JOURNAL of FORENSIC ODONTO-STOMATOLOGY
VOLUME 33 Number 2 December 2015

SECTION IDENTIFICATION

The Use of Incinerated Pig Head in Dental Identification Simulation

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The authors declare that they have no conflict of interest.

ABSTRACT

Purpose: The aim of this exercise was to simulate a disaster victim identification scenario to allow training in documentation of postmortem incinerated remains and reconciliation of dental data.

Method: Varying number of restorations were placed in ten pig heads. The teeth and restorations were charted, with the restorations radiographed and documented, creating an ante-mortem data set. The following day the heads were cremated. Following cooling and recording they were transported for a post-mortem examination by trained specialist odontologists who were not involved in the initial antemortem phase. Recordings included the charting of teeth, restorations, lost teeth, and radiographs to simulate a post-mortem examination. A reconciliation of postmortem to antemortem information was attempted.

Results: There was an unacceptable amount of error in the postmortem examination of the heads. The errors related mainly to avulsed teeth and incorrect opinion of which charted surfaces the restorations were placed upon. Also noted were a considerable number of root fractures occurring beneath the crestal bone. This observation does not mimic the evidence observed in human incinerated teeth where the crowns tend to fracture off the roots at the dentin-enamel junction.

Conclusion: The use of incinerated pig (Sus Scrofa) heads is not an ideal model for forensic odontology training in disaster victim identification. Differences in both anatomy and behavior following exposure to heat were shown to hamper documentation and subsequent comparison to antemortem data.

KEYWORDS**:** Forensic odontology, identification, incineration, pig heads, stabilization.

JFOS. December 2015, Vol.33, No.2 Pag 1-8
ISSN :2219-6749

INTRODUCTION

The identification of deceased victims is required for legal and ethical reasons. [1] The process of identification in a severe fire event may be extremely difficult and prolonged due to damage or destruction of physical evidence such as clothing, documents, tattoos, fingerprints, and hair; [2] furthermore DNA may be unobtainable [3] As the dental structures are the most resilient structures of the body [4, 5] they are commonly utilized as the identifying method of choice in severely incinerated cases. However, the loss of water and organic component causes shrinkage and cracking of the teeth and supporting bone [6, 7] consequently any minor force can fracture the brittle teeth and bones or cause teeth to be dislodged. This causes disruption of bony features and loss of the anatomical location of teeth. [8-10] This loss of postmortem evidence leads to examination problems with regards to comparison of antemortem and postmortem data with subsequent delays to the reconciliation (formal identification) phase of the investigation. [11] These delays create frustration and anger for relatives and friends of the victims as sometimes months may pass before the authorities have sufficient information to release the remains.[12] Therefore it is vital to maximize the postmortem information by creating an appropriate pre-disaster protocol and quality control, with the enforcement of that protocol through training and maintaining Standard Operating Procedures. [13] Much of the success of any identification operation can be attributed to pre-planning, a sound response plan and training. [14-16] Areas of training specifically related to incinerated remains include the use of stabilization sprays of remains before movement, wrapping and protection of the heads before transportation, handling, documentation and radiography.

The aim of this exercise was to simulate a disaster victim identification scenario to allow training in documentation of postmortem incinerated remains and reconciliation of dental data. For this purpose pig (*Sus Scrofa*) heads were considered for a training exercise involving incinerated tissues. They are readily available, inexpensive and similar in size to human heads. As they are an omnivore rather than herbivore, the enamel and dentine from swine and human teeth share structural similarities, [17] although there is a greater stiffness and high fracture resistance of human cusps. [18] Figure 1 displays the anterior teeth of a juvenile *Sus Scrofa*.

A previous study has shown that the oral maxillofacial region of miniature pigs is similar to that of humans in anatomy, development, physiology, and disease occurrence. [19] As the heads were to be incinerated, previous research has noted that the burning of lean pig's tissue is comparable to burning of human remains. [20]

MATERIALS AND METHODS

Animal ethical approval was granted by the University of Adelaide for the study to take place, using pig heads sourced from a local abattoir.

Ten heads were transported from the abattoir to a non-clinical laboratory. Utilizing disposable hand pieces and burs, varying numbers of restorations were placed in each head. The teeth and restorations were charted, with the restorations radiographed and documented, creating an antemortem data set.

The following day the heads were placed in an animal crematorium furnace. Within the furnace, each head was placed on a separate ceramic tile and cremated for 4 hours. Following cooling, the tiles were taken carefully out of the furnace. Each tile

(with the head upon them) was carefully placed in a separate clear plastic bag and then into a body bag with bubble wrap. The body bag was transported for a trip of approximately 50 miles for a postmortem examination by trained specialist odontologists who were not involved in the initial antemortem phase. Recordings included the charting of teeth, restorations, lost teeth, and radiographs to simulate postmortem examination. Anatomical bone structure damage and the subjective ease of examination and radiograph taking were noted. Results were tabulated to correspond with the antemortem information for comparison and a reconciliation of postmortem to antemortem information was attempted.

Fig. 1: Image of anterior teeth of juvenile *Sus Scrofa* demonstrating the anatomical circular form of the lower incisors.

RESULTS

The results of the postmortem condition of the teeth are shown in Table 1 with damage sustained due to the incineration and travelling processes.

Table 1. The results of the postmortem condition of the teeth

Pig head no.	Lost in transport	Fractured crowns	Fractured roots	Tooth displaced
1	0	0	3	1
2	0	2	4	0
3	0	3	4	1
4	2	2	3	0
5	0	1	3	1
6	0	5	3	1
7	0	3	2	0
8	0	0	7	0
9	0	3	1	1
10	0	3	6	0

All the restorations remained in place. However, despite care having been taken over the transportation process, two teeth (both from case 4) were lost between incineration and examination. Eight of the heads displayed at least one fractured crown; all had fractured roots and loosening resulting in displacement from their sockets of teeth in 5 of the 10 heads. This proved to be a problem with regards to the anterior teeth as their circular morphology meant they could not be correctly orientated when placed back in the jaw. Table 2 tabulates the postmortem examination findings that could affect the reconciliation processes.

Table 2. Tabulation of postmortem examination findings

Pig head no.	Incorrect nomenclature	Missed restorations
1	0	4
2	2	1
3	0	0
4	1	2
5	3	1
6	2	0
7	1	1
8	0	0
9	3	1
10	2	1

DISCUSSION

Several difficulties were noted during this study. During the placement of the restorations in the antemortem phase rigor mortis occurred quickly. The size of the masseter and temporalis muscles of *Sus Scrofa* mean maxilla and mandible are soon difficult to separate. To overcome this it is suggested that soon after the slaughter of the animal the jaws are wedged apart to maintain easy access for the placement of restorations and the wedge subsequently removed to allow closure of the jaws before incineration. There were also difficulties in radiographing the teeth, due to a mismatch between the width of the pigs' jaws and the width of the digital sensor, resulting in elongation of the digital images.

In retrospect it was noted that the incineration had not been ideal. There had been uneven incineration of the heads due to their positioning relative to the to the heat inlet portals and the ceramic tiles on which the heads had been placed for easy extraction fractured due to heat. These issues could be resolved by better placement of the heads and use of metal trays.

Of note was a considerable number of root fractures occurring beneath the crestal bone with an example seen in Fig. 2.

Fig. 2: Postmortem radiograph demonstrating root fractures beneath the crestal bone.

This observation does not mimic the position of fractures observed in human incinerated teeth where the crowns tend to fracture off the roots at the dentin-enamel junction, an example of which is shown in Fig. 3.

There was a significant error rate in the postmortem examination of the heads. The errors related mainly to dislodged teeth and subsequent incorrect opinion of which charted surfaces the restorations were placed upon. This can be explained by the fact that the pig's lower anterior teeth have a circular morphology and it is difficult to orientate the displaced teeth correctly for charting, irradiating or replacing them into their sockets correctly. An example can be seen in Fig. 4 to Fig. 6.

Fig. 4 is the antemortem radiograph of the lower anterior teeth and of note is that the lower *left* lateral has two restorations with one of them clearly positioned on the distal surface. Fig. 5 has the postmortem radiograph of the 42 to 31 teeth showing correct orientation, however Fig. 6 (the radiographic image of tooth 32 incorrectly orientated) displays a mesially placed restoration but no distal restoration.

This lack of restoration on the distal surface would exclude a match. Due to the fractured crowns and teeth displaced, seven out of the total ten heads had at least one nomenclature discrepancy. These errors would be unacceptable in a real-life situation, and would adversely affect the

Fig. 3: An example of incineration induced fractures at or above the crestal bone height in a human.

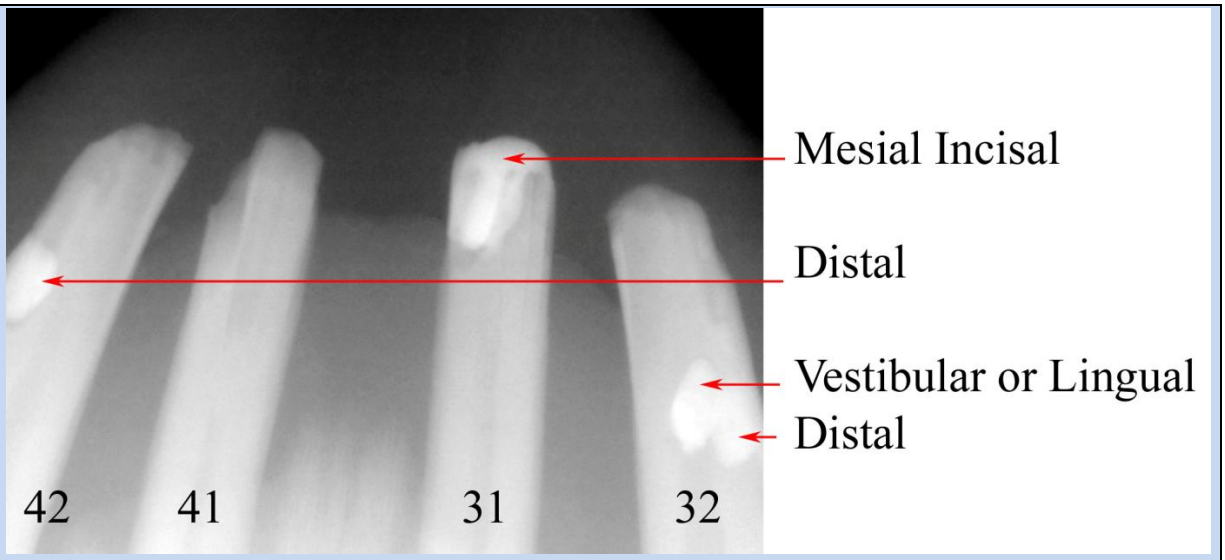

Fig. 4: Antemortem radiograph of 31, 32, 41 and 42 teeth showing four restorations including a distal restoration on the 42 tooth.

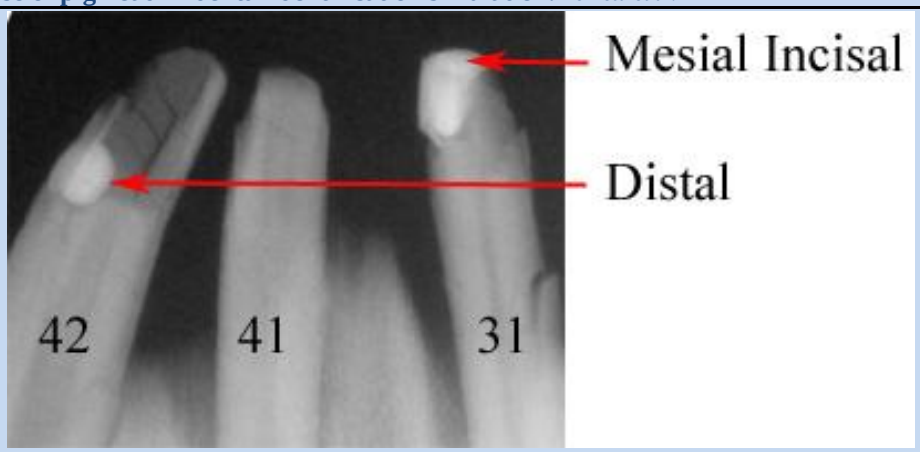

Fig. 5: Postmortem radiographs of the same area as Fig. 5 with the 31, 41 and 42 teeth correctly orientated.

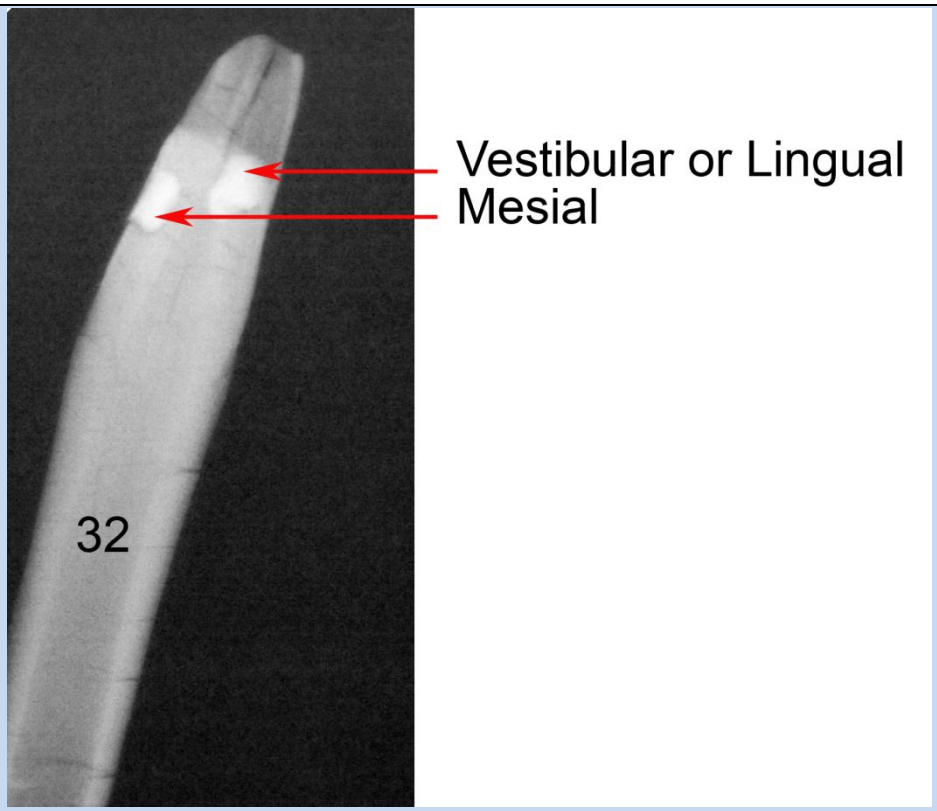

Fig. 6: Postmortem radiograph of the 32 tooth incorrectly orientated suggesting a mesially placed restoration.

reconciliation process. As a consequence of these observations it was decide not to continue to utilize incinerated pig heads as a model for the forensic odontological training.

CONCLUSION

Incinerated pig (*Sus Scrofa*) heads is not an ideal model for forensic odontology training in disaster victim identification. Differences in both anatomy and behavior following exposure to heat were shown to

hamper documentation and subsequent comparison to antemortem data.

ACKNOWLEDGEMENTS

Members of the Forensic Odontology Unit, University of Adelaide are acknowledged for their assistance in this project.

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