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Beyond the flames: understanding the impact of loss without body recovery or identification in fire-related mass disaster contexts

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Abstract

The World Trade Center attack (2001), the Black Saturday (2009), the Malaysia Airlines Flight 17 (2014), the wildfires of June and October in Portugal (2017), the California wildfires (2018)—these are a few examples of mass disaster events, specifically related to fire and high temperatures, which resulted in multiple casualties and several people unidentified and/or missing. Besides the physical destruction, the lost lives are one of the main consequences of these contexts. Dealing with the loss of a family member may not be an easy process; however, it is easier to accept when there is a body to bury. Conversely, not knowing the whereabouts of a person who might have been involved in a disaster makes mourning and returning to daily life harder. The family of the missing/unidentified lives in doubt and in a state termed as "ambiguous loss". Forensic anthropologists face several challenges and obstacles when detecting and analyzing burnt skeletal remains, which are increased in mass disaster contexts. However, the suffering experienced by the families of the victims of these contexts is far superior. Therefore, it is of utmost importance to employ all efforts to achieve the identity of these victims to allow the families to mourn, as well as to reassure society that no death is insignificant. Thus, the importance of identifying the victims of scenarios involving fire/heat is addressed in this paper through a brief description of some mass disaster events, emphasizing the challenges faced in identifying burnt remains and the psychological consequences families endure resulting from it.

Keywords: forensic sciences; forensic anthropology; mass disasters; burnt remains; identification; ambiguous loss

Introduction

In revisiting its genesis, the work of the forensic anthropologist aimed primarily at the identification of badly decomposed or skeletonized human remains [1, 2]. However, forensic anthropology has evolved greatly as a scientific area and forensic anthropologists now have competencies that allow them to go far beyond identification [1–4]. The contemporaneous forensic anthropology expert also detects and collects human remains *in situ*, estimates the postmortem interval, and performs trauma analysis [1, 3]. Adding to these daily tasks, forensic anthropologists can also participate in investigations of human rights violations and in mass disaster contexts [1–3, 5, 6].

Terrorist attacks, plane crashes, and natural catastrophes (e.g. volcanic eruptions, floods, wildfires) are events that can be classified as mass disasters [7, 8]. The number of casualties is usually high in such events; however, the way death occurs is also important to classify an event as a mass disaster [9]. Nuzzolese and Di Vella [9, p.261] define mass disaster as "a serious disruption to life that causes, or threatens to cause, death or injury to numbers of people, extensive damage to property, or contamination of the environment on a scale beyond the capacity of public services operating under normal conditions, and requiring the special mobilisation or organisation of those services". In the aftermath of a mass disaster, disaster victim identification teams integrate different forensic experts (anthropologists, odontologists, radiologists, pathologists, etc.) that aid in the recovery and identification of victims.

The main purpose of response teams in a mass disaster context is the recovery of the victims, not only the living but also the dead. Therefore, their efforts are split between helping the survivors and identifying the deceased [10]. In the aftermath of a mass disaster, the cadaveric remains can be highly altered; thus, the presence of a forensic anthropologist is of utmost importance in detecting and recovering the remains [4, 5, 11–13]. When these contexts involve fire and/or high temperatures (e.g. plane crashes, bushfires, wildfires, terrorist attacks involving explosions), the presence of these experts is heightened due to the fact that cadaveric alterations are more pronounced and skeletal remains can easily be mistaken for debris and *vice versa* [14–18]. The presence of an expert who is familiar with the human skeleton and aware of the changes that factors such as heat/temperature can produce on bones is fundamental to ensure a quick, efficient, and thorough recovery. Nevertheless, forensic anthropologists face

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an exceptionally challenging task when it comes to working in these contexts. For one, the analysis of burnt skeletal remains is, in itself, very complex due to the changes that bones present due to thermal action [19, 20]. Exposure to high temperatures causes changes at the microscopic level, encompassing four phases: dehydration, decomposition, inversion, and fusion [21, 22]. In these phases, bones lose water, the organic components undergo pyrolysis, there is a loss of carbonates, and the inorganic matrix recrystalizes, respectively. These alterations have repercussions at the macroscopic level leading to changes in colour, density, morphology (e.g. warping), size, and even heat-induced fractures [20, 22–25]. Equally complex is the detection and recovery of burnt skeletal remains on site as these heat-induced changes render them nearly indistinguishable amidst the debris [18, 26, 27]. Thus, it leads to both the recovery of pieces of evidence without forensic interest and neglecting smaller size bones/fragments [14, 15, 28].

Catastrophe events are becoming more frequent due to climate change, with wildfires, bushfires, and floods threatening communities, ecosystems, and economies. In 2023 alone, we have witnessed several devastating large-scale events, such as the wildfires that burnt over 430 000 hectares in Chile (30 January 2023 to February 2023), and resulted in the loss of 24 lives [29]; the wildfires that affected Canada (1 March 2023 to October 2023) [30]; and the wildfires in Maui, Hawaii (8 August 2023), which saw a death of 97 and 31 missing people (with initially 2 000 people unaccounted for) [31, 32]. Situations like this reinforce the need for trained forensic anthropologists to be employed in the field and to do their best to recover as much evidence (i.e. human remains) as possible, sifting through all the debris to find even the tiniest piece of (sometimes, charred) bone to return to bereaved relatives. Recovery and identification of the dead hold special importance because they impact the lives of their relatives [10, 33]. While it is crucial to allow for closure and emotional healing related to the mourning and grieving process, it is also essential for dealing with legal matters, such as remarriage, inheritance, life insurance, or emigration proceedings [6, 9, 34–36].

This paper briefly describes some mass disaster events associated with fire/heat that had a big impact worldwide. Although the scenarios depicted can be devastating and tragic, the aftermath for the surviving victims (namely friends and family of the deceased and/or missing) can be agonizing. Therefore, the importance of identifying the victims of scenarios involving fire/heat is addressed here.

September 11, 2001—World Trade Center attack

The terrorist attack on the World Trade Center in 2001 [37] is widely recognized as one of the most significant mass disasters of the 21st century, underscoring the intricate nature, complexity, and importance associated with recovering burnt skeletal remains. The collision of hijacked planes with the Twin Towers resulted in the loss of 2 753 human lives [37]. The cadaveric remains were extremely fragmented, scattered, and burnt due to the explosions and consequent fires. The severe alterations to the cadavers, as a result of the fires and also due to the towers collapsing, caused extreme difficulties in recovering the remains [13, 16, 38, 39]. Initially, over 20 000 fragments of human remains were recovered, and thousands of nonhuman remains were recovered and later discarded (see [40] for further details about the recovery process). The difficulties were extended to the identification process, as can be attested by the fact that over 20 years after the attack, 1 104 victims remain unidentified [37, 41]. Nevertheless, ongoing advancements in technology and forensic methodologies are being dedicated to the identification of the remaining victims, with occasional new identifications taking place [41–43], giving hope to the families who lost loved ones in this tragedy.

Black Saturday

The 2009 bushfires in Victoria, Australia, also demonstrate the impact on victim identification efforts. Strong winds, lightning strikes, heat, faulty powerlines, and arsonists, all contributed to creating a horrifying Saturday, that became known as Black Saturday [16]. These devastating fires resulted in the loss of 173 lives [16, 44]. Forensic experts faced several challenges in recovering the bodies due to extreme fragmentation and thermal-induced alterations [14]. Additionally, the presence of house debris mixed with human remains, along with the absence of forensic anthropologists on the teams that first visited the scenes, caused an incomplete recovery of the remains. Moreover, materials such as tile and wood were also collected, under the premise that they were bone [14]. Consequently, it was necessary to revisit the sites in an attempt to collect more remains and information [44]. Besides the fact that it no longer is the original scenario, subsequent revisits further complicate the identification process by assigning new reference numbers for each newly recovered cadaveric element. This means that fragments belonging to one individual could be catalogued with different reference numbers, thus delaying identification and, consequently, the return of the victims to their families.

Malaysia Airlines flight 17

The Malaysia Airlines flight 17, attacked on 17 July 2014, further highlights the challenges faced in identifying victims of mass disasters. The flight from Amsterdam to Kuala Lumpur was shot down over eastern Ukraine by a Russian missile, resulting in the death of all passengers and crew members [16, 45]. Recovery and investigative processes were complicated due to a set of factors. The main problem was the access to the crashing site: the aircraft crashed in Hrabove (Donetsk Oblast), a zone of armed conflict, thus unsafe for the investigators and forensic team to work [45]. The extreme fragmentation, heat-induced alterations, and decomposition of the cadavers resulting from the explosion and consequent crash of the aircraft further complicated the scenario. These factors resulted in an incomplete recovery of the remains for many of the flight passengers [45]. The challenges were such that, 1 year after the tragedy, several small fragments were still being recovered from the site and sent for analysis [16, 45]. Nevertheless, two of the 298 fatal victims were not possible to recover [45].

2017 Portugal wildfires

Two periods of wildfires affected the centre region of Portugal in June and October 2017, causing the demise of over 100 people [46, 47]. Considered as one of the largest fires to affect the centre of Portugal, the fires of June (from 17th to 20th) consumed 45 328.6 hectares and killed 66 people [48–50].

At the origin of fires were the adverse weather conditions—extreme temperature, low relative humidity, and thunderstorms [48, 50, 51]—providing the optimal circumstances for a catastrophe. A few victims died at their houses, due to either low mobility or trying to defend their properties; however, most of the victims, perished on the roads, trapped inside their vehicles, as they tried to escape the flames [46, 51]. The fires in October resulted from the strong and dry winds generated by hurricane Ophelia, associated with the dry soil and vegetation, caused by the high temperatures registered throughout the year [48, 51]. Such combination of factors led to the destruction of 244 000 hectares within 10 h [49, 50] and the death of 51 people [49, 50]. However, here most of the victims were elderly people (over 65 years old), with health and mobility issues, thus perishing in their homes [47].

The high intensity of the fires caused extreme alterations to the cadavers [46, 47], and forensic anthropologists were called on site to help detect and recover cadaveric remains. Despite these challenges, it was still possible to identify the victims. Albeit, there is a male individual from the October fires who, according to accounts from relatives, was in his home at the time of the fire, and whose house was consumed by the flames. Despite all the efforts to find his body, no remains were recovered. However, he was listed as one of the fatal victims of the event [47].

2018 California wildfires

In 2018, California was also affected by a series of wildfires resulting in a total of 106 deaths [52, 53] and one missing person [54]. The cadaveric remains presented severe heat alterations, which posed serious challenges not only to the recovery of the remains but also to their identification [55]. A significant part of the remains from the Camp Fire suffered such extensive alterations that they resembled the bodies submitted to the commercial cremation process, with 90% of the victims being identified using ANDE Rapid DNA Identification system [55]. The recovery of the remains was difficult and repeated visits to the site were necessary [55]. Subsequently, this translates into the classification of several new cadaveric fragments separately, even though they might be related to a body previously recovered. Adding to the already challenging context, several of the families affected had pets. Therefore, it was necessary to distinguish between human and nonhuman bones [55].

Discussion

The examples above are just a small representation of mass disasters involving thermal action in recent years. They illustrate the devastating consequences common to all scenarios alike: the lives that are lost and the bereaved families of the deceased and missing. In these situations, there is severe physical damage such as destroyed houses and cities, hectares of burnt forest, and, undoubtedly, casualties. However, the psychological consequences, including the ones associated with losing a loved one, are far more complex and should not be disregarded [10, 56, 57].

Losing a loved one is a difficult and complex experience where mourning and grieving are essential processes one must navigate through. This emotional journey is, however, fundamental in allowing individuals to cope effectively with their feelings and ultimately find a healthy manner to resume to their daily lives [58–60]. Mourning and grieving are inherently challenging journeys that manifest differently for each individual, as they grapple with accepting the reality of the loss of a loved one [58, 61]. Achieving a state of peace after loss often requires time but can eventually be reached (in most cases), even though the path towards it might unfold as a gradual process and be unique to each individual [61].

Death and the grieving process are perceived differently across cultures [62–64]. In most cultures, the death of a person is a tragic event, and they must be remembered for the life they led and the impact they made in their community. Conversely, others view death as the beginning of a new stage of the life cycle and it must be celebrated. Despite the variations in cultural beliefs, where varying degrees of significance may be attributed to the body and the soul, honouring and caring for the deceased's physical remains is at the centre of most funerary rituals performed [63]. Therefore, for most people, regardless of their culture, the presence of the body is extremely important for the funerary practices and mourning process; hence, having access to the body becomes crucial for funerary customs and for engaging in mourning ceremonies.

In mass disaster contexts, especially the ones involving heat, the process of recovering and identifying human remains is a great challenge. This challenge can sometimes be completely impossible to overcome, resulting in unidentified bodies or even unrecovered remains. In these situations, where an identity cannot be ascertained to the remains or no remains can be recovered at all, the mourning process for the families is further aggravated [33, 65–67]. The absence of answers creates feelings of uncertainty and doubt in people who do not know what happened to their relatives or friends or where they might be [65, 68, 69]. Numerous questions are raised, and until there is some kind of physical evidence (such as a cadaver), these relatives are in constant suffering and live in a state termed as ambiguous loss [68, 69]. Boss [70] described ambiguous loss as a state where the missing person is absent physically but is present psychologically to their family and friends. Therefore, they are constantly thinking about the missing person and where they might be, consequently living in an alert state, thinking they might return [68, 69]. According to psychiatrist Marzia Marzagalia [36], this state creates symptoms similar to those of people who are tortured.

Losing a relative to death or not knowing what happened to them has complex psychological implications; nonetheless, the legal ramifications should not be overlooked. Following the death of a person, there are legal procedures that must be taken, for instance, money and property inheritance, life insurance premium, or salary payments [34], all of which require a death certificate. However, in cases where one is presumed to have perished in the context of a mass disaster, but their remains were never recovered, these proceedings can be delayed or even unachievable, due to lack of hard evidence of their death. Even years later, complications may arise if one wants to remarry but no legal evidence of the death of their late partner exists. Furthermore, in immigration instances, a death certificate may be required under specific circumstances [36], putting on hold the lives of people whose relative was never found or officially declared dead. Such situations not only complicate proceedings, but also make people relive the pain, exacerbating the suffering of the bereaved.

The longer the time elapsed after the event, the greater the challenge to obtain information. By contrast, the suffering endured by the families of the victims does not decrease with

time. There is, in fact, an intensified need to obtain answers and closure. Thus, until a cadaver is recovered and identified, the families exhibit feelings of inability to give up on looking for answers [68, 69], and consequently, moving on with their lives, because they feel that is by continuing to search for their loved one that they demonstrate their love and concern with them [65, 66, 68, 69].

Final remarks

Forensic anthropologists have an exceptionally challenging task when it comes to working in mass disaster contexts associated with fire and high temperatures. For one, the analysis of burnt skeletal remains is, in itself, very complex due to the changes the bones present as a result of thermal action. Equally complex is the detection and recovery of burnt skeletal remains on site as the heat-induced changes render them nearly indistinguishable amidst the debris. Nevertheless, the pain and suffering endured by the relatives of the victims, who do not have the remains of their loved one(s) to mourn and allow some closure, is greater than any difficulty that may arise during the work carried out by the forensic anthropologist. In fact, the suffering is one of the reasons why the specialized knowledge and skills of these experts are not only necessary but also meaningful. When a (burnt) cadaver is identified, it is no longer just a number, but becomes a person with a story to be told. As a result, some answers can be given to the families and friends and, hopefully, their pain and uncertainty can be eased. Furthermore, it is not only important for the emotional well-being of the bereaved, but also has a significant impact on legal proceedings.

The analysis of burnt human skeletal remains has proven to be an important side of forensic anthropology, which should continue to be developed. Even though every scenario presents unique characteristics (type of disaster, circumstances, geographic location, etc.), there is one factor that remains unchanged, i.e., the victims, both the deceased and their living relatives. Therefore, it is of utmost importance to employ all efforts to recover and achieve the identity of these descendants in order to allow the families to mourn, as well as to reassure society that there are no insignificant deaths.

Authors' contributions

Maria Beatriz Barreiro was responsible for conceptualization and writing of the original draft; Maria Teresa Ferreira and Miguel Morgado performed supervision roles and participated in the reviewing and editing process of writing. All authors contributed to the final text and approved it.

Compliance with ethical standards

The authors state that there are no ethical issues to report.

Disclosure statement

The authors report there are no competing interests to declare.

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