G11 An Objective, Dynamic Bitemark Overlay Technique

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After attending this presentation, attendees will be informed about a method of producing bitemark overlays that are objective, reproducible, and aid in the analysis of the 3D interaction between a dentition and a bitten surface. Attendees will understand the principles behind the overlay's creation and use.

This presentation will impact the forensic science community by demonstrating how many of the complexities inherent in the production and imaging of traditional bitemark overlays can be addressed and will understand how to make and work with objective overlays that eliminate imaging problems and subjective decisions. Attendees will also understand how these overlays can be used to build a 3D appreciation of the interaction between a dentition and a bitten surface.

Bitemark templates or overlays (also known as "exemplars") are traditionally considered to comprise outlines of incisal edges of teeth used in the comparison process. The use of only the incisal edge outlines ignores the mechanics of the wide biting process and fails to document the palatal anatomy of the upper incisor teeth. Further, many of the techniques used to produce them have been shown to be subjective, introducing a potentially uncontrolled source of error to an already error-prone process.

This presentation seeks to address the subjective elements of overlay production and additionally creates a series of contour slices through a model that can be used to examine the 3D interaction between a dentition and a bitten surface.

Initially, an accurately cast dental model of a dentition to be compared with an alleged bitemark injury is obtained and a digital model of it is produced by rendering isosurfaces from a high-resolution laser scan of the model. Laser scanners with a resolution of 20 microns or better are becoming increasingly common in dental offices and laboratories and a typical scanner will produce a model of a dental cast in approximately 75 seconds.

The mean angle of the occlusal plane to the substrate at the time of biting is estimated and the occlusal plane of the virtual model is positioned accordingly to the horizontal. If the plane is not evident, then two comparisons are suggested, one with a horizontal occlusal plane and one with the maximum estimated angle to the bitten surface. Both are used, and it is said that the true angle lies somewhere between these extremes.

The digital model can then be cut into virtual slices at whatever interval is deemed appropriate, commonly 0.5 millimeters. Each slice can be rendered as a 3D structure or as an outline drawn around the bottom of the slice. Each of these slices represents the tooth surface at the relevant distance from the occlusal plane and can be used separately or assembled in any combination to examine the 3D interaction between the injury and the overlay, addressing the "dynamic" aspect of the technique.

When different individuals are provided with the scan resolution and the original cast (or an accurate copy) and they agree on the position of the occlusal plane and the slice interval, they will end up with the same result, addressing the objective aspect of the technique. The rendering of outlines from the base of each slice creates objective hollow-volume contour overlays that can be reproduced by different operators.

When the successive slices are used, either in sequence or assembled, comparison with impressions or marks resulting from contact between the substrate and the palatal surfaces of upper incisors and marks resulting from dragging of the dental arch across the bitten surface becomes possible, often increasing the number of characteristics that can be used for comparison.

The technique is illustrated and its application in reducing uncontrolled errors in overlay production phase of the bitemark comparison process is demonstrated.

Forensic Odontology, Bitemark, Bitemark Overlay