

Identification of Burnt Body through Different Techniques

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Available online at: www.xournals.com

Received 10th December 2018 | Revised 7th February 2019 | Accepted 14th March 2019

Abstract:

The burned bodies also plays a vital role in showing various significant changes in both the physical as well as chemical properties and that might be create the obstacles to the anthropological tests as well. The burnt remains resemble the heat increases the difficulties in the identification of bone which is completely dependent on the exposure temperature. The present study focus on the discussion of different techniques for the purpose of identify individuality of a person from the burned remains. Here covering the major aspect there involved different techniques named FTIR, X-Ray, PMCT (Post-mortem Computed Tomography) which plays a vital role in dealing with the burnt remains like bones teeth etc. The review basically summarize the different application of technique used which is ultimately helpful in anthropological research of the burnt remains and also enlisted to make aware with the advanced technologies for the anthropological analysis. The study forces on the challenges faces by the anthropologist while determining the identification in the manner of person's identification as the burned buries remnants.

Keywords: Burned Remnants, PMCT, X-Ray, FTIR

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Introduction

For understanding the nature of heat with the bone, there is need to know about the basic structure and function of the bone. It is a living connective tissue that continually works in repairing and remodeling itself during lifetime against the damage or stressors. The bones' composition maintain this function. Bone is mainly consist of organic and inorganic material. Actually the organic materials i.e., collagen and protein are inbuilt in an inorganic matrix. The combination of organic and inorganic material provides the strong support, and semi-flexible skeletal structure through which the person is capable to show tensile and compressive forces during locomotion. The function of bones as it provide the shape to the body, protect the organs, provide the attachment to the muscles and act as devices for movement. With these properties and function, the bones also work as a storage site for storing the minerals and contains marrow by which blood cells are developed and stored, and supply the body. The personal identification through the use of soft tissue become difficult because of the putrefaction, mummification and severe burn. In these cases, the hard tissue i.e., bones and teeth are only materials by which the forensic investigator or anthropologist can estimate the precise identification.

During fire, the fire begin through the burn of skin and soft tissues and after that reach to the skeletal muscles. In the exposure of high temperatures, bones' chemical properties are altered and structural integrity is reduced and lost. This is because of the evaporation, degradation of organic material and inorganic matrix transformation. According to the scientists and researchers, the organic and inorganic degradation is a complex procedure which is not completely understood yet. In the current scenario, decomposition, dehydration, inversion and fusion (combine together) are used as a stages of heat modification process.

Categories of Fire Modification Degree

The classification explains the degrees of thermal changes through amounting the living tissue.

1. Charring: Internal organs remain
2. Partial Cremation: Soft tissue remain
3. Incomplete Cremation: Bone fragments remain
4. Complete Cremation: Only ash remain

Classification of thermal alteration:

1. Recognizable for identification: It is considered under smoke death in which epidermal blistering and hair singeing are the characterized features.
2. Possibly recognizable: the degree of charring at different place such as hand, feet, genitalia and ears.
3. Non-recognizable: in this classification, the head and extremities are destructed or disarticulated at major level.
4. Extensive burn destruction: In this destruction, the skull and extremities are damaged, fragmented or even missing.
5. Cremation: The level at which there is no tissue or remain left, while osteological fragments are dispersed and imperfect (**Schmidt and Symes, 27, 28**).

Weight of Burnt Bones

At the time of burning, the weight of the bone is decrease as the present water and organic materials is destroyed; the water is vaporized and organic materials are combusted and release carbon dioxide. After complete burning or cremation, the human body are left with 2,000 and 3,000g cremated female and male bones respectively.

According to the researchers Ortnera and Turner-Walker, Compact bone is made up of 62% bone minerals, 24% organic matrix and 14% water. As the water is evaporated and organic matter is decompose and form carbon dioxide and the remaining 62% are not affected or released by burning process. The temperature for decreasing this weight (loss of water and organic matter) occur at 400 to 700 degree Celsius. Through Fourier Transform infrared spectroscopy (FTIR) were used by Fredericks et al on burnt bone powder to check the collagen quantity by measuring the ratio of amide to phosphate. In the DNA test, the decrement in organic content is considered as DNA is an organic component of the bone.

Identification of Burnt Bones by Advanced Technology

Before the analysis of sample (burnt bones), there is need to collect the bone samples. The forensic team face the major challenge in collecting these samples. The forensic anthropologist usually collect the femoral bone for the DNA analysis, but in the extreme burn case, where the corpses show more

thermal destruction, the spinal cord or even dura mater is collected because they resist thermal injuries at certain limit more than the extremities.

In case of burnt human remains, the main role of the forensic anthropologists is to obtain morphological features as much as possible from the fragmented and fragile burnt bones. In the most advanced technologies, the micro CT-imaging technique is available that can observe the detailed morphology of the small materials. It not only work on the surface layer of the fragmented bone but also the sliced histological image and considered as a non-destructive technique. In the micro-CT scanning system, there are two main components; micro focal X-ray source and high resolution X-ray detector. For collecting 360 degree view of the object, there are two designs, one is rotating the support that consists of diagonally positioned X-ray tube and detector and another is rotating the object placed on a precise manipulator (Imaizumi, 2015).

Another technique for the identification of burnt skeleton remains is post mortem computed tomography (PMCT). It is especially used to differentiate between normal post mortem changes and changes due to heat. In most of the cases, the corpses are damaged extremely due to which the secondary sexual features are no not applicable to distinguish the gender, while the deep organs are kept in safe zone by the abdominal wall or peritoneum. So, on the PMCT, the uterus and prostate are shown and allow the radiologist to make a difference between genders (Coty *et al*, 2018).



Figure- Burnt Remains in Post Mortem Computed Tomography

Identification of Burnt Body through Teeth

1. The dentition contain incisors, canines, premolars and molars with different shape and

size. The interspaces is also vary between teeth among the individuals.

2. Changes in the teeth like dental restorations, dental anomalies and pathologies also a great indication in precise identification.
3. Peri-oral musculature cheeks, lips and tongue protect the teeth from physical and thermal injuries.
4. The enamel, outer covering of teeth is most indestructible component of human body and not react with the putrefaction, mummification and severe burning.
5. The risk of contamination with DNA is less because of the reduced porosity of teeth in teeth in comparison of bone.

In the maximum temperatures, the teeth and dental structures are durable. The crematoria's temperature range is around 950 to 1000 degree Celsius. While the burning vehicles reach 1000 degree Celsius. The bearable temperature of teeth without appreciable loss is about 650 degree Celsius. The part of the teeth, crown can survive even high temperatures about 1000 degree Celsius.

Factors of fire exposure:

1. Exposure of body: The exposure of body at fire depends on the condition and position of the body related to the fire. It may be on non-combustible floor during the fire, on the burning item, on the flammable floor that breakdowns during fire, Metal framework like car seat, or may be exposed from all sides called commercial burning.
2. Size of fire: The length or space where fire occur, plays a vital role, the area or size can be explained as the burning of single item or multiple items. The whole room or area may be included. Other than these, the continued post-flashover burning is also involved.
3. Duration of exposure: The time at which fire takes place is called duration of exposure. The duration play a critical role in defining the manner and cause of death. In duration of exposure, the ante mortem and post mortem covers.
4. Condition of Bone: After combustion or burning, during investigation, the scientists and anthropologist looks for the condition of body or bone; fresh and green or dried (Schmidt and Symes, 9).

Difference between burnt human and non-human remains

The major task of the forensic anthropologist is to identify whether the bone is related to human or non-human because this information can eliminate or narrow down the investigation. In case of non-human remains, the investigators stop their investigation but in human remains cases, they try to find the clues to solve the mystery. If we talk about the un-burnt human remains, the forensic anthropologists would be able to find; is it related to human or not? The identification of burnt body as belong to the human or non-human may be done by the tissue if present. The serum are used for the precipitin test for the species identification. The saline or aqueous solution of tissue/soft material for the precipitin test in which it reacts with the human ante serum, if precipitin is formed, show the presence or confirmation of human serum. But extreme burning create the difficulties in this test. Then, the bones if available or burnt bones is considered as the forensic tool for the purpose of identification (**Deadman, 1964**).

Though when the bones are found in charred or burnt condition, the morphology of the bones has been disturbed or changed completely which make the identification difficult or may be impossible. The morphological changes are warping, fracturing and patination that eradicate or obliterate the marked which are used in the taxonomic identification.

For the differentiation between human and animal from burnt bones are done with other analytical techniques. In these analytical techniques, microscopic evaluation of bone histology can be used but before using this technique, it is necessary to find at which temperature the bone was burnt. On the very first level, the identification of histological pattern is concern because during the life time, the different species lay down bone and remodel. The bones are made up of tubular cellular structures, also known as Haversian osteonic systems which appear circular in cross section, relate to the human foetal

bone. While in animals especially in herbivores, plexiform osteon pattern which is made up of the rectangular laminar plates is present and this pattern is substituted and overprinted by Haversian osteons in adult animals. So, the osteonic units banding show the human species and the plexiform bone presence indicates the non-human species. With the combination of morphological and metrical analysis of osteon parameters in making the multivariate discriminant function models are proved highly effective in sorting out the burnt bones of human from other commonly occurring species (**Mallett, Blythe and Berry, 146**).

Conclusion

In current scenario, the forensic anthropologists have developed many advanced technique to identify the individual found in the disaster, mass fatality, in arson or fire case. The major challenge is faced in burnt case where the body of the person are incapable to define the features like sex, race etc. This paper discussed about the different techniques for the identification of an individual and provide the clear view to the anthropologist for solving the mystery. The PMCT (Post Mortem Computed Tomography) plays the vital role as it can reveal the gender of the person as the uterus and prostate are shown through PMCT while the outer appearance is not cleared. After the analysis, the paper also discuss about the major forensic tool i.e., teeth. The teeth remain intact and contain the DNA at very temperature because of the enamel, and cementum (high temp bearable components). In the last, the paper concluded that through the use of these techniques, the burnt body can be identified but the collection and preservation should be done properly.



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