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Original Article

Effect of high temperatures on root canal obturation – an aid in forensic identifications

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ABSTRACT

The forensic odontologist strives to utilize the human dentition throughout each stage of dental evaluation. Their radiographic morphology and filling materials are often the main features for identification. The knowledge of detecting this is a valuable toolmark in the presumptive identification of the dentition of a burned victim. Teeth may have differences in withstanding temperatures and can be correlated with the adequate qualities and quantities of the traces of burned bodies. This relies on the previous records as well as the radiographs. This greatly narrows the research for the final identification that is based on postmortem data. To evaluate and compare the effect and resistance of root canal obturated teeth to different temperatures using radiovisiography for the purpose of identification in forensic analysis. The study was conducted on 56 extracted teeth which were divided into four groups of 14 teeth each based on the different temperatures. Group A - 200°C, Group B - 400°C, Group C - 600°C, and Group D - 800°C. Damage to the teeth subjected to various temperatures can be categorized as intact, scorched, charred and incinerated. At 800°C, the tooth completely charred whereas at 200°C and 400°C the tooth showed both visual and radiographic changes. Utilizing knowledge of charred human dentition and residues of root canal obturated teeth can help in recognition of bodies burned beyond recognition.

Keywords: Teeth, forensic identification, high temperature

Introduction

Historically teeth and dental materials have been studied to aid the identification process of human remains.[1] Forensic odontology, in particular, has been seen to be useful when the damage has been caused by heat. Teeth survive severe fires due to their high resistance and also because they are protected by the soft and hard tissues of the face and other elements which may also be present.

Human identification is one of the major fields of study in forensic science as it aims at establishing a human identity. Dental identification is considered to be the most reliable and frequently used methods of identification. The establishment of forensic odontology is a unique discipline that has been attributed to Dr. Oscar Amoedo (Father of Forensic Odontology) who identified the victims of a fire accident in Paris, France in 1897.[2] At times, fire in a building may prove to be a wildfire and can easily go out of control, with devastating, fatal effects. Fire is considered to be one of the major causes of morbidity and mortality throughout the world and identification of a body from the fatal fire remains a difficult task. Norrlander classified body burns into five categories: Superficial burns, destroyed epidermis areas, destruction of the epidermis, dermis, and necrotic areas in the underlying tissues, total destruction of the skin and deep tissue, and burned remains.[3]

Fire remains one of the major causes of morbidity and mortality throughout the world. Adequate knowledge on the properties of teeth and dental materials commonly used in restorations following exposure to high temperatures can prevent unintentional destruction of the evidence as well as increase the chances of a positive identification.[4] Most of the features of damage to the oral tissues can be observed directly by the naked eye. Additional radiographic, microscopic investigation, either optical or electronic, is useful in studying the finer details of root canal filling materials and any distinguishing traits present.[5,6]

Identification of human remains in mass disasters is a difficult task. Identification of burned bodies starts with the objects that have remained with the body. Teeth have been considered to be the most indestructible part of the human body. Teeth have the highest resistance to most environmental effects such as fire, desiccation, and decomposition. Teeth survive most natural disasters and provide a positive, personal identification of an otherwise unrecognizable

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body. It begins with the correlation of dental records to observed restorations.[7] Since the destruction of burned victims of the last three categories is comparatively extensive, such remains cannot be identifies by conventional methods like visual examination.[8,9] In such cases, the forensic odontologists, assist by comparison means between the postmortem records and the antemortem records. Studying the effect of heat on teeth would also ascertain the temperature reached by the fire if an accelerator was used and whether the blaze was the cause of death or the victim was dead before the fire. This would be highly pivotal in cases where skeletal remains are discovered. Additional information obtained from the available root canal filling material after a fire enhances the possibility of a positive identification.

In recent years, dentistry has been benefited from a marked increase in the development of endodontic root canal filling materials.[10] However, the usefulness of traditional materials has not been eliminated. Forensic odontology is concerned with the identification of root canal obturated teeth when subjected to variable temperatures, which provide important postmortem clues with the availability of premortem records.[11,12] In cases of mass disasters associated with fire, identification of the burned victims can be a real challenge to the forensic team. It is hypothesized that a systematic approach toward the inspection of the obturated teeth after the burn can ensure maximum data and help in identification of the burned body.

Aims and Objectives

1. To subject the root canal obturated teeth different temperatures.
2. To assess the degree of destruction in color, shape, and structure of the obturated teeth, after incineration.
3. To broaden the knowledge of resistance of the teeth, obturation material, and to different temperatures.
4. To evaluate the findings of the study with regard to its application to forensic identification.

Materials and Methods

In this study, 56 extracted teeth were collected from the Department of Oral and Maxillofacial Surgery. An access opening was prepared using Endo Access bur and Z bur and canal patency was checked using No.15 K file. Then, the working length was determined by the radiographic method. The biomechanical preparation was done using step back technique. The canal was copiously irrigated with 5.25% sodium hypochlorite and normal saline. The apical enlargement was done until No.45 K file. All the teeth were obturated using lateral condensation technique using conventional gutta-percha cones, and zinc oxide eugenol as a sealer and post-endodontic restoration was done with composite. Then, the 56 teeth were divided into four groups of 14 teeth each:

- Group A-200°C,
- Group B-400°C,
- Group C-600°C,
- Group D-800°C.

Now, the radiographs and pre-incineration images of all the samples were taken. Teeth of specific subgroups were placed in a ceramic crucible and subjected to the respective temperatures. Once the target temperature was reached, the teeth were removed from the furnace. Teeth were allowed to cool, and post-incineration radiographs and images were taken. The incinerated material was then examined for the changes and resistance to temperature using naked eye and radiovisiography for forensic analysis.

Results

The effect of varying temperatures on the root canal obturated teeth was observed mainly in the form of color change, ranging from brown and black to gray also radiographic changes were noted.

At the highest temperature (800°C) they completely charred.

At 400°C and 600°C, teeth showed voids in obturation radiographically and also minor cracks.[13,14]

At 200°C teeth showed mild difference in obturation and no difference radiographically.

Discussion

Forensic medicine works for forensic identification.[15-17] By its nature, it is a multidisciplinary team effort relying on positive identification methodologies. In forensic odontology, a great deal of effort goes into identifying the victim.[18,19] A method of identification in forensic odontology is to examine the burned bodies and its finer traces, as well as to examine the resistance of teeth and restorative material to high temperature.

In our study, we have observed the visual and radiographic damage to the root canal obturated teeth due to fire. In our research, the root canal obturated teeth showed colour change as well as a change in the tooth structure. This is directly related to the level of carbonization and incineration of teeth. All of these changes were also described by Merlati *et al.,* by Gunther and Schdmidt-quoted by Rotzscher, Horsanyi L1975, Muller *et al.*, 1998, and Merlati *et al.*, 2002.[20,21] Thus, small fragments of teeth can be identified from the burn remains, and a reliable estimation of the temperature of exposure can be made.

We had incinerated all the groups at 200°C, 400°C, 600°C, and 800°C. However, it has to be pointed out that height and weight muscles may prove unreliable in human identification because of the drying of tissues. A skeleton may be a great asset, but as bones are subjected to heat, fractures occur, due to the action of dehydration on the bony collagen. When the elasticity of the bone is reduced, it undergoes shrinkage deformation and the distortion results in a fracture. Similar results were observed in our study, and some patterns of the fractures were typical to heat and assisted in tracing the origin of the fire.[22,23]

From these, observable damages of the teeth subjected to variable temperatures and time can be categorized as intact (no damage), scorched (superficially parched and discolored), charred (reduced to carbon by incomplete combustion), and incinerated (burned to ashes).

The results of our research provide valuable information about the difference in thermal stability of the root canal obturated teeth. The results clearly indicate that as the temperature increases the rate of destruction of teeth also increases.

It can be stated that along with the fire remains, effects on root canal obturated teeth should arm the clinician with additional means of narrowing the possibilities of positive determination. Utilizing methods to access the fire remains will prevent loss of potential dental records, on condition that dental records of all the procedures are maintained accurately.

Conclusion

Forensic dental identification of the victims of fires is often a complex and challenging endeavor. Utilizing knowledge of charred human dentition and residues of root canal obturated teeth can help in recognition of bodies burned beyond recognition. It is hoped that this study can imprint the importance of the pre-planned and systematic approach toward the preservation of charred dentition, as at times it could prove to be the best evidence for identification of those who are extensively burned.

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