

# DENTAL DIAGNOSTIC RADIOLOGY IN THE FORENSIC SCIENCES: TWO CASE PRESENTATIONS

**K.Nicopoulou-Karayianni,<sup>1</sup> A.G.Mitsea,<sup>1</sup> K.Horner<sup>2</sup>**

1. Oral Diagnosis and Radiology, Dental School, University of Athens, Greece

2. Oral and Maxillofacial Imaging Clinic, School of Dentistry, University of Manchester, UK

## ABSTRACT

Dentomaxillofacial radiology is a useful tool in forensic science to reveal characteristics of the structures of the dentomaxillofacial region. Postmortem radiographs are valuable to the forensic odontologist for comparison with antemortem radiographs, which are the most consistent part of the antemortem records that can be transmitted during forensic examination procedures. By using dentomaxillofacial radiology we can, therefore, give answers to problems dealing with identification cases, mass disasters and dental age estimation. We present the contribution of dentomaxillofacial radiology to the forensic sciences through two cases of deceased persons, where identification was based on information provided by radiographs. The right performance, interpretation and reportage of dentomaxillofacial radiological examination and procedures can be extremely valuable in solving forensic problems.

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**Key words:** forensic odontology, forensic science, radiology, identification

## INTRODUCTION

Forensic radiology comprises the performance, interpretation and reporting of diagnostic radiological procedures that pertain to the courts and the law.<sup>1-4</sup> The use of radiology in forensic sciences is not new and it has now been over a century since a radiograph was first introduced as evidence in a court of law.

Postmortem radiographs are a valuable tool for the forensic odontologist because they, and antemortem radiographs, provide a source of robust and detailed information for comparative purposes. Even if antemortem radiographs are not available, it is very

helpful to take postmortem radiographs.<sup>3,5</sup> It is important that the forensic odontologist takes intraoral radiographs of all of the usual tooth bearing sites, including edentulous areas, in order to screen for the possibility of unerupted teeth and retained roots and to view the anatomic structures.<sup>3</sup> The contribution of dentomaxillofacial radiology is very important in:

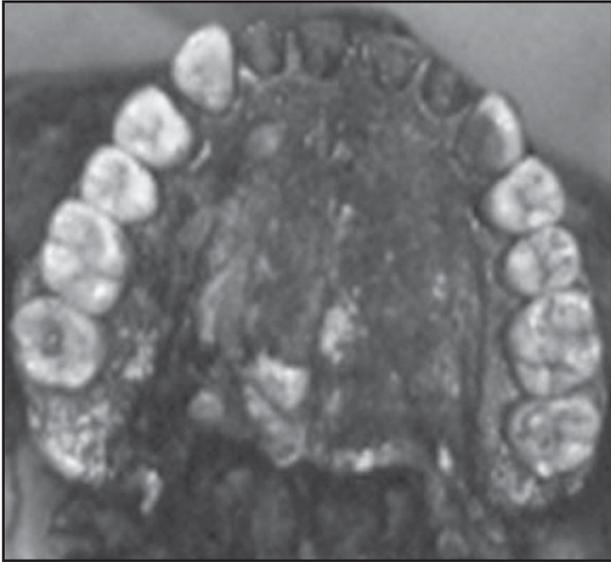
- a. identification cases
- b. mass disasters (radiographic comparison has increased the number of positive identifications<sup>6,7</sup>)
- c. age estimation cases

The aim of this report is to illustrate the contribution of dentomaxillofacial radiology to the forensic sciences, using two cases, where identification has been based on the information provided by radiographs.

## CASE 1

The first case concerns the identification of a young woman. Human bones were found on a beach on the island of Santorini, Greece (Fig.1). There was some circumstantial evidence to indicate that they belonged to a young, female, American citizen who had disappeared on this island almost two years previously. It was impossible to base the identification procedure on visual examination or analysis of the fingerprints – in other words, on classical methods – since only bone remains were found. Moreover, DNA analysis could not be performed since the young woman in question was a native Asian who had been adopted in the USA. The possibility of identification had to be based on data provided by antemortem dental records.

Interpol located the missing girl's dentist who was able to supply her antemortem dental records. The only available data from these were a panoramic



**Fig.1:** Case 1 - Postmortem maxillae



**Fig.2:** Case 1 - Antemortem panoramic radiograph taken almost 10 years earlier



**Fig.3:** Case 1 - Antemortem bitewing radiographs

radiograph (Fig.2) and four bitewing radiographs (Fig.3). These had been taken almost ten years before the remains were found.

The jaws were examined and three periapical radiographs were taken of the mandibular molar area bilaterally and the right maxillary molar area (Fig.4). A comparison of antemortem (panoramic and bitewing) and postmortem (periapical) radiographs was carried out. Specifically, the root morphology of the molars, the morphology of the pulp cavities, the morphology of the right maxillary sinus and its relationship to the roots of the upper right molars and the bone morphology of the mandible were evaluated.

It was found that the morphology of the roots and the pulp cavities of both the molars of the right maxillary region and the molars of the mandible were consistent in antemortem and postmortem views. However, the third molars in both jaws were present in the antemortem radiographs but not in the postmortem radiographs. This was not unusual since the antemortem radiographs had been taken ten years previously and it was reasonable to assume that the third molars had been removed during this intervening period. The existing fillings in the teeth were evaluated and also found to be consistent. Careful study of the antemortem panoramic radiograph and the postmortem periapical radiograph of the right maxillary molar area revealed

that the size of the second molar filling was smaller in the postmortem radiograph. The remains of the cranium were reexamined and it was found that a portion of the filling in the upper right second molar had broken away and the cavity was partly empty, thus explaining why the filling appeared smaller in the postmortem radiograph. Reassessment of the radiographs then revealed that the distal part of the filling, as shown in the antemortem panoramic radiograph, was identical in shape to that presented in the postmortem radiograph.

The conclusion drawn was that the skeleton belonged to the young, female, American citizen who had disappeared.



**Fig.4:** Case 1 - Postmortem periapical radiographs

## CASE 2

A tourist discovered a skeleton on the island of Karpathos, Greece. This coincided with a police search for a Swedish citizen who had disappeared two years previously from the location. Clinical and radiographic examinations of the remains were undertaken (Fig.5). The Swedish embassy was asked to locate dental records for the missing person. An Interpol "Victim Identification Form", a floppy disk containing three digitized radiographs (two bitewings and one periapical) and an intraoral photo were provided.

The morphology, size, midline deviation, occlusion and shade of the teeth were evaluated on antemortem and postmortem photographs (Fig.6). The morphology of the fillings, the type of prosthetic restorations (crowns, bridges and inlays), the root canal treatments and root fillings and the intraradicular posts were all evaluated from the radiographs (Fig.7).

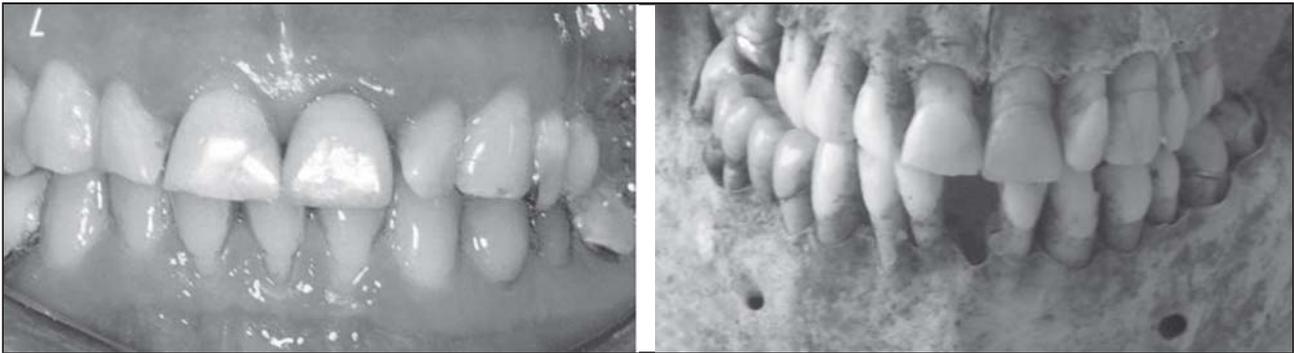
Twenty-eight concordant findings allowed a positive identification of the missing Swede to be made.

## DISCUSSION

Forensic dentistry for identification purposes is based on the comparison of antemortem and postmortem findings with resultant matching or exclusion.<sup>5,8-11</sup> The identification procedures are related to the availability, quality and type of antemortem records. The most accurate data obtained during the forensic dentistry identification procedures are those that are derived from postmortem and antemortem radiographs. These are useful even in cases concerning young individuals with little or no dental treatment edentulous individuals. Radiographs are advantageous in an international context since they overcome the disadvantages of different languages and different classification systems and are accepted in courts of law as legal evidence. Dentists sometimes register only the treatment that they have performed, but radiographs reveal all previous restorations that are present within a particular field of view. It is imperative that radiographs are labeled and mounted correctly. Although therapy performed in the time span between antemortem and postmortem radiographs may change the characteristics of even unique restorations, an



**Fig.5:** Case 2 - Postmortem remains



**Fig.6:** Case 2 - Photographic comparison of morphology, size and shade of teeth, occlusion and midline deviation



**Fig.7:** Case 2 - Radiographic comparison of restorative endodontic treatment morphology in (A) postmortem and (B) antemortem

explainable difference that would not preclude identification can be recorded.<sup>6,7,10-14</sup>

By studying the radiographs it is possible to evaluate details that otherwise could have been overlooked. The radiographs could reveal information concerning the anatomical structures (such as sinuses), the bone patterns (nutrient canals, incisive canal, median suture), bone pathology (sclerosis, radiolucencies), teeth and pulp morphology, root number and form, retained roots, impacted teeth, the type, extent and position of fillings, the type of prosthetic restorations, endodontic treatments, the placement of retention pins and posts, the placement and type of implants and the placement of osteosynthesis plates.<sup>5,6,8,9,12-14</sup>

Due to the fact that at the start of an investigation we are usually unaware of the status of antemortem radiographs, multiple postmortem images should be obtained.<sup>4</sup> Technically, with postmortem changes,

film positioning may be more difficult, particularly in cases where it is necessary to dissect jaws in order to take radiographs.<sup>3,5,8,9</sup> In some cases only fragments or portions of the jaws or teeth are available for examination and should be radiographed in several orientations. In forensic radiography we should also keep in mind that exposure adjustments may be necessary during the radiographic procedures. Postmortem changes in soft tissues, which may involve complete loss of tissue, mean that the normal exposure settings for a patient may not apply.<sup>3,4,8</sup>

Nowadays, dental records are often electronic, including digital or digitized radiographs and intraoral photographs. The use of electronic dental records lead to improvement in the accuracy and quality of antemortem dental information.<sup>9-11</sup> Digital radiographs and intraoral pictures have the main advantage that they can be easily transferred and evaluated. Moreover, they can be computer processed and enhanced to generate more useful information for the identification procedures. There are documented cases that would have been unresolved without the use of digital enhancement techniques.<sup>9,10,15-16</sup> Forensic odontologists should also be aware of the limitations of electronic dental records. The transfer of such information, including radiographs or intraoral photographs, may raise ethical issues concerning the patient's privacy. Moreover, the probity of the data included in electronic dental records has yet to be evaluated.<sup>9,10,14,15</sup>

In conclusion, radiographs are a paramount tool in forensic dentistry because they reveal unique information about anatomy and previous dental treatment.<sup>6,7,16</sup> The cases discussed in this report are examples of the essential role of both antemortem and postmortem dental images in identification.

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**Address for correspondence:**

Anastasia Mitsea  
 18 Ellis str.  
 121-37 Peristeri  
 Athens  
 GREECE  
 Tel: + 30 21057 52433  
 e-mail: amitsea@dent.uoa.gr