F12 Comparative Analysis of Hollow Volume Overlays Fabricated Using Adobe® Photoshop®

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After attending this presentation, attendees will be familiar with several methods of digital hollow volume overlay production using Adobe® Photoshop®. The objectivity/subjectivity of each method will be discussed and the similarities and differences of the results of each method will be compared and statistically analyzed.

This presentation will impact the forensic community by investigating the techniques of fabricating computer generated overlays. The study also explores whether they are reproducible and consistent techniques as they relate to the admissibility of bite mark evidence in court.

A difficulty in bite mark analysis is examiner subjectivity in creating exemplars, including hollow volume overlays. Many efforts have been made to achieve objective methods for overlay fabrication based on a scanning technique first described by Christensen in a 1996 AAFS presentation and later published by Bowers and Johannsen. In 2000, Pretty and Sweet presented information on the effectiveness of bite mark overlays. In 2002 and 2003 respectively, Dailey and Tewes each independently presented techniques for improving overlay objectivity and incorporated topographic mapping of dental casts. McNamee, Pretty, and Sweet reported in 2004 the comparative reliability of computer generated bite mark overlays. Brzozowski and McGivney investigated the accuracy of Photoshop® generated overlays by an analysis using WinBite software. In a continued effort to demonstrate reliable and reproducible methods of overlay production, this study focused on utilizing Adobe® Photoshop® in a manner that emphasizes examiner objectivity.

This study evaluated the ability of independent examiners to produce similar hollow volume overlays when given specific instructions utilizing Adobe® Photoshop® software. Thirty examiners were provided a digital image of scanned dental casts and were directed to follow specific steps in fabrication of the hollow volume overlays. Three different methods of specific overlay instruction were provided to each examiner. Examiners were not allowed to alter or enhance any image beyond what was provided in the instructions. A fourth technique utilizing a more subjective method was also included for comparison. In addition, a brief questionnaire was included to obtain specifics regarding variations in individual examiners' hardware, software version, and bite mark analysis experience. After a two week interval, examiners were then again requested to produce an additional set of four overlays using the same instructions. To facilitate compliance, all instructions and scanned casts were distributed and results were returned by electronic mail.

The resulting overlays were then analyzed by pixel by pixel comparison of each image. Statistical differences between the results of each method of overlay production were recorded for all examiners. Additionally, overlays created by individual examiners were analyzed to investigate intra-examiner reliability. The overlays from the various techniques were analyzed to establish a mean for each technique and to determine the variation from the mean for each overlay.

This study asks and evaluates whether the use of Adobe® Photoshop® allows the production of consistent and reproducible hollow volume overlays when prescribed techniques are followed. The study further analyzes the statistical significance of the differences between the overlays produced.

Digital Overlays, Bite Mark Analysis, Reliability