G26 Combining 3-Dimensional (3D) Technology With the Traditional 2-Dimensional (2D) Smiling Photographs to Aid in Accurate Forensic Dental Identification

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Learning Overview: After attending this presentation, attendees will better understand the application of 3D technology in accurate forensic dental identification using smiling photographs and will appreciate the difference in certainty of conclusions reached with other comparison methods. Additionally, attendees will learn the advantages of using 3D software in the field of forensic odontology.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by exploring a novel technique for increasing the accuracy in dental identification, which supports further research in the field.

Background: Accurate human identification is of utmost importance for humanitarian, legal, and social reasons. The methodology of comparative identification is based on comparison of Antemortem (AM) and Postmortem (PM) records. However, as with many methods used in human identification, traditional forensic odontologic techniques can at times be unsuitable for reasons including lack of dental records and when information from available dental records is irrelevant to investigation. Smile photographs may emerge as valuable alternative sources of AM data in the forensic environment. They specifically register the unique features of the anterior dentition while recording the shape, position, angulation, incisal alignment, and occlusal relation of visible maxillary and mandibular teeth.

Technological advances in 3D imaging enable useful techniques for the interpretation of smile photographs with human identification purposes. Facilities such as 3D surface laser-imaging technologies have spawned new applications in dentistry. Using a laser scanner, dental plaster models can be converted into 3D images that may be viewed in any preferred orientation and may be subjected to quantitative analysis.

Goal: To explore novel odontological methods by comparing 2D digital smiling photographs with 3D dental models.

Materials and Methods: The study sample consisted of 35 randomly selected smiling photographs of patients who gave consent to participate in research in the Orthodontics Department, Dundee Dental Hospital, Dundee, Scotland. The photographs of the subjects obtained for this study were of varying quality. The smiling portion in the images were cropped and archived, and these images were considered as AM images.

Thirty-one dental casts of the same photographic sample were retrieved from the orthodontic laboratory, which were archived for treatment purposes. All the dental casts were laser scanned to create indirect 3D digital images of dental models and were considered as PM digital models. This study was conducted in two phases. In phase one, 31 digital 3D models were visually compared with 35 of the smile photographic samples showing upper and lower front teeth (canine to canine). The opinions were reached based on the International Criminal Police Organization (INTERPOL) Disaster Victim Identification (DVI) guidelines: Identity Established, Probable, Possible, and Exclusion. After a wash-out period of a week, the second phase of comparison was made using 3D Rhinoceros® software in which the selected 2D AM photograph was superimposed with the 3D digital model, with emphasis on incisal contours of anterior teeth and any morphological traits. Both methods of comparison were performed by the principal investigator.

This study hypothesizes that a valid imaging technique will aid in increasing the accuracy of human dental identification by comparing smiling photographs with dental models. The justification is based on shape, dimensions, and alignment of teeth of an individual, which can comprise a specific and unique set.

Results: Phase 1—In direct comparison of AM photographs and PM dental models, conclusions were reached in 26 cases (identity possible: 16; probable: six and four as established) only; one was wrongly identified, and it was not possible to form an opinion in four cases. Phase 2—With the application of 3D comparison software, conclusions were reached in all the 31 samples (identity possible: seven; probable: 13 and 11 as established) and were correct. This 3D technique made it possible to reach opinions in more cases than when compared to direct comparison. A significant increase in certainty among the opinions reached was observed when using the 3D comparison software.

In summary, it was possible to reach a conclusion in more cases when using the 3D comparison software, and those conclusions expressed a higher degree of certainty, which is the crux of this study as to whether the 3D comparison software adds significant value.

Forensic Dental Identification, Smile Photographs, 3D Comparison