

## Case Report

# Identification of a Charred Body through the Radiographic Morphology of the Frontal Sinus – A Case Report

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**Abstract**

**Introduction:** The identification of charred bodies consists of a challenging procedure during forensic investigations. Forensic Dentistry and Anthropology arise essential to enable human identification through biological hard tissues, such as teeth and bones respectively.

**Objective:** To report a case of positive human identification using the radiographic morphology of the frontal sinuses from postero anterior radiographs of the skull.

**Case report:** In 2013, an unknown body of a 41-years-old male was found charred inside a residence. The charred body was referred for medical, dental and radiographic exams in order to retrieve information about the cause of death and identity. After checking police lists of missing persons, potential relative were found providing ante-mortem postero anterior radiographs from the skull. The radiograph was reproduced post-mortem, allowing for comparisons and positive identification.

**Conclusion:** The present study highlights the usefulness of frontal sinuses as identification tools in the routine of forensic sciences and reinforces the need for properly registering and storing radiographic data, making of it potential source of legal evidence in the courts.

**INTRODUCTION**

In a forensic scope, human cadavers may become directly or indirectly charred. Mostly, the first indicates criminal body incinerations, such as in murder cases [1,2]; while the last is often observed in accidental circumstances followed by incinerations, such as in traffic accidents [3,4] and natural mass disasters [5]. The identification of charred bodies consists of a challenging procedure during forensic investigations. Specifically, the human bodies found charred do not have soft tissues preserved, lacking recognition through facial traits and identification through fingerprints. In this context, Forensic Dentistry and Anthropology become essential to enable human identification through biological hard tissues, such as teeth and bones respectively.

Radiographic registration of hard tissue information is consolidated in the forensic environment as a reliable and useful pathway for the comparative process between Ante-Mortem (AM) and Post-Mortem (PM) data. Several radiographic techniques for the assessment of hard tissue are described into the medical literature. However, in the last few years, Poster Anterior (PA) radiographs of the skull revealed optimal applicability and reliability for outlining the frontal sinuses [6].

The frontal sinuses consist of cavities inside the human frontal bone of the human skull. These anatomic structures may reveal different patterns of volume, position, and arrangement, becoming useful forensic identifiers [7]. Unilateral and bilateral aplasia of the frontal sinuses is rare, making the assessment of radiographic morphology feasible most of the time [9]. During

the human development, the frontal sinuses are not observed at born, becoming only radiographically detectable around the 4 year of age. The frontal sinuses achieve complete expansion at the end of adolescence. Further morphologic alterations are only possible under traumatic or pathologic conditions [10], making the frontal sinuses also applicable for reconstructive human identifications as an anthropological marker of age.

In this context, the present study reports a case of positive human identification of a charred body through the radiographic morphology of the frontal sinuses.

## CASE PRESENTATION

In 2013, a charred human body was found apparently abandoned inside a residence. After local investigation, the body was referred for autopsy in order to retrieve information regarding the cause of death and identity.

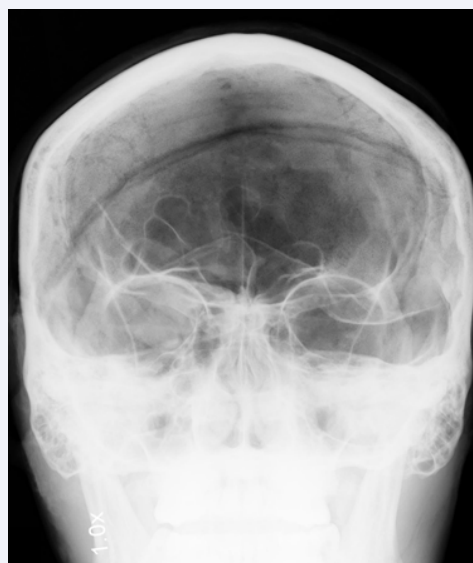
The medical autopsy report revealed carbonization of the soft tissue of face, head and neck; deep carbonization of the thorax, abdomen, pelvis, arms and hands; partial carbonization of the legs and external genitalia, revealing male gender; presence of a gunshot wound in the region of temporal bone; and presence of a gunshot wound in the left region of the thorax. Additionally, soot was not observed into the upper respiratory tract indicating that the victim was not breathing during the incineration. Based on that, the cause of death was established as acute anemia produced by firearm projectiles.

The dental autopsy report revealed complete eruption of the entire permanent dentition, indicating that the victim was older than 20 years old, according to Nicodemo et al. [8], 1974.

The radiographic autopsy report revealed that a single firearm projectile remained inside the body. The projectile was referred for ballistic exam. Moreover, the radiographic assessment of the skull, performed using PA technique (Figure 1), revealed that the frontal sinuses were present bilaterally, presenting lobes and secondary septa. Police investigations were carried in parallel to the cadaveric exams indicating a potential victim, which was a man of approximately 41 years old missing for 24 hours. After interviewing the potential relatives of the victims, police officers requested any medical record related to the victim. A lateral and a PA (Figure 2) radiograph of the skull, dated from 2010, were obtained. Both AM and PM PA radiographs of the skull were used for radiographic comparative procedure (Figure 3). Positive matching was achieved considering several parameters (Table 1), such as the number, shape, and position of the lobes and septa of the frontal sinuses, culminating in a positive human identification.

## DISCUSSION

In forensics, the morphologic analysis of the frontal sinuses through radiographs of the skull is performed for more than 90 years, even being accepted in the American courts [11]. Since that time, several cases of positive human identification founded on the uniqueness of the frontal sinuses were reported in the scientific literature. Silva et al. [2], 2008, reported a case of positive human identification taken into account the outline of the frontal sinuses in PA radiographs of the skull, highlighting



**Figure 1** Post-mortem radiograph of the skull (2013), after craniotomy, highlighting the arrangement of the frontal sinuses.



**Figure 2** Ante-mortem radiograph of the skull (2010), highlighting the arrangement of the frontal sinuses.

the importance of manipulating brightness and contrast if digital images for better comparative outcomes. Another case of positive human identification based on the frontal sinus radiographic morphology was reported by Silva et al. [7], 2009. The authors specially stated about the advantage of reproducing PM the same radiographic technique performed AM. Apart from case reports, original studies were also developed in order to enhance the practical performance of comparing frontal sinuses in the forensic routine. David and Saxena [12], 2010, investigated the uniqueness of the frontal sinus morphology, revealing that it could be used as an additional tool for human identifications.



**Figure 3** Radiographic comparison between ante-mortem (A) and post-mortem (B) data, highlighting a bifurcation of the median septum (arrow).

**Table 1:** Morphologic parameters addressed during the comparison of frontal sinuses.

Parameter	AM PA radiograph (2010)	PM PA radiograph (2013)
<b>1. Median septum</b>	Bifurcated, displaced and tilted to the right side.	
<b>2. Number of lobes</b>	9	9
2.1. Right side	5	5
2.2. Left side	4	4
<b>3. Number of secondary septa</b>	2	2
3.1. Right side	1	1
3.2. Left side	1	1

AM: Ante-Mortem; PM: Post-Mortem; PA: Postero Anterior.

A reliable level of uniqueness was also observed by Patil et al. [13], 2012, observing that no two individuals had the same sinus morphology. Other studies focused on developing the study of frontal sinuses for anthropological purposes, such as sex differentiation [14]. Yet Silva et al. [6], 2014, investigated the influence of altering the vertical angle in PA radiographs of the skull, indicating that PM documentation of the frontal sinuses should be carefully approached.

In the present study dental and medical autopsy reports were interpreted in forehand to assess the age of the victim and to assure that the frontal sinuses were completely developed. Only after that the frontal sinuses were quantitatively examined considering the number of lobes and septa, as well as the

position of the median septum. Surely, other forensic pathways can be considered under the need for identification, such as the PM reconstruction of anthropological traits of the victim [15], estimating age and stature, and differentiating sex and ethnicity; the superimposition of radiographic images [16]; even through DNA analysis from bone tissue [17]. However, the adequate quality of AM radiographs of the frontal sinuses enabled a reliable comparative identification.

On the other hand, limitations for the forensic use of frontal sinuses may occur, mainly consisting in the lack of AM radiographic data of the full skull, making this technique restricted to specific applications, such as in the present case. Other limitation potentially detected is the quality of radiographs, which may be caused during image acquisition or after inappropriate storage. Based on that, the present study highlights the need for properly registering and storing radiographic data, making of it a potential source of legal evidence to support forensic cases.

## CONCLUSION

Forensic facilities worldwide are equipped with a broad range of devices. However, in special situations, such as in developing countries, high-cost imaging and molecular technologies are not available, making necessary the application of alternative but reliable pathways for human identification. Therefore, the present study reported a case of positive human identification based on radiographic records, expressing the potential use of the frontal sinuses as identifiers in the forensic environment.

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