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Original communication

The utilization of a commercial gloss spray in stabilization of incinerated dental structures

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ABSTRACT

Purpose: Incinerated human remains may require dental comparison to establish identity. The remains are often fragile and minor forces can damage teeth and facial bones, disrupting anatomical relationships, and impairing the ability to compare with antemortem records. This study evaluated the ability of a commercially available gloss spray to stabilize teeth in incinerated remains.
Methods: Lower anterior teeth of scavenged sheep mandibles were incinerated in a furnace at a temperature of 500 °C for 35 min. Before a series of vibration tests, the left side of each sample was treated with the spray, with the right side acting as a control.
Results: Significant retention of dental data was achieved utilizing the spray in comparison to the non-stabilized sides.
Conclusion: This study showed that a commercial clear gloss spray did not affect the ability to document or perform radiographic assessment of restorations, and statistically improved the stability and anatomical relationships of incinerated dental remains in scavenged sheep mandibles. Commercial products, such as the one tested in this study, are readily available and could be deployed at a mass disaster situation. However, the spray should not be used if there is any suspicion that accelerants might be involved at the scene.

1. Introduction

The identification of severely incinerated human remains usually requires the services of forensic odontologists due to the lack of visual identifiers, loss of fingerprints and degradation of DNA. Imaizumi et al. found no amplification of DNA in specimens burnt at 250 °C or higher,[1] and Tsuchimochi et al. stated that exposure to temperatures lower than 300 °C are required in order for DNA to be preserved.[2] Successful identification by dental comparison not only depends on the availability and quality of antemortem data but also the maintenance of the postmortem dentition. Loss of the organic component of bone and teeth during incineration causes shrinkage and cracking, resulting in fragility[3–5] and making the task of forensic odontologist difficult. Before moving or transporting incinerated postmortem evidence, documentation should be conducted at the scene and stabilization procedures should be utilized[6] as minor forces can destroy brittle bones and teeth rendering them unfit for identification purposes.[7,8]

A number of methods for stabilization have been previously reported.[9] When plastic wrap was used for protection of the head, Hill et al. observed that less damage was sustained and the dental evidence retained within a confined area.[8] Griffiths and Bellamy suggested that the evidence should be protected with a shock-absorbent layer during transportation.[7] The use of non-radiopaque cement such as cyanoacrylate adhesive allows forensic odontologists to obtain radiographs without further damage to the teeth.[7] This method is useful although large areas would require many tubes of cyanoacrylate and would be more easily covered by a spray mechanism. To stabilize anthropological specimens, Grevin advocated the use of a glue gun,[10] Fairgrieve[11] suggest the use of PVA water based glue whilst Mayne Correia and Beattie[12] also suggested soaking bone fragments in water diluted PVA for 1 min to stabilize them. These methods would not be practical or desirable with incinerated remains at a scene. Mincer et al.[13] reported a number of methods cited by odontologists to stabilize incinerated human remains, which included

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Cyanoacrylate (Crazy® glue, Superglue®), polyvinyl acetate (PVA), "Glue", "Wax", Duco® cement, Spray acrylic, Clear self-curing dental acrylic, dental bonding agent, Bioplastic®, Transparent tape, clear fingernail polish, and Dental "sticky" wax. Cyanoacrylate and Polyvinyl acetate (PVA) were the most common choices with almost 25% of surveyed practitioners using these materials.[13] Mincer et al.[13] also conducted tests of several materials using single-rooted human teeth that were incinerated in a dental laboratory porcelain furnace at 427 °C (800 °F) for 20 min. Different materials were applied by brush or spray and the treated material subjected to vibration using a dental laboratory plaster vibrator. All treated remains were reported as better preserved than untreated remains, however no data were published to support the findings. They found that all the stabilizing materials had some disadvantages, such as difficulty of application, long setting time, and production of unnatural sheen. All the tests by Mincer et al. were on individual teeth set in plaster, which did not assess the retention of teeth in incinerated bone. The separation of teeth from the alveolar bone complicates identification. It requires anatomical recognition and opinion on from where individual teeth, roots or segments of teeth have originated.

No published statistical data on the stabilization of incinerated dental remains were found in a literature review search utilizing Pub Med, Scopus, Google Scholar and forensic odontology textbooks. It was hypothesized, however, that a commercial spray would allow good coverage of material, with ease of use, and that there would be clear statistical data supporting improved stability of all dental structures subjected to movement following incineration.

2. Aims

The aim of this study was to test and produce statistical data on the effectiveness of a readily available commercial clear gloss spray material to stabilize incinerated dental remains.

3. Materials and methods

Dulux® Spraypack™ clear gloss enamel (Dulux®, Clayton, Australia) was used in this study. It is a commercially prepared product containing 10% Butoxy Ethanol, <10% Butanol and 30–60 % Toluene in a spray can. The product was chosen as it eliminated the need for measuring and mixing and its container eliminated evaporation, spillage and leaks, as well as providing easy storage.

An animal model was chosen for initial testing of teeth and bone. Following University of Adelaide animal ethics approval (Project No: ST02/11), scavenged sheep heads were sourced. The anterior segments of eight sheep mandibles were collected, each containing eight anterior teeth. To test the effect on unfilled teeth and restorations (i.e. mimicking human dentitions), on each side of the jaw one tooth was filled using amalgam (SDI, Bayswater, Australia), one tooth filled using composite (Filtek™ Supreme XTE, St Paul, USA) and one tooth was drilled as a cavity preparation, as seen in Fig. 1.

Following the placement of restorations, all samples were stored in a freezer to protect them from decomposition. Approximately 2 h before incineration each sample was defrosted by air exposure. Photographs and radiographs of each sample were taken.

Incineration of the mandibles was performed using a SEM Muffle furnace (S.E.M PTY LTD, Magill, Australia) within a fume extraction unit. This furnace has a maximum operating temperature of 1150 °C and has been tested to 800 °C, displaying a temperature fluctuation of ± 5°C. After initial trials, a temperature of 500 °C for 35 min was set to incinerate the specimens. This was the temperature and time reached before there was detachment of the dental crowns from the roots.

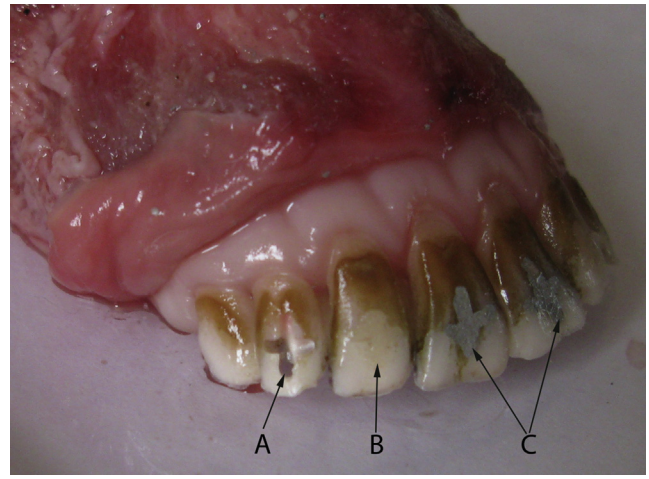

Fig. 1. Sheep mandible before incineration showing 'A′ cavity prepared tooth, 'B′ composite filling and 'C′ amalgam filling.

Following a short cooling period of approximately 15 min, one side (left) of each sample was treated (sprayed) for 30 s whilst the other side (right) acted as a control, as seen in Fig. 2. The spraying time was approximately 30 s at a distance of 25 cm. The spray rate (nozzle) was left at the factory setting and all surfaces must appear wet and all the spraying was performed by the same investigator. The setting time was 20 min. Each specimen was then placed on an Elektro Porex vibrator (Renfert GmBH, Hilzingen, Germany) for stabilization testing. The use of the dental vibrator (usually utilized for pouring stone models) was designed to mimic potential forces associated with movement of remains from the scene to the mortuary. The vibration time was 6 min, set at maximum power, for all specimens which was divided into three 2 min sections. At the end of each section, the condition of the specimens was noted visually for detachment (defined as separation from its socket) and/or fractures (defined as separation of tooth fragments).

The levels of examination were by unaided visual observation, photographic examination using a Canon® Digital Single Lens Reflex camera (Canon, Tokyo, Japan) with a basic 7.4–44.4 mm lens, and radiographic examination using a Nomad™ Hand Held X-ray

Fig. 2. Sheep mandible following incineration and spraying of one half on vibrating plate before shaking.