



### F29 Problems With Human Bite Mark Analysis

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After attending this presentation, attendees should appreciate the potential seriousness of problems associated with bite mark analysis and gain an understanding of the inherent benefits of 3-dimensional analysis of bite injuries.

This presentation will impact the forensic community and/or humanity by providing the forensic odontology community with an increased understanding of the 3-dimensional nature of bite injuries, and stimulate further ideas for research and practice.

Bite mark analysis is currently an extremely contentious topic. For a subject with such potentially serious outcomes for both suspect and victim, little research analyzing methods and evaluating outcomes is reaching peer reviewed journals. Although admissibility of bite mark evidence has been explicitly established and routinely accepted in the U.S. and other legal systems for a long time, some odontologists argue that bite mark methodology has never really undergone critical examination and legitimately passed the Frye test for admissibility. Other legal observers are rightly concerned that forensic odontologists are giving insufficient critical attention to the quality of bite mark evidence presented to the courts.

In Australia, there are many uncertainties surrounding bite mark evidence. The natural tendency to see what one wants to see, thereby tempting examiners to over-interpret bite marks, has led to serious difficulties when bringing such evidence before the courts. Two notorious Australian cases, *R v Raymond John Carroll and Lewis v The Queen*, have seen bite mark evidence rejected as 'unsafe' and convictions overturned on appeal. Perhaps for such reasons this area of forensic science is currently undergoing review and re-evaluation. Generally, courts now look for quantitative rather than simply descriptive analysis before accepting scientific evidence and it can be anticipated that future developments in bite mark analysis will have to comply if convictions are going to be made with confidence.

Perhaps the logical path to take is to analyze bite marks in 3-dimensions. There are three factors of 3-dimensionality involved when one person bites another - the curved surface of the skin, the shape of the biting object and the depth of the injury should the tooth/teeth puncture the skin to create a depression, although this is probably rare. The injury, as it is being inflicted, is 3-dimensional - the skin deforms to accommodate the shape of the teeth. However, once the teeth are withdrawn, the skin is restored to its original shape and the resultant mark is represented 2-dimensionally on the curved surface of the skin. If the force of the bite is great enough to leave an indentation in the skin, then the injury itself is also 3-dimensional.

In this study, 40 study models of human dentitions and 40 Hydroflex silicone rubber models of wax bites, made by the same subjects, were digitized by laser scanning. The Cartesian co-ordinates of a series of landmarks on each image were used to describe the dentitions and the bite models using 3D-Rugle3© software (Medic Engineering, Japan). Morphometric differences between dentitions and bite models were compared using a variance-covariance matrix. Using cross-validation techniques on all possible matches and non-matches, an algorithm was developed which estimated the probability of a dentition matching its corresponding bite model. This gave rise to a Receiver Operating Characteristic (ROC) curve with a range of values for specificity and sensitivity. For this sample of 40, the best algorithm gave a 15.4% chance of wrongly convicting an innocent person i.e. 15.4% of the non-matching dentitions and bites could not be distinguished from the true match.

#### **Bite Mark, 3-D, Quantitative**