Bite-mark analysis: statistics as a tool in assessing validity and reliability of bite-mark evidence

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ORAL PRESENTATION

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ABSTRACT

Background: In 2009, the National Academy of Science conducted a review of forensic disciplines and their role as expert evidence in the US. The review took into consideration cases in which the convicted individual was subsequently exonerated due to DNA testing following judicial reassessment. Together with other latent print identification techniques, the report was critical of forensic odontology, and in particular of bite mark analysis and comparison. The NAS reported that the limitations of forensic techniques included inadequate scientific underpinnings, a paucity of research on human observer bias, and lack of technological innovation. It indicated that both scientific and systemic changes need to be made to bite-mark analysis, to ensure their reliability, establish standards and to promote practices that are consistent. Instead of dismissing bite-mark analysis as just another poor forensic science, the path forward should be to understand the drawbacks of the technique and follow a rigorous and comprehensive research program to address issues that are relevant to the improvement of bite-mark analysis.

Materials currently used in making dental casts for forensic investigations of bite-marks undergo structural and chemical changes during setting, and the casts may not be completely accurate as a consequence. Intraoral 3D scanning of dentitions has the potential to provide a fast, accurate and non-invasive method of recording dental information, however, they are yet to be validated for use in forensic investigations.

Aim: The aim of this study was to assess the reliability and validity of a portable intraoral 3D scanner appropriate for recording suspect dentitions in forensic investigations.

Methods: Reliability of the intraoral 3D scanner was quantified by comparing means of test-retest, rater-rater and method-method differences, calculation of intra-class correlation coefficients (ICC) and standard error of measurements (SEM) of 110 landmark dental features made on 50 sets of human dental casts. To estimate the intra-class correlation coefficients, a novel method of concurrent assessment of inter-and intra-rater reliability in a three-factor (subjects, methods, raters) design with replication was carried out by extending the approach of Eliasziw et al for two factors with replication. The approach by Eliasziw et al allows concurrent assessment of reliability between and within methods and raters and has never been used in bite-mark analysis.

Conclusions: This study addresses the paucity of research on using technological advancements to enhance the scientific

underpinnings in bite-mark analysis. The methods used in this study demonstrate that the measurements of landmark features made from the portable intra-oral 3D-scanner are reliable and of comparable reliability to those made by conventional hand-held callipers and can be a used to record and measure dental information during bite-mark analysis.

Significance of this presentation: In this presentation, I will briefly outline my research and compare the estimations of ICCs using a conventional approach (Shrout and Fleiss) and by using the approach by Eliasziw et al and the differences of using the above mentioned methods in a reliability study with repeated measurements.