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Disaster Victim Identification in Mass Disasters: Challenges, Innovations and Case Studies

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Abstract

While airplane crashes are statistically quite rare, they often create complex situations that involve both medical and legal issues. When these tragedies happen, identifying the victims becomes much more than just a technical task; it's fundamentally about honoring their humanity. This paper takes a close look at how victim assessment and forensic dentistry come together in the process of identifying disaster victims (DVI), specifically focusing on airplane incidents. In these cases, the remains of the victims can be extremely fragmented, mixed together, or severely damaged.

Keywords: Disaster Victim Identification; Humanitarian; Victim assessment; Forensic Nurses

1. Introduction

Forensic Odontology is the branch of dentistry which, in the interests of justice, deals with the proper handling and examination of dental evidence and with the proper evaluation and presentation of dental findings as defined by Keiser Neilsen[1]. This branch of expertise deals with the examination of dental evidence such as unidentified skulls or bones, teeth, blood, saliva, and tissue injuries like bitemarks.

Humanitarian forensics is closely tied to both forensic science and human rights, functioning in situations where the focus is not only on identification but also on the broader humanitarian concepts. It involves the application of forensic methods, but in the interest of upholding human dignity, restoration of identity, and providing closure to families of the deceased[2]. This field brings ethical responsibility to the forefront, recognizing the cultural, emotional, and psychological toll that delayed or doubtful identifications can have on the community.

Forensic Nursing is a speciality realm under nursing that brings together healthcare , forensics and justice. This nomenclature is still under the process of being adapted in India, but shows to be a promising field[3]·Morris Tidball-Binz, in his Schofield Oration, emphasized that HFA is not just a scientific endeavour but a moral concept that can help to understand the gap between forensic science and human rights. A powerful example of humanitarian forensics in action is the identification of missing children during Argentina's military dictatorship (1976–1983). Many were born in captivity and raised under false identities, separated from their families by force. The Grandmothers of Plaza de Mayo, driven by love and determination, worked with forensic scientists to develop the Index of Grand-parenthood a genetic tool that helped confirm biological relationships and restore stolen identities[4].

Victor Penchaszadeh emphasized the delicate balance between the science of identification and the deep emotional, psychological, and cultural needs of families affected by these tragedies. He highlighted how critical it is to approach the process with sensitivity, ensuring that while scientific accuracy is essential, the rights, dignity, and emotional well-being

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of the families are always respected. Recognizing the importance of standardized procedures in disaster victim identification (DVI), the Interpol General Assembly, during its 65th session in 1996, passed Resolution AGN/65/RES/13. This resolution called for the use of the Disaster Victim Identification Form and stressed the need for multidisciplinary teams, including police officers, forensic pathologists, and forensic odontologists. By bringing together experts from different fields, this approach ensures a thorough and coordinated response to the complex challenges of identifying victims in mass casualty events[5][6].

2. Recent Crises in Aviation (2024-202

An efficiently managed incident occurred in 2024 with the tragic plane crash in Brazil, which claimed the lives of 62 individuals. A carefully coordinated DVI protocol ,and the success of the identification process Brazilian forensic authorities, managed to identify every victim. The primary method of identification was fingerprint analysis, which proved effective for the majority of the bodies recovered. However, when fingerprints were unavailable due to the extent of trauma or decomposition, dental records stepped in as a crucial secondary identifier. Families were asked to provide dental records and radiographs, which were then matched with postmortem findings[7].

In contrast, another case in 2024 brought attention to the long-term importance of forensic odontology: the Lake Huron plane crash, originally occurring in 2007. Human remains from the decades-old crash were recovered and identified through dental analysis, demonstrating the long-lasting relevance of dental records, especially in cold cases where DNA may have degraded or contextual records are incomplete[8].Meanwhile, a maritime disaster involving African migrants further exposed systemic challenges in DVI namely the lack of accessible antemortem data such as dental records or fingerprint registries, which drastically hampers identification outcomes. In these cases, despite the best efforts of forensic teams using a combination of methods, the identification rate remained low due to missing baseline data[9].

3. Statistical Data

A systematic review encompassing 22,345 victims from global mass disasters reported an overall identification rate of 86.21%, with 15.21% of these identifications achieved solely through forensic odontology, and an additional 6.21% using dental methods in conjunction with other techniques[10]. Another study analysing 20,569 victims found that 14.7% were identified using dental records, demonstrating the global reliance on dental identification, especially in scenarios where DNA or fingerprint identification is not feasible[10]. The durability of dental structures, even in extreme conditions such as high-impact crashes or fires, further underscores their importance in the identification process[11].

Despite its significance, the effectiveness of forensic odontology can be hindered by the lack of accessible antemortem dental records. A study in India highlighted that only 3% of dentists had participated in mass disaster identifications, primarily due to inadequate record-keeping and limited awareness of forensic odontology's role[12]. Interpol's DVI guidelines advocate for the inclusion of forensic odontologists in identification teams, emphasizing their role alongside other specialists like forensic pathologists and fingerprint experts to ensure comprehensive and efficient identification[13].

4. Call for Action

The importance of community engagement, culturally-informed consent protocols, and the inclusion of anthropologists and grief counselling personnel ; forensic nurses in DVI teams, especially in mass fatality incidents are important. Their roles can vary from being an aid in psychosocial support to assisting in core humanitarian work.

Case studies, such as the identification efforts in the 2004 Indian Ocean tsunami and the MH17 crash, have highlighted how culturally sensitive practices like repatriating remains with traditional garments or rituals can provide solace to families and uphold the dignity of the deceased[14]. Therefore, embedding ethical reflection and cultural competence into forensic training programs, particularly in countries like India where cultural diversity is vast, is essential for the evolution of a truly humanitarian practice.

5. DVI Protocols

According to Iyer et al. (2020), the role of forensic odontologists in DVI is integral, especially in scenarios where post-mortem bodies are severely damaged due to fires, explosions, or crashes. Their ability to match dental structures with antemortem records ensures the accurate identification of victims. A significant challenge in India is the inconsistent

maintenance of dental records, which hampers the effectiveness of forensic odontology in DVI operations. Patel and Prakash (2019) emphasize that dental professionals in India often lack sufficient training and awareness regarding the importance of preserving dental records, which can prove crucial during mass disasters. This lack of standardization in record-keeping has been identified as one of the main barriers to effective victim identification[15].

The importance of improving dental record management was further highlighted by a study from Desai et al. (2020), which reported that inadequate record-keeping led to difficulties in matching post-mortem and antemortem dental data in the aftermath of disasters[16].

To address these issues, India has been working towards adopting international protocols for DVI, including Interpol's guidelines that recommend the inclusion of forensic odontologists in multidisciplinary identification teams. According to the Ministry of Home Affairs (2021), these guidelines have been integrated into India's national DVI response protocols, ensuring that forensic odontologists work alongside forensic pathologists, fingerprint experts, and police personnel during identification efforts. Furthermore, the Indian government has emphasized the need for training and awareness programs for dental professionals to ensure they are prepared for the challenges of mass disaster identification[17].

6. Future Concerns

A major concern is the lack of consistent dental record-keeping, particularly in low- and middle-income countries, which limits the effectiveness of dental identification in mass disasters[18]. Bridging this gap requires national policies that mandate standard dental documentation and encourage integration into health systems. Additionally, the shortage of trained forensic odontologists and the need for interdisciplinary disaster training present logistical obstacles in timely response[21]. Technological advances like AI-assisted identification and digital dental records offer promise but raise ethical concerns regarding privacy and access[19][20].Integration of training of forensic nurses in certain nations that are prone to natural disasters and not solely aircraft incidents , will prove to be a boon in providing psychological support. Cultural sensitivity will also remain a critical concern. As disasters increasingly impact diverse populations, DVI teams must ensure respect for cultural and religious practices, including in how remains are examined, handled, and returned to families. Future protocols must embed these considerations from the start, not as afterthoughts.

7. Conclusion

This study is explored certain aspects of DVI , where in multi disciplinary factors could be incorporated in the future cases. Implementing new methods for dealing effectively with these factors may help to identify and improve outcomes in the long term.

Compliance with ethical standards

Disclosure of conflict of interest

There are no conflicts of interest.

Statement of ethical approval

This review is based solely on previously published data and does not involve human participants or animals. Therefore, ethical approval was not required. Additionally, all secondary data used in this review was obtained from open-access repositories or published case reports that were already anonymized and publicly available. No identifiable personal data has been used.

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