



Odontology Section – 2005

F22 Determining the Accuracy and Reproducibility of Adobe® Photoshop® Overlay Techniques Using WinBite Software

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After attending this presentation, attendees will understand the usefulness of overlays in bite mark analysis; will be able to understand the different techniques used to producing overlays; and will appreciate the accuracy of digitally prepared overlays.

This presentation will impact the forensic community and/or humanity by demonstrating the accuracy associated with digitally prepared overlays in bite mark analysis can now be quantified.

The use of bite mark evidence in court has been a controversial issue in the forensic community. The concerns regarding bite mark analysis include examiner objectivity as well as the reliability and reproducibility of the current methods used by forensic odontologists.

The methods of bite mark analysis have come under even closer scrutiny as a direct result of the 1993 U.S. Supreme Court *Daubert* Ruling. The *Daubert* Ruling set a new standard for the admissibility of scientific evidence in the federal courts and has been accepted by many state jurisdictions as well. This new standard requires that the utilized scientific methods be tested, reproducible and have a known or potential rate of error.

Recently, members of the forensic odontology community have made efforts to test and report the reliability of various bite mark overlay methods used for courtroom presentation.

Other odontologists have been exploring new methods of bite mark analysis using stereometric and mathematical approaches to reduce examiner subjectivity. One of the most widely accepted methods of bite mark overlays is the computer generated overlay. Bowers, Sweet, and Senn have suggested protocols to produce overlays using Adobe® Photoshop®.

The goals of this study are to assess the reproducibility and reliability of different methods of overlay production.

A dental cast of interest was scanned at 72 dpi and saved as a bit mapped (BMP) image. Two examiners then produced overlays of the working surfaces of the incisors, canines and first premolars. Each examiner reproduced 20 overlays of the same scanned image of the dental cast. Half the overlays were fabricated by using the Threshold Tool and the other half with the Magic Wand tool.

On the dental cast the occlusal surfaces of the teeth were measured with a digital caliper and the "centroids" were marked with black pen. The marked dental cast was then scanned and saved as a 72dpi BMP image.

WinBite software was used to produce a mathematical description of the dental cast and a mathematical description of each the 40 overlays.

WinBite is a computer program written in Visual Basic®. Data is stored in a Microsoft Access® database. WinBite can analyze the pixels that compose each tooth segment of an overlay. The pixels are mathematically summed to yield a centroid at the center of the tooth segment. The centroid is recorded with X axis and Y-axis coordinates. Once each tooth segment of the overlay has been analyzed and recorded, the lengths of lines that connect adjacent centroids are calculated and recorded. Then the angles formed between adjacent lines are calculated and recorded. The coordinates of the centroids, lengths of the connecting lines and measures of the described angles form the mathematical description of the overlay. A similar method was used to produce the mathematical description of the cast.

WinBite software was then used to look at the differences between the cast and each overlay. The sum of the differences of corresponding line lengths and the sum of the differences of corresponding angle measurements were combined to yield a numeric discriminator. The discriminator is a measure of how much a given overlay deviates from the cast. The discriminator was used to rank each of the overlays as they compared with the cast.

The primary goal of the study was to measure and rank the ability of different methods to produce a suitable and scientifically accurate overlay. The subjectivity introduced by each examiner was also measured.

The intent was to establish both the reproducibility and reliability of different methods of fabricating overlays and to establish error rates for these methods.

Bite Mark, Forensic Odontology, Overlay