

# Role of Forensic Odontology in Tsunami Disasters

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## Abstract

On December 26, 2004, a 9.4 Richter scale earthquake occurred north of Sumatra Island and a forensic investigation was required for identification of tsunami disaster victims. In general, the purpose of an investigation was to identify the victim, to determine the time and place of death along with the cause and manner of death. In case of tsunami disaster, the main purpose of forensic investigation was the identification of victims. This article review the role of TTVI (Thai Tsunami Victim Identification Team), Thai forensic team, International disaster victim identification (DVI) team in tsunami identification, methods used for identification, problem encountered, number of bodies identified and remained for identification and plan for future.

## INTRODUCTION

The Indian Ocean tsunami of 26 December 2004 created unprecedented challenges for forensic identification of dead bodies. Epicenter in the Indian ocean of 9.0 Richter magnitude quake was at north west of the Indonesia's Sumatra Island with a series of after shock waves. The tidal waves reached 6 provinces in the west coast of southern Thailand, 5395 deaths, 8457 injuries and 2991 missing, 1.895 bodies are waiting for identification (Thailand National Police Office Report, June 9, 2005, Personal Identification Center Report, June 29, 2005). The complete examination was conducted by a team of trained and experienced forensic experts. In Sri Lanka, identification of dead was not a high priority in the acute phase.<sup>1</sup> The first responders departed for Phuket, Thailand on 31 December 2004, consisted of 20 disaster victim identification (DVI) teams trained police officers including three officers from the forensic management branch of CID. The Health Sciences Authority departed a forensic pathologist and mortuary technician, who were subsequently joined by two DNA scientists. Also, there were two forensic odontologist from the Singapore Armed forces and a volunteer from private practice. The team was complemented by fine emergency behaviour officers, the relief team consists of forensic pathologist, a technician and a forensic death investigator, as well as four dentists in private practice.<sup>2</sup> After many deaths were reported, with no forensic team in the affected areas, forensic and other relevant professionals from other regions of the country self reported to the disaster sites. Each team prepared with relevant staff, necessary

equipment.

The deceased bodies were recovered and transferred to morgues by rescue teams. Without any refrigerated container nor method to preserve the bodies, the forensic teams had to examine the bodies quickly as before the corpses decomposed. The forensic teams recorded external appearances, personal belongings and specific marks on the deceased following their protocols. Photographs were taken in almost every case with digital cameras. For identification different methods were used for identification such as DNA (Dental tissue, rib, femur), dental identification.

In general, the purpose of an investigation was to identify the victim, to determine the time and place of death along with cause and manner of death. In case of the tsunami disaster, the purpose of the forensic investigation was identification of victims. This article reviews the process of identification of victim in tsunami, important method of identification, short coming of identification process, team work identification and further recommendation for successful mass disaster identification.

Disaster sites: Table 1 shows the sites, work done and number of bodies examine and DVI teams (countries)

**Figure 1**

	Work done and no of bodies examine	DVI identifications team (country)
First sites : sites khao lak	- initially 100 bodies are examined - one thousand bodies were transferred to bang maung - it consisting of four field mortuaries	Australian, Singapore, New Zealand, Dutch, Chinese, British, Belgian, German, Nordic
Second sites: thachatchai (north-western region of phuket Island)	-	Australian, German
Third site: Krabi	-	Japanese, Israeli and Korean

## DVI IDENTIFICATION PROCESS

It consisted of four main steps i.e. body tagging and bagging, finger printing, forensic pathology and forensic dentistry.

First, the bodies were refrigerated both before and after the identification procedure. The labeling of each body with identifying number, followed by bagging. Finger printing was impossible because highly decomposed bodies, which almost invariably showed extensive post mortem skin desquamation or peeling.

Each body was examined by forensic pathologist, forensic death investigator, mortuary technician and a photographer. First, the bodies were conveyed to the mortuary from the finger printing section. The scribe received and signed the tracking form. The pathologists and scribe confirmed the body number using pink PM DVI form. The body number was photographed. The body clothes were rinsed/washed by technician. Washed jewelry and personal identification with number were photographed and sealed in a bag. External examination was carried out and recorded. A incision was made for internal examination. Evidence of any disease was sought and recorded. Mandible or teeth was removed for forensic dental examination.

Forensic dentistry team was divided into two parts i.e. dental examination and dental radiology. The first forensic team consist of two odontologists and one senior odontologist. Facial bilateral dissection was performed to examine the maxilla and mandible. The teeth were rinsed/brushed for

clear examination. Dental examination was denoted on pink DVI form Interpol charting system (World Dental Federation Tooth Numbering). During the dental examination, teeth that might have received root canal treatment were identified for further radiographic investigation. Two untreated teeth with large pulp were selected for DNA profiling. If teeth were not available, then femur shaft or rib was selected. Two bitewing radiographs were taken and labeled, each exposed film with body number by two dentist. The radiograph was recorded with pink DVI form. Teeth were sent for DNA profiling. After final check of the documents and radiographs, body was released to the refrigerated containers.

Dental structures are the hardest and most resilient tissues of the human body.<sup>3</sup> Examination of European tourists in tsunami by gold inlay, crown, bridge work and dental implants.<sup>2</sup> It has been found that even identical twins do not have identical dentition.<sup>4</sup>

Missing teeth, caries, fillings and prostheses, any other disease, or any pathologic lesion and dental material used for identification. Implant system used were popular in European and Scandinavian designs, suggesting that the deceased might have been foreign nationals.<sup>2</sup> In post mortem pink teeth were found,<sup>2,4</sup> it is possible to have a positive identification based on a single unusual dental feature.<sup>5</sup> In dental examination, dental records made before death were compared to the dentitions of the unknown deceased. The more accurate and complete the dental records were, the greater would be the likelihood of a positive identification.<sup>2,6</sup>

Ante-mortem data relating to the deceased victims sex, age, physical attributes, medical history, dental records, and the next of kin's DNA profiles were recorded by other staff in yellow DVI forms. Both data were added in computer software system (plass data)© for comparison and final result denoted on white DVI forms.

## VICTIM IDENTIFICATION

Total number of deaths was approximately 5395. In early phase, 560 bodies were identified by families and released by local authorities. In early phase examinations were conducted with limited resources and limited cold storage for dead bodies. Mostly bodies were identified by external appearances and physical evidences. Thai forensic team examined 3698 and released 1151 bodies before TTVI (Thai tsunami victim identification team) came.<sup>7,8</sup> With passage of time, it becomes more difficult to identify the body due to

decomposition. Hence, dental team examined 2070 and released 111 victims identified based on dental records.

After the first week, forensic teams from other countries started arriving in Thailand, forming an International Disaster Victim Identification Committee to work in collaboration with the Royal Thai Police.<sup>9</sup> In Phuket, the committee's information center was established with the financial support of the Australian government. The Thai government decided to combine the efforts of the Thai forensic experts, the Thai Royal police, and international disaster victim identification committee teams, and on 13 January the Thai tsunami victim identification (TTVI) center was established in Phuket.<sup>10</sup> In collaboration with Interpol, the TTVI established a central mortuary in Phuket, sponsored by the Norwegian governments. It was decided to examine or reexamine all 3777 remaining victims using Interpol standard protocol.<sup>11</sup> This included external examination, photographs, personal effects, dental examination, forensic pathological examination, and DNA sampling from teeth and bone. As of 27 July 2005, 7 months after the disaster, TTVI had identified 2010 victims, with over 1800 cadavers remaining unidentified.<sup>12</sup> Sixty one percent of victims were identified by TTVI using dental examinations, 19% using finger print records, 1.3% using DNA analysis, 0.3% using physical evidence and 18% of cases, more than one type of evidence.<sup>13</sup> There are 2315 bodies left waiting to be identified.

### SUCCESSFUL IDENTIFICATION METHODS

Forensic identification techniques such as dental, fingerprint, and DNA analysis are effective because they can identify decomposed or damaged bodies. Most importantly, these methods are only useful if comparative data are available. While finger print data were recorded for Thai citizens when their identify cards are issued, and many western victims had dental records, comparative data may be scarce in many parts of the world. Few countries have the capacity for DNA collection and analysis following large natural disaster. DNA identification is expensive, technically demanding, and logistically difficult to implement on large scale.<sup>14</sup> In case of the tsunami in Thailand, it proved to be a relatively unimportant method of identification. DNA identification should not be considered as a first live method of identification, but rather should only be implemented when physical, fingerprint and dental methods have been unsuccessful.<sup>15</sup> Fingerprint plays much more important role in identification of Thai citizens. This number will be increased since more ante mortem finger prints are received

from Thai victim families. In Phuket, dental identification proved to be expeditious, accurate and cost effective.<sup>2</sup>

The DNA technology was not first line method. Among the victims, a high number of relatives are expected be found, as well as entire families that died without any family reference to compared with. The additional complication of reduced availability of direct reference samples should also be considered. The situation can also be further complicated by rate and speed of body recovery from the sea, affecting DNA integrity in some cases. An undetermined proportion of bodies has not yet been discovered and may never be.<sup>16,17</sup> All these challenges require an approach to identification process of the tsunami victims as an integral forensic science identification effort, based not only upon DNA data but also on forensic anthropology, fingerprinting, odontology, radiology.

### PROBLEMS ENCOUNTERED DURING IDENTIFICATION

Refrigeration for preserving human remains was not available soon enough after disaster, necessitating the use of other methods such as dry ice or temporary burial. The most of the bodies had decomposed considerably by that time. The use of dry ice was reasonably effective, but it was difficult to manage, logistically intensive, and a significant cause of work related injury. None of the countries could quickly mobilize sufficient refrigerated containers. The lack of a central command center and the national mass fatality plan of disaster are important problems.<sup>13</sup> The system of numbering and labeling the body was not well organized at the beginning caused difficulty in tracking the bodies later on. Shortage of forensic experts caused incomplete data collection from the every corpse. At the beginning, since there are many groups of people engaged in the scene, both official and volunteers, and this is the first experience of Thai disaster team in a tsunami, the DVI protocol are not fully deployed. Various types of protocols have been used in personal identification which are reports forms of unknown bodies, ante-mortem and postmortem form of the federal bureau of investigation, (FBI)<sup>18</sup>, US Department of Justice and local made report form, these caused problems in transferring data into DVI data base for matching and comparison.<sup>19</sup> None of the countries had a single organization with jurisdiction for recovery, identification, and disposal of bodies.

### RECOMMENDATIONS

1. Mass fatality plans should be included in

international and national disaster prepared mass activities.

2. Each countries should have a mobilize sufficient refrigerated containers.
3. Well trained officers i.e. forensic experts or volunteers in collecting ante mortem data from the bereaved families are needed.
4. Every dentist or physician should maintain ante-mortem records.
5. Manpower strength available for instant activation should be established. These should include local personnel, law enforcement agencies, transportation companies as well as specialists such as forensic odontologists, forensic pathologists forensic anthropologists fingerprints specialists etc. with good tea work.<sup>21</sup>
6. Update equipment and supplies should be maintained in a ready condition at all times. The material should be periodically checked, out dated materials should be replaced.
7. The education and training of the disaster team and related group should be done periodically to ensure readiness of the team, to update and refine the protocol for better performance.
8. If resources and comparative data are available, simple methods can be supplemented by forensic techniques i.e. dental, DNA analysis and finger point.
9. A good organization should have an agreed mandate to coordinate the management of dead bodies.

Finally, no country has sufficient capacity to respond to very large disasters, and networks of countries, forensic institutes, and international agencies such as WHO and Interpol are needed to provide assistance, funding for the management of the dead following future mass disasters.

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