

## ORIGINAL ARTICLE

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## Dental identification of war victims from Petrinja in Croatia

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**Abstract** In this paper the authors report their experiences and problems encountered in the identification of war victims from Petrinja in Croatia. Soon after Croatian forces regained Petrinja in 1995, four mass graves were discovered from which the bodies of 46 civilians, 38 males and 8 females, were recovered. Identification of the victims was performed at the Department of Forensic Medicine and Criminology at the School of Medicine in Zagreb. A forensic odonto-stomatologist from the Department of Dental Anthropology of the School of Dental Medicine at the University of Zagreb participated in the identification process by carrying out dental identifications. A total of 27 victims (59%) were identified, while 19 (41%) are at present still unidentified. Identification by supportive and anthropological evidence (e.g. sex, age, height, personal documents, dress, jewellery) was achieved in 43% of cases, while identification based only on dental records was achieved in 16%. The most useful dental characteristics for the purpose of identification were fixed and removable prosthetic appliances for oral rehabilitation. The reason for the low number of dental identifications was the lack of antemortem dental data which could be compared with postmortem dental records.

**Key words** Teeth · Identification · Forensic dentistry · Mass Graves · Prosthetic appliance · War victims

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### Introduction

Human dentition possesses several characteristics which make it unique and easily recognisable. Some have resulted from gene pooling and specific racial characteristics and others reflect chemical and structural changes in teeth resulting from pathological processes and treatment.

Dental restoration is the most unique feature of an individual's dentition and together with developmental characteristics, represents the key to dental identification. An important characteristic of teeth is their durability. Teeth are the hardest part of the human body to destroy. In cases of burning the jaws and teeth are well protected by the tongue, lips and cheeks. They are also frequently relatively well preserved even after being buried for thousands of years [1–5]. For these reasons teeth are frequently used for the identification of dead bodies of unknown identity. Apart from natural disasters and traffic accidents, the need for dental identification also arises during and after wars [6–8].

The war which broke out in Croatia in 1991, caused massive destruction and tragedy for the people who lived there. The remains of some victims have now been recovered, and some of these individuals have been identified. Some of the first identified victims of war in Croatia were recovered from the Mass Grave Ovcara near Vukovar. The identification was carried out by members of the UN Commission for Human Rights and by the Physicians for Human Rights. The approach that these two teams took in the identification process proved to be very successful and, therefore, a good guideline for further identifications [9].

This paper reports on the results of our identification of a number of civilians killed during 1991. All of the individuals were recovered from four grave sites in, or in the near vicinity of the town of Petrinja in Croatia.

## Materials and methods

During 1995, four mass graves were discovered in the vicinity of Petrinja. The graves were generally in the form of a rectangular pit, usually 2m deep and 3 × 3m in size and contained the bodies of local inhabitants killed during 1991. The graves were located with the help of witnesses, individuals who helped load or bury the bodies, and in one case an individual who survived a mass execution. Surviving witnesses, and relatives of the deceased also supplied most of the information about the victims recovered from the mass graves. Once the location of the graves was determined, the bodies were exhumed in the presence of international observers: European Community observers, representatives of the Hague War Crimes Tribunal, and members of the Committee for Missing and Killed Individuals formed by the Croatian Government which includes one forensic odonto-stomatologist. Recovery of the bodies was carried out under the supervision of medical, and physical anthropology forensic experts, but without supervision of the forensic odonto-stomatologist. Exhumation of the graves proceeded in several stages during the Fall and Winter of 1995.

As each body was located, it was assigned a code and a number (for example Villa Petrinja, 7) and photographed. Most bodies were older farmers frequently with completely edentulous jaws, and no dental records. Bodies were removed from the grave and placed in a black, plastic body bag for shipment to the Department of Forensic Medicine and Criminology at the School of Medicine in Zagreb. Dental identification of the bodies was carried out by a forensic odonto-stomatologist from the Department of Dental Anthropology at the School of Dental Medicine, University of Zagreb. His task in the identification process was to document the postmortem dental status of each exhumed victim and compare it with the antemortem dental records. All antemortem data were collected by the specially appointed committee. The data were provided by physicians and dentists of the victim, relatives, friends or other persons who were in contact with the victim shortly before death.

Identification of 17 individuals recovered from Mass Grave 1 (Villa Petrinja) began on 15 September 1995. Identification of 22 individuals recovered from Mass Grave 2 (Army Barracks Matanovic) and 3 individuals recovered from Mass Grave 3 (Hospital) began on 12 October 1995. Identification of the bodies recovered from Mass Grave 4 (Cemetery) began on 5 December 1995.

Each recovered body was examined by members of the multi-disciplinary team of experts which was assembled to deal with the identification of the exhumed individuals. The team was established under the authority of the Government of the Republic of Croatia and consisted of nine scientists from diverse disciplines including forensic medical examiners, criminologists, a forensic anthropologist and a forensic odonto-stomatologist and this is the only existing team for identification in the country. The time necessary for identification was 3–5h per body depending on the quantity of antemortem and postmortem data.

Dental examination was carried out after the dentition was prepared according to standard postmortem procedures e.g. removal of jaws, cleaning and inspection [10]. All oro-dental characteristics (i.e. occlusions, abrasions, aloplastic fillings, missing teeth, developmental anomalies, colour changes, prosthetic appliances, and evidence of smoking), were carefully recorded in the postmortem Interpol Disaster Victim Identification forms. All recovered dentition was photographed, and X-rays were taken of selected teeth using the intraoral method with a long conus [11, 12]. After the dental status of each individual was recorded comparisons were made with, unfortunately scant, antemortem data. Interviews with relatives of likely candidates for identification proved to be very helpful. Forensic DNA testing, based on DNA extracted from both bone and teeth, was attempted in several cases when dental comparison and other standard forensic methods were unsuccessful [13–15].

## Results

As shown in Tables 1 and 2, 46 bodies were recovered from four mass graves in the Petrinja area during 1995 and of these 38 (83%) were male and 8 (17%) were female. A total of 27 victims (59%) were identified based on existing antemortem data and 19 victims (41%) are as yet unidentified.

Teeth contributed to the identification of 20 victims i.e. 43% of all cases. Identification achieved only by dental records was achieved in 16% of cases. The most useful dental criteria for identification were fixed and removable prosthetic appliances, aloplastic fillings (amalgams, composites) and deposits of nicotine indicating heavy smokers (Tables 2–4).

All cases in which dental comparison contributed to identification of victim are shown in Tables 3 and 4. Case number 8, recovered from Mass Grave 1, was identified by veneer crowns on the upper central incisors (teeth /11, 21/), and by a lower right veneer bridge with metal occlusal surfaces (teeth /44,45,46,47/). The metal construction was made from palladium and the veneer was made from a composite material. The second case (No. 14) from Mass Grave 1 was identified by composite (teeth /12,13, 16,22,26,45/) and amalgam fillings (teeth /14,34,37,44, 47/). The third case (No. 16) was identified by a gold crown (tooth /26/), and by a veneer crown made of palladium and acrylate on the upper right lateral incisor (tooth /12/). During an interview with the wife of the deceased we learned that a cast core was performed on the same tooth and X-ray examination confirmed this. (Table 3).

In the other cases from Mass Grave 1 dental comparison supported other collaborative evidence and assisted in establishing the identity of the victims (Table 3).

In Mass Grave 2 identification was achieved solely by dental comparison in two cases. Case number 8 was identified by a metal bridge (teeth /22,23,24,25/) made from a

**Table 1** Sex distribution of identified and unidentified victims. (No.E. Number of exhumed victims, No.I. Number of identified victims, No.U. Number of unidentified victims)

No.E.	Male	Female	No.I.	No.U.
46	38	8	27	19
100%	83%	17%	59%	41%

**Table 2** The distribution of identified and unidentified victims by site and means of identification. (No.I.den Number of victims in which dental comparison supported other evidence, teeth Number of victims identified only by means of dental comparison, 1 Villa Petrinja, 2 Army barracks "Matanovic", 3 Hospital, 4 Cemetery)

Site	No.E.	No.I.	No.I.den	teeth	No.U.
1	17	11 (65%)	8 (47%)	3 (18%)	6 (35%)
2	22	12 (55%)	10 (45%)	2 (10%)	10 (45%)
3	3	3 (100%)	1 (33%)	2 (66%)	–
4	4	1 (25%)	1 (25%)	0	3 (75%)
Total	46	27 (59%)	20 (43%)	7 (16%)	19 (41%)

**Table 3** Dental characteristics used in the identification of victims recovered from Villa Petrinja

Site	No.	Sex	Means of identification	Dental records used in the identification process
1	2	M	– craniotomy – stature – teeth	healthy dentition antemortem extraction of: 23, 24, 26, 27
1	8	M	– teeth – clothing	11, 21 veneer crowns 44, 45, 46, 47 veneer bridge
1	9	M	– DNA – stature – teeth – keys	colour of dentition, amalgam fillings
1	10	M	– DNA – stature – teeth – clothing	antemortem extraction of lower molars: 36, 37, 46, 47
1	11	M	– DNA – stature – teeth – clothing	amalgam fillings in maxilla 15, 17, 27, 38
1	13	M	– P.I.D. – teeth – belt	amalgam fillings in: 26, 27, 37
1	14	M	– teeth – stature – sweater	composite fillings: 12, 13, 16, 22, 26, 45 amalgam fillings: 14, 34, 37, 44, 47
1	16	M	– teeth – clothing	26 gold crown 12 veneer crown 12 cast core

white and yellow alloy. Closer inspection revealed that this bridge was made of a combination of gold alloy and palladium without veneers. Case number 16 was identified by gold crowns on the upper right canine (tooth /13/) and the first upper right premolar (tooth /14/). This result was also supported by diastema mediana.

The last two cases identified only by dental comparison were recovered from Mass Grave 3 and in case number 1 identification was achieved because of the presence of removable total dentures made of methylmethacrylate. Case No. 2 was identified by a gold crown on the upper right first premolar (tooth /14/) and amalgam fillings (teeth /15,27,28,47/) (Table 4). In all other identified individuals from Mass Graves 2, 3 and 4, dental comparison contributed to identification by supporting other evidence (Table 4).

**Discussion**

Approximately 3000 people were killed or disappeared in Croatia during the war. The majority were killed and buried in mass graves nearby temporarily occupied Croatian towns during 1991. At the end of the war in 1995 the bodies of killed civilians needed to be found and identified [16, 17].

Dental comparison has become indispensable in the personal identification of victims of mass disasters. It

**Table 4** Dental characteristics used in the identification of victims recovered from Army barracks Matanovic, Hospital and Cemetery. (P.I.D. personal identification card)

Site	No.	Sex	Means of identification	Dental records used in the identification process
2	1	M	– stature – teeth – clothing	antemortem extraction of molars
2	3	M	– P.I.D. – teeth – clothing	colour of dentition, teeth destruction
2	8	M	– teeth – clothing	22, 23, 24, 25 gold bridge
2	9	F	– P.I.D. – teeth – clothing	upper and lower dentures from acrylate
2	11	M	– P.I.D. – teeth – cigarettes	diastema mediana, smoker
2	12	M	– P.I.D. – stature – teeth	diastema mediana
2	14	M	– stature – teeth – clothing	malocclusion
2	16	M	– teeth – clothing	13, 14 gold crowns
2	17	M	– teeth – stature – clothing	upper and lower dentures from acrylate
3	1	F	– teeth – clothing	upper and lower dentures from acrylate
3	2	M	– P.I.D. – teeth – medication	14 gold crown
3	3	M	– forensic anthropology – teeth	colour and morphology of dentition
4	2	M	– P.I.D. – keys – teeth	severe abrasion

allows a relatively quick and very reliable identification of a great number of individuals, but only in the cases where antemortem data exist and can be obtained [7, 18–21].

War, accompanied by fighting, civilian deaths and mass burials, presents a specific situation as antemortem data are frequently very scant. Previous experiences of identification teams, as well as those of the Croatian identification team, indicated that identification of war victims was seriously hampered by lack of dermatoglyphic characteristics and dental and medical antemortem data commonly destroyed during the war [22–24]. Existing dental records were frequently burned, or otherwise destroyed during the fighting and occupation of Petrinja. Another reason for the lack of antemortem data was the age of the victims who were mostly elderly people who had not visited a dentist for a number of years and the legal period for mandatory keeping of medical data in Croatia is 10 years.

Evidence from surviving witnesses and relatives also helped to narrow the range of possible victims recovered from the mass graves. As the deceased were not buried according to the rules of the Geneva Convention, the remains were commingled. Every effort was made to identify each body and, in cases where the parts of the body were displaced, to correctly attribute all parts. The identification procedure consisted of finding and confirming all data relevant to the identification of the individual. Very frequently, data on age, sex and stature narrowed the range of possibilities and complemented by personal items such as documents, jewellery (e.g. wedding rings, watches) and clothing which were crucial for establishment of the identification. In such cases dental identification simply confirmed the identification of the victim.

The results of the dental identification presented in this paper are not as good as could be expected if precise antemortem data had been kept. The reason is that the war environment caused the destruction of dental records and frequent migration of populations to different areas of the country. Dental identification was therefore often impossible. Strinovic et al. [17] encountered similar problems during the post war identification processes also performed on the exhumed bodies of the victims of war in Croatia. Griffiths and Oettle [23] also reported similar experiences with regard to the dental identification processes on the exhumed bodies from mass graves in the Ukraine.

The presence of very characteristic prosthetic appliances for oral rehabilitation confirmed the identities of the victims in all cases identified by dental status. In most cases the appliances were bridges with gold crowns. Identification through prosthetic appliances was based on the photographs of victims and information collected by their surviving relatives and friends. Since the victims were mainly from the local elderly population, prosthetic appliances were the most frequent dental records.

The situation that we have faced here supports the suggestion that individual names or social security numbers should be engraved in the dentures and fixed partial appliances to facilitate personal identification in all possible accidents [25–28]. Marked dentures could be very useful for the identifications of bodies after mass disasters, however, this is not a common practice and successful identifications by this means are low [18].

In the few cases where the victims identity was doubtful and antemortem data were not available, the identification was performed by the isolation and hybridization of DNA from bones and dental tissues according to classical procedures [13–15, 29, 30].

Identification of the maximum possible number of exhumed victims in Croatia has been attempted by the interdisciplinary approach involving one forensic odontostomatologist, several forensic pathologists, one forensic anthropologist and numerous auxiliary staff. This paper presents only a small segment of the effects of the war in Croatia. By describing the dental identification processes and their results we intend to point out some of the problems encountered during post-war identifications in Cro-

tia in a situation where the consequences of war were the limiting factors [31].

To conclude, the results of this paper show a mandatory need for interdisciplinary team work because the two basic identification procedures (teeth and fingerprints) are often insufficient for the identification of exhumed victims of war. The results also stress the importance of the inclusion of trained forensic odonto-stomatologists in the team for identifications after mass disasters such as wars.

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