F35 Topographic Mapping to Improve Objectivity in Bite Mark Analysis for Adobe® Photoshop® Hollow Volume Construction

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The educational goals of this presentation are to present a method using sequenced topographic maps of teeth for improving objectivity in computer-generated, hollow volume bite mark overlay construction, while also increasing evidence collection of biting edges superior or inferior to the plane of occlusion.

As interpretive bite mark analysis continues to advance, two aspects of the process can be improved: 1) Objective differentiation of the biting edges for hollow volume construction, and 2) Construction of pseudo 3-D images for locating incisal edges relative to the plane of occlusion.

Users of Adobe® Photoshop® have recognized a need for interpretation when selecting biting edges that are responsible for a bite mark. Johansen and Bowers also noted this need for judgment in their text, *Digital Analysis of Bite Mark Evidence*: "Selecting the biting edges is the most subjective step in this entire process." Biting edges present a range of gray scale that requires operator judgment when using the Photoshop® Magic Wand tool. Enhanced contrast at these edges would reduce the subjective judgment, and increase objective differentiation for the hollow volumes. Last year, Dr. J. Curtis Daily addressed this matter with a topographic mapping technique to enhance biting edge contrast by using paired colors of dental stone for the suspects' casts and a surrounding stone matrix.

Regarding the second aspect, bite mark analysis frequently examines only two-dimensional relationships, alignment and rotation, of teeth when comparing suspects' teeth to a two-dimensional photograph. In their 1973 text, Luntz and Luntz recognized the importance of considering the position of each biting edge relative to the plane of occlusion, as well as their lateral position in the arch. While position and rotation are important for the two-dimensional location of the biting edges, the superior-inferior (S-I) location should also be evaluated to analyze more fully, the various injury intensities within the bite mark. This S-I evidence is not complex to gather and display. It can be documented and illustrated with transparent topographic overlays, as hollow volume constructions for most bite mark cases. Because a bite mark is the result of a three dimensional sequence of events, it is reasonable to analyze the evidence in all three dimensions.

The technique presented here offers an easy solution to the problem of biting edge selection, and simultaneously permits the collection of evidence relating to the three dimensional sequence of individual tooth marks within the bite mark. Sets of each suspects' casts are fabricated using the Bowers & Johansen technique, followed by the incremental S-I reduction of incisal/biting edges. Prior to scanning each reduction into Adobe® Photoshop®, the biting edges are circumferentially marked to enhance contrast on the white dental stone. This is objectively completed with a graphite pencil placed 45 degrees to the reduced plane. Each subsequent reduction, with its circumferential contrast mark, is scanned and printed as a transparent overlay, using the foregoing procedures. The successive, S-I occlusal plane overlays, or maps, are stacked to illustrate a pseudo 3-D image of biting edges that contact the victim early in the biting stroke, versus those teeth contacting later. This third dimensional evidence cannot be collected or examined with a single overlay. Marking the biting edges with a pencil prior to scanning increases the gray scale contrast, which facilitates use of the Magic Wand tool for hollow volume construction. The technique is repeatable and reduces operator subjectivity that would influence the selection of biting edges and the resulting hollow volume overlay.

In summary, this technique increases accurate and objective bite mark evidence collection using established and familiar, computergenerated hollow volume protocol. Also, it captures S-I, third dimensional evidence to analyze more completely, the contact sequence of individual teeth and bite mark intensity, during the biting stroke. Users are encouraged to add this technique to their resources and continue testing the application.

Bite Mark Overlays, Topographic Tooth Mapping, Psuedo 3-D Computer Overlays

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