µm.

References:

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Bitemark Analysis, Incise Scanner, Superposition

 ** Presenting Author*