F37 A Mathematical Approach To Bite Mark Analysis Using Bite2000 Software©

Paula C. Brumit, DDS, Southwestern Institute of Forensic Sciences, Dallas, TX, 103 East Beltline Road, Suite H, Cedar Hill, TX; and James McGivney, DMD, 66 Grasso Plaza, St. Louis, MO*

The educational goals of this presentation are to present to the forensic community a method in which objective, mathematical bite mark analysis can be performed with the aid of a computer program.

The process of bite mark identification and evaluation is complex at best and requires considerable expertise by the forensic odontologist. The use of bite mark evaluation has increased dramatically since the introduction of bite mark evidence into the justice system. In 1952, *Doyle v. Texas* was the first known case in the U.S. to reach the appellate level.

In 1993, the court case *Daubert v. Merrell Dow Pharmaceuticals* explained specific factors and standards to assist the trier of fact. At present the standards require that: 1) the expert's technique or theory can be or has been tested—that is, whether the expert's theory can be challenged in some objective sense, or whether it is instead simply a subjective approach that cannot reasonably be assessed for reliability, 2) the technique or theory has been subjected to peer review and publication, 3) there is a known or potential rate of error of the technique or theory when applied, 4) standards and controls were used and maintained, and 5) the technique or theory has been generally accepted in the scientific community.

In 1994, the court case *State of Minnesota v. Stephen Andrew Hodgson* was significant in that it was the first appeal case to consider bite mark evidence resulting from the *Daubert* ruling. The findings in this case supported that bite mark evidence presented by an accepted expert was admitted correctly. The court was satisfied that bite mark analysis was neither novel nor an emerging science. Since that time, no bite mark evidence has been refused admission due to arguments regarding *Frye* or *Daubert*.

At present, bite mark analysis has no mathematical foundation. Bite mark analysis has relied on a number of empirical methods of relating the suspected biter's teeth to a photograph of the bite mark. Models of teeth have been directly placed on the photograph. Recently computer generated overlays have allowed visualization of the suspected dentition on the photograph of the bite mark. Other methods have been developed to remove documentation-method induced distortion from the bite mark. All these methods are investigator specific, are highly influenced by investigator technique and equipment, and are subjective in their rating of the linkage between a bite mark and a specific dentition. There exists a need for a mathematical basis for bite mark analysis.

A study has been undertaken to attempt to relate a series of digital images of dentitions to their mathematical descriptions. A method of assigning a mathematical representation of a dentition has been published in the *Journal of Forensic Sciences* by James McGivney, DMD and Robert Barsley, DDS, JD. (*A Method For Mathematically Documenting Bite Marks*. McGivney, J.,Barsley,R.,44(1):185-186)

In this study, dental models of 20 individuals were obtained. Many of their models were pre-operative orthodontic models and displayed various unique dental features. The models were digitally scanned to produce 20 upper digital images and 20 lower digital images. Bite2000 Software© was used to produce a mathematical description of each image. A protocol was developed to scan in the dental features of each image in a uniform manner. The mathematical descriptions were completed by two different investigators to determine the effect of investigator-induced error. Thus 80 total mathematical descriptions were produced and entered in a Microsoft Access Database.

Finally a new mathematical description was generated for a set of these images selected at random. Find Software© was used to compare the randomly selected descriptions to the database of 80 mathematical descriptions.

The study found that a mathematical description could correctly find the appropriate image at a tolerable error rate.

Bite Mark, Forensic Odontology, Computer Software

 ** Presenting Author*