



# Tsunami 2004—experiences, challenges and strategies

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**Abstract.** The identification case work after the Tsunami disaster was a great challenge for the forensic experts. Especially the DNA analysis of the postmortem samples demonstrates the problems caused by the fast and extensive decomposition of the DNA under the environmental conditions in Southeast Asia. The work of the first days and the case work analysis of the taken samples are presented. © 2005 Published by Elsevier B.V.

*Keywords:* Tsunami; Identification; Forensic molecular genetics

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## 1. Introduction

The Tsunami after the sea quake in Southeast Asia on the 26th of December 2004 represents the largest disaster in the modern World. Especially Thailand and Sri Lanka as major tourist centres demanded a large number of victims from different European countries. International Disaster Victim Identification (DVI) teams were present in Thailand to help identify the recovered bodies. Such a number of different teams and the circumstances in the area were a great challenge for the organisation. It was necessary to adapt the different teams to a common strategy of investigations. The international centre established the guidelines for the forensic-medical, forensic-odontological and forensic genetic investigations. The collection of the postmortem data was done by forensic specialists. The guidelines for the DNA analysis request a collection of different samples from every investigated body – two healthy teeth, rib, bone or similar tissues – for examination. The biggest problem seems to be the expected rapid degradation of the DNA. So the suggested strategy in such cases should be to test samples very soon to assess the suitability for genetic typing. A high level of degradation of the DNA was observed and special procedures of extraction were necessary to get a result.

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### 1.1. First days

The situation as shown in Figs. 1 and 2 present the problems of the work flow. The environmental conditions lead to a very fast and extensive decomposition of the bodies. Hundreds of them were kept in different temples of the Khao Lak and Krabi region without cooling. An identification of the victims by relatives or friends was impossible, also the separation of foreigners and locals. In the first days it was important to organise the cooperation between the different DVI teams. Especially the guidelines for the investigations were changed several times and the teams mostly did not include a specialist for forensic molecular genetics at this time. It was recommended to take two healthy teeth or pieces of rib or bone for DNA analysis. Some of such samples are shown in Fig. 3. The state of the material was poor and it was feared that the degradation of the DNA is rapidly progressing. At the same time the International Coordination Center of the DVI teams under the leadership of the Thai Police discussed about the strategies for DNA typing. The established Scientific Subcommittee decided to use the AmpFLSTR® Identifiler® kit (Applied Biosystems) for the analysis of January and sent the samples to a laboratory in Beijing (China).

## 2. Materials and methods

Samples from the TTVI IMC were analysed. After cleaning the surface and deep-freezing in liquid nitrogen the samples were cut up. The material was ground in a bone mill. Depending on the material up to 5 g of DNA could be obtained. For the DNA extraction the GEN-IAL First-DNA Kit (Institut für angewandte Laboranalysen GmbH) and the chloroform-phenol-protocol was used. Primer and PCR following the manufacturer's instructions for the AmpFLSTR® Identifiler® (Applied Biosystems) or the PowerPlex16 (Promega Corp.) kits. The products were analysed using capillary electrophoresis (ABI Prism 3100 Avant DNA Sequencer, Applied Biosystems) in denaturing polymer (POP4). Allele assignment was performed by comparison to allelic ladders.

## 3. Discussion

The results of the investigations of the samples demonstrate the high degree of DNA degradation. The circumstances after the Tsunami with high temperatures and humidity led to this situation in a very short time. The known strategies in mass disaster management could not be used in such cases. Especially the teeth and bones taken first were problematical in the analysis. These kinds of samples normally stored in routine cases of identification are



Fig. 1. Situation at temple Wat Ban Muang shortly after the Tsunami.



Fig. 2. Working conditions in the first weeks.

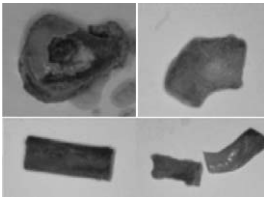


Fig. 3. Samples taken in the first weeks.

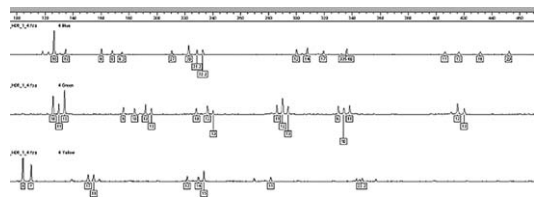


Fig. 4. Result of typing of a contaminated sample using PowerPlex16 (Promega Corp.).

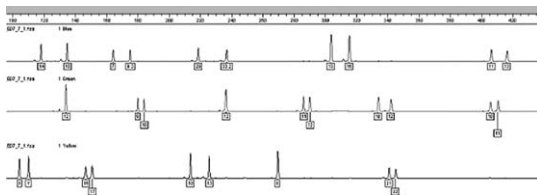


Fig. 5. Result of typing of a sample using PowerPlex16 (Promega Corp.).

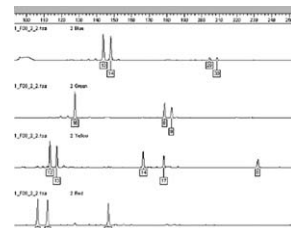


Fig. 6. Result of typing of a sample using AmpFLSTR® Identifier® (Applied Biosystems).

not useful in such situations. We obtained a success rate of 60%. Additionally the results showed full and partial profiles with a fragment length up to 200 bp. In some cases a contamination of the sample was observed. This is a result of using uncleaned equipment (Figs. 4–6). The problems of the DNA-analysis during the initial period are explicable. The situation improved after a decision was made to take 10 cm or later two 5 cm pieces of femur during the final inventory protocol. In summary it has been established that the DNA analysis is highly time-consuming and labour-intensive in such cases. This is the obvious reason for the poor level of identifications based on DNA analysis.

In addition to the environmental conditions, that a high number of victims were recovered particularly late from the water was a great challenge. The warm ocean water with a high salt concentration increases the decomposition of the bodies. The situation in the disaster region was unprecedented for all experts. The fast collection of samples for DNA analysis was impossible too. The experiences of the Tsunami disaster should be that standard guidelines are necessary. A number of laboratories representing the full and wide field of possibilities and certified for forensic analyses of every nation should be the basis for rapidly addressing and solving these problems. Success can be obtained only on a basis of national and international cooperation. The rate of identifications using DNA matches was approximately 10% by the end of August.

#### 4. Conclusion

So an important conclusion for further work in this field is an agreement on international standards and also the training of specialists who are able to coordinate the analysis. The Tsunami showed also that DNA analysis can be very helpful in such mass disaster case work as a part of the forensic field work.