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## TECHNOLOGICAL ADVANCES IN DENTAL VICTIM IDENTIFICATION

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*The authors declare that they have no conflict of interest.*

***Background:*** *Victim identification, from a dental perspective, is primarily a pattern recognition and comparison exercise. However situations occur that may preclude the forensic odontologist from applying direct comparison techniques. These include inadequate quantity or quality of the post-mortem evidence. This can result from extreme trauma, fragmentation or incineration.*

*Another factor may be the lack of adequate ante-mortem information. This could result from lack of, inability to locate, quality, or age of the dental record. Any one of the above circumstances, post-mortem or ante-mortem, could preclude the odontologist from establishing a positive identification though image pattern comparison or even the less desirable or reliable: positive dental treatment record correlation, either through narrative or odontogram comparison.*

*This presentation will discuss three separate techniques and applications of technology, which can be useful under extreme conditions for forensic dental identification. The specific technologies are: Scanning Electron Microscope/Energy Dispersive x-ray Spectroscopy (SEM/EDS) X-ray Fluorescence spectroscopy (XRF) Computer aided design and computer aided manufacturing (CAD/CAM) restorative or orthodontic systems*

***Method:*** *SEM/EDS allows for evaluation of not only the microstructure of a tooth or dental material but also the elemental composition. The specific elemental composition of a particular dental material may provide another level of certainty to establish a positive dental identification. Application of this technology to fragmented, incinerated remains in an airplane crash provided additional information useful to the dental identification team. The analysis not only confirmed the presence of endodontic therapy but more specifically the brand of root canal sealer used in treatment. This identification of the material was verified by accurate notation in the dental treatment record. Therefore, although the post-mortem material was of poor quality and quantity, the microscopic technology and quality ante-mortem dental record provided useful information to counter that deficiency. An added benefit of this technology is the fact that incineration does not preclude use. As opposed to the laboratory based SEM/ XRF provides a portability component and therefore can be used in the field or a morgue setting. It also allows*

*for analysis of both large and small specimens with no specimen preparation required. XRF provides a “point and shoot” analysis with direct data base comparison. Studies have shown that restorative composite dental materials have identifiable elemental compositions in type and quantity. In cases where teeth with composite dental restorations are charted an elemental analysis may significantly increase reliability of identification. An individual tooth, with multiple restorations of different manufacturer brands, or multiple brands in variant sequences in the oral cavity, significantly increases the information available for comparison. The material is no longer identified as simply a composite resin but a specific material in a specific pattern or sequence and therefore increased variance for identification. This application is of course dependent on accurate record keeping that specifically documents the manufacturer brand in the dental record. Aside from dental material identification, technology has also provided the forensic odontologist with another form of a dental patient record. This does not refer to digital records or radiography associated with the “paperless” office. Digital restorative dentistry and orthodontic or splint therapy have established CAD/CAM databases of retrievable, reproducible dental information. This information can be recovered from dental laboratory or dental offices computer systems. These three dimensional (3D) models can be used to be compared directly to postmortem remains or recovered dental materials.*

**Results/Conclusion:** *Examples of all of the above technologies, as applied to specific cases and situations, will be presented in order to educate the forensic dental community and increase awareness of these innovative approaches to forensic dental identification.*

**KEYWORDS:** Forensic Odontology, Mass Disasters, Identification, SEM.