F16 The Use of Geometric Morphometric Methods in Forensic Odontology: Overview and Analysis of the Human Dentition

H. David Sheets, PhD, Canisius College, Department of Physics, 2001 Main Street, Buffalo, NY 14208; Peter J. Bush, BS, Laboratory for Forensic Odontology Research, School of Dental Medicine, SUNY at Buffalo, B1 Squire Hall, South Campus, Buffalo, NY 14214;and Mary A. Bush, DDS, SUNY at Buffalo, B1 Squire Hall, 3435 Main Street, Buffalo, NY 14214*

The goal of this presentation is to present an established technique for shape analysis, and to illustrate how this method can be useful in describing the human dentition.

This presentation will impact the forensic science community by providing an analytical tool that can help to describe and compare similarities/differences within the human dentition.

One of the central questions in bite mark analysis regards the question of uniqueness of the human dentition. Few attempts have been made to address this question. Prior studies have typically used traditional metric dimensional parameters to depict the variation in human dentition. However, this method may not be appropriate with regard to bite mark analysis, as it does not address the manner, and degree to which these features transfer to the bitten surface.

Most studies on dental uniqueness have ignored the possible effects of the skin and reported the results based on the query: *Are the discrepancies of the incisal surfaces of the 12 anterior maxillary and mandibular teeth sufficient to describe uniqueness within a group of individuals or given population?* There is a loss of resolution with transference of the dentition to skin. With regards to bite mark analysis, many of the subtle metric measurement differences that allow for distinction of dentitions, may not transfer to the tissue. Therefore, the more pertinent question may rest with the ability to relate how a given shape or (mal) alignment pattern compares to a given population, within these limitations of measurement resolution. One such method to describe shape variation between specimens is Geometric Morphometric analysis.

The fundamental basis of one class of Geometric Morphometric analysis involves placement of landmark points on either 2D or 3D datasets from which the landmarks can be analyzed statistically as a unit.

The information extracted by means of this technique includes shape variance analysis and statistical treatment of populations from which can be extracted match rates. Amongst the tools available from statistical analysis is principle component analysis (PCA) with which the principle variation of shape can be plotted and visualized.

In order to evaluate this method for bite mark analysis, two different populations were obtained. One was a two dimensional (2D) dataset and the other was three dimensional (3D). In 2D, landmarks were placed that depicted the mesial to distal extensions of each anterior tooth, the intercanine extension, and rotation of the teeth in question. For 3D, curves were placed on the incisal edges of the 6 anterior teeth (upper and lower), each curve containing 10 datapoints (60 total for each arch).

For the 2D dataset, landmark placement was accomplished using tspDIG freeware. The 3D landmark placement was accomplished using Landmark freeware. The landmark data was extracted and statistical analysis was completed using IMP suite of freeware written by the author (HDS) and modified for this project.

Established methodology in geometric morphometric analysis will be described and illustrated with examples from biological shape analysis. As applied to bite mark analysis, the tools necessary to describe the dentition are presented. An initial approach to searching for matches will also be shown. This presentation serves as an introduction and overview of the capabilities of this technique.

Forensic Odontology, Bite Mark Research, Geometric Morphometric Analysis

 ** Presenting Author*