
Dead Men Do Even Tell Filled Tales

S. Anitha Rao¹, G. Venkateshwar Rao², V. Chandrasekhar³,
Kolli Tejaswi Chowdary⁴, Shaik Sana⁵

¹Professor and HOD, Department of Conservative Dentistry and Endodontics, Mamata Dental College, Khammam. ²Dean, Principal, Professor and HOD, Department of Oral & Maxillofacial pathology and oral Microbiology, Mamata Dental College, Khammam. ³Professor, Department of Conservative Dentistry and Endodontics, Mamata Dental College, Khammam. ⁴III Year Postgraduate, Department of Conservative Dentistry and Endodontics, Mamata Dental College, Khammam. ⁵II Year Postgraduate, Department of Conservative Dentistry and Endodontics, Mamata Dental College, Khammam.

How to cite this article: S. Anitha Rao, G. Venkateshwar Rao, V. Chandrasekhar et al. Dead Men Do Even Tell Filled Tales. Indian Journal of Forensic Medicine and Toxicology/Volume 18 No. 2, April-June 2024.

Abstract

Background: Dental identification of deceased individual is a core task in the forensic dentistry. The accurate recording of clinical procedures has become more important over the time because of the increasing trends of lawsuits worldwide. Advances in imaging, root canal anatomy and restorative materials have been consistently emerging in present research and practice. Hence, the purpose of this paper is to provide an update on interrelationship between restorative dentistry and forensic personal identification.

Aim: To observe the effects of predetermined incineration temperatures (400 and 800) on unrestored and restored teeth with different restorative materials, and its effect on length of tooth and volume of the pulp under Stereomicroscope and CBCT.

Materials and Methods: 48 extracted premolar teeth were divided into 2 groups based on predetermined temperatures and subdivided into 4 subgroups based on restorative material used. Subgroup i- Unrestored teeth, Subgroup ii- class I Amalgam restoration, Subgroup iii- class I Amalgomer restoration and Subgroup iv- class I Cention restoration. The Antemortem and postmortem records were compared using Stereomicroscope and CBCT.

Results: Teeth exposed to incineration at different temperatures will be analyzed under Stereomicroscope and CBCT.

Keywords: Forensic dentistry, Amalgam, Cention, Amalgomer, Stereomicroscope, CBCT.

Introduction

Forensic odontology is a unique discipline credited to the pioneering of Dr. Oscar Amoeda.

Forensic odontology identified the victims of fire accident in Paris, France in 1897 is one of the branches of dentistry that deals with the proper handling

Corresponding Author: S. Anitha Rao, Professor & HOD, Department of Conservative Dentistry and Endodontics, Mamata Dental College, Khammam.

E-mail: anidental@yahoo.com

Submission date: April 3, 2024

Revision date: Oct 13, 2023

Published date: April 27, 2024

This is an Open Access journal, and articles are distributed under a Creative Commons license- CC BY-NC 4.0 DEED. This license permits the use, distribution, and reproduction of the work in any medium, provided that proper citation is given to the original work and its source. It allows for attribution, non-commercial use, and the creation of derivative work

and examination of dental evidence and proper evaluation and presentation of the dental findings in the interest of justice.^{1,2,3}

In the history, teeth and dental materials have been studied as an aid in the identification process of human remains.⁴ Forensic odontology in particular has been found to be useful when the damage has been caused by heat. Fire causes 1% of the global burden of disease. An average of 1,80,000 deaths every year occurs by burns. Several communities cremate dead bodies at 760⁰c-1150⁰c resulting in the reduction of all tissues to ashes except teeth & bones.^{4,5}

Restorative materials like Gold, Porcelain, Silver Amalgam, Composite are often unaffected even after prolonged exposure to fire. So the combination of healthy and restored teeth is said to be as unique as fingerprint. However the teeth & restorations undergo some changes when exposed to fire.⁵

Most of the features that damage the oral tissues and dental restorations can be seen directly by the naked eye but use of microscope as an adjunct can be very helpful in observing the finer details of dental tissues, the surface involved in the dental treatment.^{6,7}

Radiographs of teeth are one of the components of patients dental records and are definitive evidence in the court.⁴ Comparing the radiographic records will exploits the matching of corresponding features at two levels i.e., external shape and internal architecture. With the recent developments in the endodontic imaging technology, the endodontic cone-beam computed tomography (CBCT) records of the root canal anatomy and post-treatment provide particularly rich sources of the characteristics that promote individualization. To date, limited studies have been done on the 3-D technology using the CBCT for the forensic analysis in human identification.^{1,8}

Thus a combination of both morphologic and radiographic evidence would greatly enhance identification. So it is important to study the effect of heat on intact teeth and teeth restored with different restorative materials clinically & radiographically.⁴

AIM

The purpose of the present study was to observe the effects of predetermined incineration

temperatures (400 and 800) on unrestored and restored teeth with different restorative materials, and its effect on length of tooth and volume of the pulp under Stereomicroscope and CBCT.

Methodology

Inclusion & Exclusion Criteria:

Intact human permanent premolar teeth collected from institutional tooth bank which were extracted due to orthodontic and periodontal purposes with mature apex were included and teeth with root crack, internal resorption, external resorption, caries were excluded.

Preparation Of Specimens:

In this study, freshly extracted 48 intact human permanent premolars extracted due to orthodontic and periodontal purposes were collected and stored in saline until use. GV Black's class I cavities of depth and width of 2mm were prepared using diamond burs with water coolant (Figure 1)

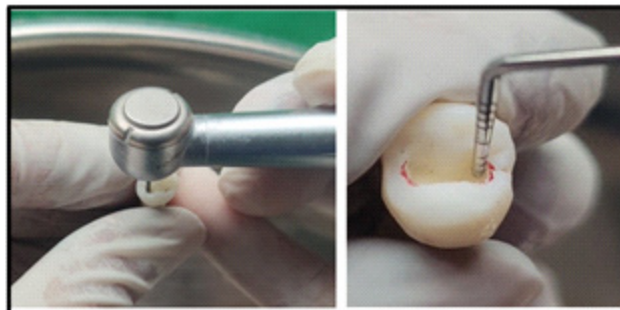


Figure 1: preparation of class I cavity on the specimens

Grouping:

A total of 48 teeth were divided into two groups based on incineration temperatures and further subdivided into four groups based on material used (Figure 2). From each subgroup half of the samples were evaluated for radiographic changes and other half for microscopic changes under CBCT and Stereomicroscope respectively.

Group 1 - 400°C

Group 2 - 800°C

Subgroup 1 - Control

Subgroup 2 - Amalgam(N=6)

Subgroup 3 - Cention (N=6)

Subgroup 4 - Amalgomer (N=6)

Results

The results were obtained by comparing both ante-mortem and post-mortem reports. The microscopic changes were compared under Stereomicroscope at 20x magnification and radiographic changes were compared using Cone Beam Computed Tomography.

At 400 Stereomicroscopic changes revealed discolored teeth intact crowns and loss of enamel translucency and root surface presented with minute vertical fracture lines in almost all samples irrespective of the group, amalgam surface showed increased granularity with intact marginal adaptation, in both Cention and Amalgomer group teeth presented with discolored restoration and contraction of the restorative material along the margins which was more pronounced in Cention group (Figure 4,5).

The CBCT changes revealed no significant changes in all groups except a thin radiolucent line extending till the base of the restoration in both Cention and Amalgomer groups.

At 800all the teeth were fragile, discolored and fragmentation and vertical fracture lines were more pronounced in all the groups, Stereomicroscopic changes revealed discolored dentinal tubules in control group, and even fragmented portion showed intact Amalgam restoration with granular changes, and dislodgement of restoration was seen in both Amalgomer and Cention groups but more pronounced in Cention group.

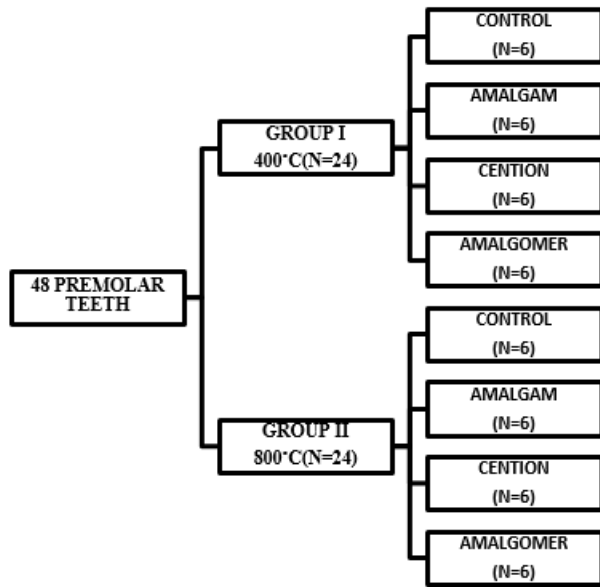


Figure 2: grouping of the specimens

After grouping, the restorative materials were manipulated according to manufacturer’s instructions and were restored in respective groups (Figure 3). Then the teeth were subjected to CBCT and Stereomicroscope and these were considered as antimortem records.



Figure 3: Restoration of the specimens using different restorations

The samples were then subjected to pre-determined incineration i.e-400 and 800 in a digital burnout furnace for 15 minutes with an incremental frequency of 30 /minute in 2 cycles. After incineration teeth were again subjected to CBCT and Stereomicroscope and these were considered as postmortem records.

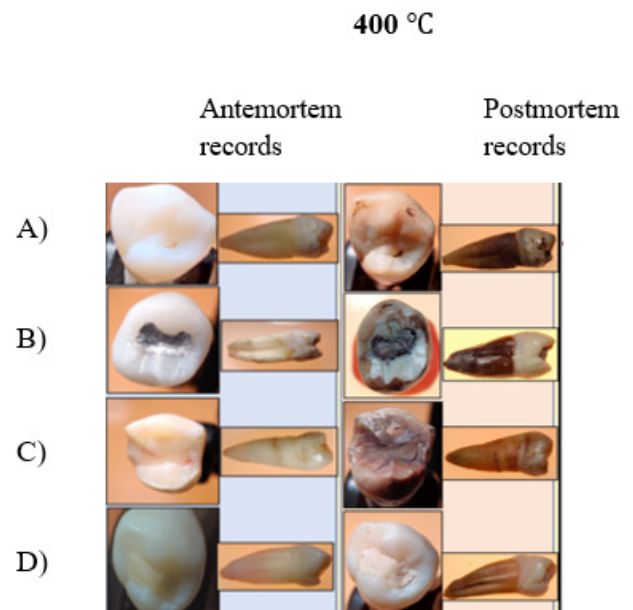


Figure 4: Stereomicroscopic Changes observed at 400 °C in all groups a) Control group b) Amalgam group c) Cention group d) Amalomer group

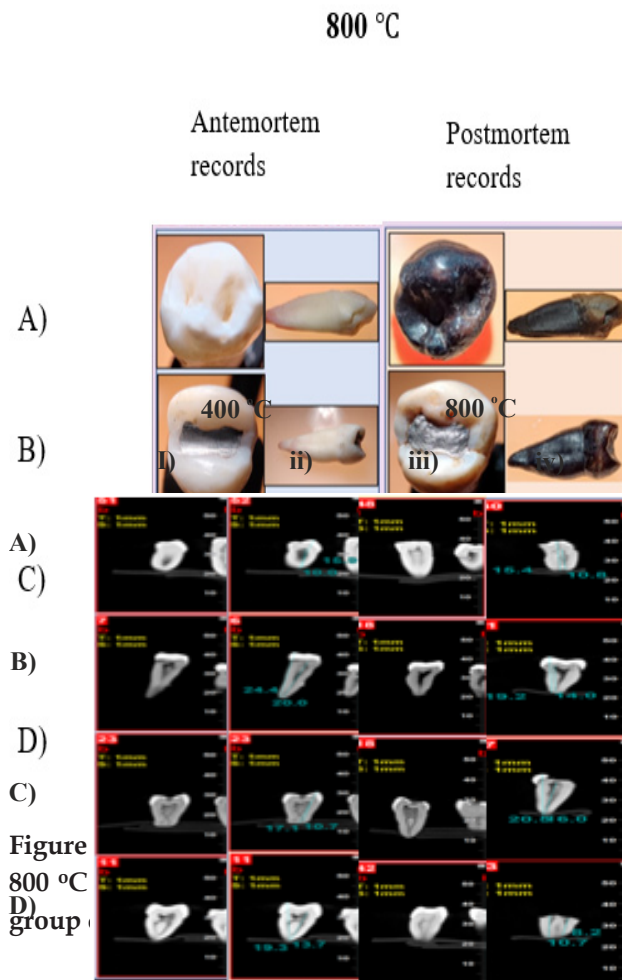


Figure 6: CBCT Changes observed at 400°C 800°C in all groups a) Control group b) Amalgam group c) Cention group d) Amalomer group i) and iii)-Antemortem records ii) and iv) postmortem records

Discussion

Identification of burned victims through forensic dental analysis is difficult due to total loss of soft tissues. In such cases forensic odontology plays an important role in the medico-legal investigations because the dental remains can withstand temperatures to certain extent as they are extremely hard.¹

Incidents such as the domestic fires of up to 649°C, burning of gasoline occur at around 800-1000°C and cremation of individuals happens at

around 760-983°C. So In this analysis, the teeth were subjected to two different temperatures of 400°C and 800°C, simulating different temperatures for various fire incidents. The temperature of fires accidents depends on several factors, including the duration of the combustion, whether the place of the incident is an open or closed space, the materials used to stop the fire and the quality of the oxidant.^{1,9}

In the present study, the period of 15 min was selected for the exposure to the heat, following a previously described methodology (Patidar et al.2010; Pol et al. 2015), in which the authors concluded that the changes that occurred in the materials after 60 min were no different from those that occurred after they were exposed to the heat for 15 min.⁸

Identification of individuals through dental records is dependent upon finding similarities between teeth and restorations present in a known person's dental records and those present in an unidentified deceased, so adequate information on the dental condition prior to death must be available.⁷ The National Registry of Forensic Odontology has requested to various dental colleges to maintain dental records of patients and keep them updated at regular intervals. Arora and Bansal also proposed a meticulous plan for linking dental records with Aadhaar database.¹⁰

Considering the scarcity of literature that correlates the properties of dental restorative materials to the forensic field, this study aimed to evaluate the effect of heat on restorative materials like Amalgam, Cention and Amalomer. Among them Amalgam showed highest resistance to heat followed by Amalomer.

Silver amalgam initially (at 400°C) showed loss of glaze, expansion, and finally at 800°C, globule formation and splintering which was in accordance with the study done by Patidar et al 2010.⁶Merlati G 2004 also observed formation of globules and increased granularity due to mercury evaporation which was also observed in the present study at both temperatures i.e., 400°C and 800°C. Despite disintegration of the crowns, at different temperature levels Amalgam remained in place and maintained their shape which indicates its high resistance to heat.

Its resistance is also due to more significant quantity of crystallization reactions, that leads to more γ phases than γ_1 and γ_2 phases.^{10,11}

Amalgoner CR is a recently introduced direct esthetic posterior GIC which is said to have strength comparable to that of Amalgam due to addition of ceramic particles. In addition to having mechanical strength approximating that of Amalgam, is free of shrinkage has the excellent wear resistance, and has superior radio opacity. It is the first study to use Amalgoner for personal identification. Amalgoner showed contraction along the margins due to loss of water, discoloration of material and loss of material at high temperatures when compared to amalgam. Amalgoner showed least resistance to heat when compared to amalgam.^{10,12}

GIC restoration cracked at a low temperature of 200°C and fragmented at 800°C according to study done by Pol et al. 2015.^{12,13} Raghavan et al. 2017 also found in his study that when teeth subjected to heat GIC was found to be least resistant.

Cention N is a novel bulk fill direct posterior restorative material based on "Alkasite" technology (a subgroup of the composite resin). Its advantages include bulk placement, optional light curing optimal physical/mechanical properties and superior esthetics.^{13,14}

It was the first study to evaluate Cention for personal identification and results have showed that there was discoloration at lower temperature because composite resin materials begin to decompose due to volatilization of their organic component and complete loss of material in most of the samples at higher temperatures which indicated its least resistance to heat when compared to other restorative materials used in this study.^{15,16}

In the control group teeth showed discoloration due to heat energy denaturing the bonds within the helical collagen molecules.¹⁷ The collagen then takes on a more haphazard arrangement that affects the absorption of the visible light spectra and also cracks and fractures increased as temperature increases in accordance to Rossouw et al -1999 and Muller et al-2010 suggesting these plays a role in identification of burn victims.^{18,19}

In the present study, tooth length and pulp volume changes are more significant at high

temperatures (800 °C) which was in accordance to the study done by George et al-2018.⁵

Apart from conventional methods, in this study advanced techniques such as CBCT was used as it allows a 3-dimensional record of teeth. Studies also proven that CBCT allows for the accurate calculation of tooth volumes, and the method is highly reproducible because of the good interexaminers' agreement.²⁰

Conclusion

Forensic dental identification of burnt victims is often a daunting task. Teeth and dental restorative materials aid as valuable adjunctive in identification of burnt victims. The gold standard Amalgam shows higher resistance to heat followed by Amalgoner and Cention. The implementation of 3D technological advances offers a more accurate method and enhanced inter-relation of restorative dentistry and forensic personal identification.

Ethical Clearance: Ethical clearance was obtained from institutional ethical committee board with reference number MDC_R_088351

Source of Funding: Self funding

Conflict of Interest: Nil

References

1. Patel A, Parekh V, Kinariwala N, Johnson A, Gupta MS. Forensic Identification of Endodontically Treated Teeth after Heat-Induced Alterations: An In Vitro Study. *EurEndod J* 2020; 3: 271-276.
2. Patidar KA, Parwani R, Wanjari S. Effects of high temperature on different restorations in forensic identification: Dental samples and mandible. *J Forensic Dent Sci.* 2010 Jan;2(1):37-43.
3. Vandurangi SK, Radhika MB, Paremala K, Reshma V, Sudhakara M, Hosthor SS. Adjunctive role of dental restorations in personal identification of burnt victims. *J Oral MaxillofacPathol*2016;20:154-161.
4. Raghavan S, Birur P, Gurudath S, Keerthi G. Morphologic and radiographic changes in teeth and restorations subjected to high temperatures. *Int J Forensic Odontol*2017;2:62-66.
5. Bonavilla et al. identification of incinerated root canal filling materials after exposure to high heat incineration, *J Forensic Sci*, March 2008, Vol. 53, No. 2.

6. Pol CA, Ghige SK, Gosavi SR, Hazarey VK. Effects of elevated temperatures on different restorative materials: An aid to forensic identification processes. *J Forensic Dent Sci* 2015;7:148-152
7. Ahmed HM. Endodontics and forensic personal identification: An update. *Eur J Gen Dent* 2017;6:5-8.
8. Biancalana et al, Analysis of the surface roughness and microhardness of dental restorative materials exposed to heat sources and cold temperatures for human identification purposes, *Egyptian Journal of Forensic Sciences* (2019) 9:8.
9. Narayan VK, Varsha VK, Girish HC, Murgod S. Stereomicroscopic study on unsectioned extracted teeth. *J Forensic Dent Sci* 2017;9:157-164.
10. George R, Tan WJ, Shih Yi AL, Donald PM. The effects of temperature on extracted teeth of different age groups: A pilot study. *J Forensic Dent Sci* 2017;9:165-174.
11. Bharti R, Wadhvani KK, Tikku AP, Chandra A. Dental amalgam: An update. *Journal of conservative dentistry: JCD*. 2010 Oct;13(4):204.
12. Aparajitha RV, Selvan PS, Ahamed AS, Bhavani S, Nagarajan V. Comparative evaluation of long-term fluoride release and antibacterial activity of an alkasite, nanoionomer, and glass ionomer restorative material- An in vitro study. *Journal of Conservative Dentistry: JCD*. 2021 Sep;24(5):485
13. Krishna Prasada, Hithysh T Vidhyadhara, Comparative evaluation of sorption and solubility of Amalgomer CR and Cention N restorative material- An in vitro study, *International Journal of Dentistry Research* 2020; 5(3): 122-125.
14. Gupta N, Jaiswal S, Nikhil V, Gupta S, Jha P, Bansal P. Comparison of fluoride ion release and alkalizing potential of a new bulk-fill alkasite. *Journal of conservative dentistry: JCD*. 2019 May;22(3):296.
15. Verma V, Mathur S, Sachdev V, Singh D. Evaluation of compressive strength, shear bond strength, and microhardness values of glass-ionomer cement Type IX and Cention N. *Journal of Conservative Dentistry: JCD*. 2020 Nov;23(6):550.
16. Hiremath G, Horati P, Naik B. Evaluation and comparison of flexural strength of Cention N with resin-modified glass-ionomer cement and composite- An in vitro study. *Journal of Conservative Dentistry: JCD*. 2022 May;25(3):288.
17. Kiran et al. Detection of tooth-coloured restorative materials, *journal of forensic sciences*, 2019 doi: 10.1111/1556-4029.14122.
18. G.V. Reesu et al Forensic considerations when dealing with incinerated human dental remains, *Journal of Forensic and Legal Medicine* 2015;29:13-17.
19. Eastwood et al, The Value of Dental Restorations in Post-mortem Identification, *Journal of the Forensic Science Society* 1984; 24:569-576 Revised version received 27 February 1984.
20. Jethi N, Arora KS. Forensic endodontics and national identity programs in India. *Indian J Dent Res* 2020;31:662-665.