IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 18, Issue 4 Ser. 7 (April. 2019), PP 04-08
www.iosrjournals.org

Assessment of Morphologic Changes in Teeth and Restorations Subjected To High Temperatures: An In Vitro Study

Dr Ramesh Chandra[1], Dr. Afsana Begum[2], Dr. UrvashiOjha[3],
Dr. Rehan Ahmad Khan[4], Dr. LubnaAfreen[5],

[1]*Professor, Dept. of Conservative Dentistry and Endodontics, Career Post Graduate Institute of Dental Sciences and Hospital*
[2]*Post Graduate Student, Dept. of Conservative Dentistry and Endodontics, Career Post Graduate Institute of Dental Sciences and Hospital*
[3]*Post Graduate Student, Dept. of Conservative Dentistry and Endodontics, Career Post Graduate Institute of Dental Sciences and Hospital*
[4]*Post Graduate Student, Dept. of Conservative Dentistry and Endodontics, Career Post Graduate Institute of Dental Sciences and Hospital*
[5]*Post Graduate Student, Dept. of Conservative Dentistry and Endodontics, Career Post Graduate Institute of Dental Sciences and Hospital*
Corresponding Author: Dr Ramesh Chandra

Abstract: *In fire accidents and cremation, fires may reach temperaturesas high as 1150^0 C. In such circumstances , teeth and bones are the only remains which can help in personel identification, as teeth and restorations are unique to an individual. This "in vitro" study was to observe the effects of high temperatures on teeth restored by (1) amalgam (2) composite/adhesive system, (3) GIC vs. unrestored teeth. 10 un-restored teeth (control group), 10 teeth with class I amalgam restorations and , 10 teeth with class I composite/adhesive system restorations and and 10 teeth with Glass Ionomer Cement restorations were placed in a furnace and heated at a rate of 10°C/min. The effects of the predetermined 200^{0}C, 400^{0}C, 600^{0}C, 800^{0}C, temperatures were examined under direct vision.our observations showed that amalgam and composite material maintained the shape despite the disintegration of crown or the dislodgement of filling material.*

Key words: *Dental identification, dental materials, dental tissues, forensic odontology,*forensic sciences, high temperatures

---

Date of Submission: 25-03-2019 Date of acceptance: 09-04-2019

I. Introduction

Teeth are the components of the body that often survive severe burns because of their high resistant composition and also because they are protected by the soft and hard tissues of the face and other materials or elements which may be present. Historically teeth and dental materials were studiedto aid the identification process of human remains: particularly forensic odontology has shown to be useful when a damage caused by the heat occurred. In forensic dentistry identification of a person is done by comparing ante-mortem records with theinformation obtained from the post mortem after examination of the body which are burned beyond recognition. It is documented that teeth are the only components of the body that does not get affected by severe fire because of composition plus they are covered by the soft and hard tissues of the face(1).

Norrlander classified body burns in five categories: (1) superficial burns, (2) destroyed epidermis areas, (3) destruction of the epidermis and dermis and necrosis areas in underlying tissues, (4) total destruction of the skin and deep tissues and (5) burned remains. Since the destruction of burned victims of the third, fourth and fifth category, is extensive, such remains cannot be identified by conventional methods like visual recognition or fingerprints. In thesecases the odontologists are called to assist the identification by means of a comparison between the postmortem records of the burned, charred or incinerated individual teeth and the antemortem clinical history supported by the oralmaxillo- facial system(2).

From experimental literature, macroscopic color variations of unrestored teeth could be related to the temperature rise and time of application, from natural color through black, brown, blue, gray, white and finally pink; then, it was relieved that the temperature levels and the combustion time were inversely proportional to the rate of color changes. Color change from light yellow to bluish-white, passing through brown, were pointed out also by Merlati*et al.* and Muller *et al.*, when unrestored teeth are exposedto temperatures in the range of 150-1150°C.(4)

The aim of this study was to find out the effect of heat on the teeth and the different restorations and theirresistance to this extreme state.

II. Materials And Methods

40 extacted human maxillary premolar teeth no showing any cavities, restorations, endodontic treatments, pulpar pathology and congenital malformations, were collected.all the teeth were debrided and stored in sodium chloride 0.9% solution at room temperature , and they were randomly divided into different groups

Group 1: 10 Unrestored teeth
Group II: 10 teeth restored with Amalgam
Group III: 10 teeth restored with Composite
Group IV: 10teeth restored with Glass Ionomer Cement.

After restoration, each specimen was placed in a custom made tray made of dental investment material and the samples were then exposed to direct heat in an oven at four different temperatures viz; 200°C, 400°C, 600°C, and 800°C, As soon as each target temperature was reached, the samples were removed from the oven and allowed to cool to room temperature.All the samples were then examined by direct vision.

III. Results

Group I

200°C: Loss of brightness of enamel.The color of the crown and root changed from yellowish white to light brown.(fig:1)
400°C: Colour of the crown and root changes to dark brown and some cracks were seen (fig:2)
600°C: The crown presented a dark brown colour with black stain (fig :3)
800°C: The crown was grey with the cusps colour white and crown part of some samples shattered completely (fig:4)

Fig:1

Fig:2

Fig:3

Fig: 4

Group II
Amalgam Restoration
200^0C: The Amalgam showed an alteration of the marginal seal (fig.5)
400^0C: Loss of brightness (fig. 6)
600^0C:Retraction of amalgam filling (fig. 7)
800^0C: The amalgam showed a corrugated surface with fissures between amalgam and dental tissues (fig.8)

Fig. 5

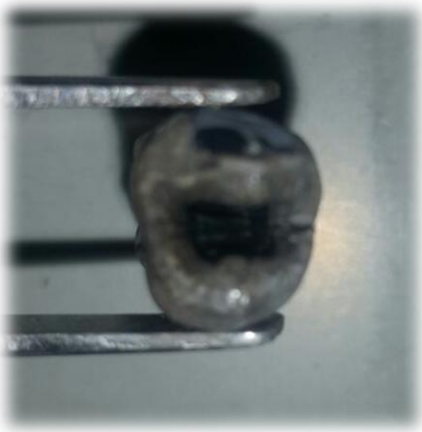

Fig. 6

Fig. 7

Fig. 8

Group III
Composite Restoration
200°C: The Composite filling showed marginal retraction and brown color (fig. 9)
400°C: Increase in the marginal retraction (fig. 10)
600°C: Colour changes to brown, some cracks appeared and few samples dislodge (fig. 11)
800°C: In few Samples there was a dislodgment of the filling (fig. 12)

Fig. 9

Fig. 10


Fig. 11 **Fig. 12**

Group IV
Glass Ionomer Cement Restoration
200°C: Teeth showed cracks on the surface (fig. 13)
400°C: Colour of the filling changes to brown (fig. 14)
600^0C: Colour changes to dark brown with cracks and dimensional contraction (fig. 15)
800°C: Samples showed a dislodgment of the fillings (fig. 16)


Fig. 13 **Fig. 14**


Fig. 15 **Fig. 16**

IV. Discussion

Teeth are amazingly resistant to heat if it is subjected to it gradually, but ifheated severely the tooth may disintegrate; else they may resist temperatures unto 1200°C.Within the behaviour of the tissues and dental restorations observed in this research, the change of colour was the most common characteristic for each range of temperature, and this was directly related with the level of carbonization and incineration of teeth(5).

In the unrestored teeth, the crown turned to a bright brown colour at 200^0C, therefore the changes of colour in the crown were from dark brown at 400^0C, brown with black pigments at 600^0C, grey with black pigments at 800^0C.In all the unrestored teeth, fissures were observed in the enamel starting from 400^0C, which turned in cracks at 600^0C as it was described by Gunther and Schdmit(7).

The charred appearance of the tooth indicates sudden and quick carbonization of the tooth and itsconversion into solid carbon as any biomaterial does on exposure to high temperatures. The teeth usedin this study were specifically restored post extraction; hence, the time elapsed since the fillings werecarried out and the teeth incinerated could not be considered. In real time, there may be a time gap betweenthe restorations carried out on the teeth and the incineration of the body. The amalgam and glass ionomerrestorations were intact even at a temperature of 800°C.The composite restorations turned to a bright brown colour at 400^0C, and at 600^0C the colour changes to grayish black color, due to the acrylic matrix combustion, according to Merlati et al.At 200^0C the amalgams and composite fillings showed a marginal contraction probably due to the evaporation of the mercury and loss of the organic matrix, as it was described by Moya et al. and Merlati et al(5).

Teeth like bones have been known to react in a predictable manner when subjected to natural elementssuch as fire, earth, and water. This study was performed on extracted teeth; hence, exact results may not beobtained when a body is subjected to an intensive heat source. Nonetheless, valuable information wasobtained regarding the predictability of effects. The effects produced depend upon variables, such as theintensity of heat, protection of surrounding tissue, duration of exposure to the heat, presence of anaccelerator, and the medium used to extinguish the fireThe effect of heat on teeth in reality is further complicated by the duration of

exposure to hightemperatures

V. Conclusion

In this study, the teeth were subjected to a single, limited, and controlled exposure to heat. We concludethat the possible temperature of exposure can be estimated by analyzing the changes in the teeth and theirrestorations, though, further studies on other materials used in the restoration of decayed or missing teethsuch as acrylic, porcelain, and stainless steel are requiredForensic dental identification of the victims of fires is very complex and challenging so knowledge of charred human dentition and residues of restorative material can help in the recognition of bodies burned beyond recognition.

References

[1]. Shubhangi P. Bagdey, RohitBalwantMoharil, Alka M. Dive, Samantha Thakur, AshishBodhade, and Akshay A. Dhobley. Effect of various temperatures on restored and unrestored teeth: A forensic study. J Forensic Dent Sci. 2014 Jan-Apr; 6(1): 62–66

[2]. Sandra Moreno, Giuseppe Merlati1, Liliana Marín2, Caterina Savio1, Freddy Moreno. Effects of high temperatures on different dental restorative systems: Experimental study to aid identification processes. Journal of Forensic Dental Sciences .2009.,vol 1(1)

[3]. Moya V, Roldan B, Sánchez JA. Materialesdentales en la identiÞ - cación. In: Odontologíalegalyforense. Barcelona: Editorial Masson, 1994. p. 269-76.

[4]. Guerra AS. Odontoestomatologíaforense. Santa fe de Bogotá: EcoeEditores, 2002. p. 1-8.m3. Ferreira JL, Espina AL, Barrios FA, Mavaréz MG. Conservación de lasestructurasorales y faciales del cadáverquemado. CienciaOdontológica 2005;2:58-65.

[5]. Andersen L, Juhl M, Solheim T, Borrman H. Odontologicalidenti Þ cation of Þ re victims - potentialities and limitations. Int J Leg Med 1995;107:229-2.

[6]. Myers SL, Williams JM, Hodges JS. Effects of extreme heat on teeth with implications for histologic processing. J Forensic Sci 1999;44:805-9.

[7]. Delattre VF. Burned beyond recognition: Systematic approach to the dental identiÞcation of charred human remains. J Forensic Sci 2000;45:589-96.

[8]. Sweet D. Porqueesnecesariounodontólogopara la identiÞcación? In: Fixot RH, editor. Clínicasodontológicas de Norteamérica: odontology íaforensevolumen 2. México: McGraw-Hill Interamericana;2001. p. 245-57.

[9]. Ferreira JL, Espina AL, Barrios FA. La odontologíaforense en laidentiÞcación de lasvíctimas de la masacre de la cárcel de Sabaneta(Venezuela). Rev Esp Med Leg 1998;22:50-6.

[10]. Sweet D, Hildebrand DP, Phillips D. IdentiÞcation of a skeleton using DNA from teeth and PAP smear. J ForensSci 1999;14:630.

[11]. Williams D, Lewis M, Franzen T, LissettV, Adams C, Whitt aker D *et al*. Determination by PCR analysis of DNA extracted from incinerated, deciduous teeth. Sci Justice J Forensic SciSoc 2004;**44:**89-94.

[12]. Urbani C, Lastrucci RD, Kramer B. The effect of temperature on sexdetermination using DNA-PCR analysis of dental pulp. J Forensic Odontostomatol 1999;17:35-9.

[13]. Endris R, Berrsche R. Color change in dental tissue as a sign of thermal damage. Z Rechtsmed 1985;94:109-20.

[14]. Muller M, Berytrand MF, Quatrehomme G, Bolla M, Rocca JP. Macroscopic and microscopic aspects of incinerated teeth. J ForensicOdontostomatol 1998;16:17.

[15]. Wilson DF, Massey W. Scanning electron microscopy of incinerated teeth. Am J Forensic Med Patol 1987;8:32-8.

Dr Ramesh Chandra. "Assessment of Morphologic Changes in Teeth and Restorations Subjected To High Temperatures: An In Vitro Study." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 4, 2019, pp 04-08.