Dental identification of unknown bodies through antemortem data taken by non-dental X-rays. Case reports

Ilenia Bianchi[1], Martina Focardi[2], Rossella Grifoni[2], Silvia Raddi[3], Amalia Rizzo[3], Beatrice Defraia[2], Vilma Pinchi[1,2]

[1]Section of Forensic Medical Sciences, Department of Health Sciences, University of Florence, Italy.
[2]Legal Medicine Unit, Careggi University Hospital, Florence, Italy.
[3]School in Legal Medicine, University of Florence, Italy

Corresponding author:
beatricedefraia@gmail.com

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ABSTRACT

The dental radiographic comparison is one of the most reliable and scientifically accepted methods for body identification (ID). The heterogeneity between AM (ante mortem) and PM (postmortem) x-rays images continues to stand as an issue for the forensic odontologist. Casual dental findings on X-rays for investigation of other structures than teeth or maxillaries, could eventually be a relevant source of dental data for the ID especially when AM dental files or X-rays are lacking. Two cases are reported in which the body ID was achieved through the comparison of PM dental X-rays with dental images obtained by radiographies of other structures (e.g. X-rays of the skull or cervical spine). These cases highlight that these occasional dental findings might provide sufficient evidence for a body identification. In the collection of AM data of missing people, the collection of all available records and radiographies of the head, neck and chest should be carefully reviewed by forensic odontologists, seeking for any available dental data.

INTRODUCTION

The usefulness of the dental structures for body identification (ID) purposes, and especially of dental treatments (e.g. conservative or prosthetic) or dental alterations for oral ritual mutilations [1] is well known. [2,3] The dental structures are rich of unique characteristics and are resilient to peri- and post-mortal agents [4] and they often therefore represent the main resources for identification either in cases of single corpses in which the body is extremely destroyed (e.g. skeletonized, charred, human remains) [5,6] or in the case of multiple bodies [7,8]. According to the literature, the x-rays comparison is the most reliable and scientifically accepted technique for the purposes of justice. [9-11] Post-mortem dental imaging usually implies the taking of intra-oral x-rays of the dental arches and, possibly, CT scans. [12,13] A panorex obtained from the CT images can anyway be used as an orthopantomogram (OPG), type of exam that cannot be usually taken from a dead body. [12] The lack of AM dental X-rays - one of the main issues which has hindered the radiological ID in the past - is nowadays largely bypassed by the digital X-rays and radiological archives which greatly improved the possibilities of storage and transmission of radiographs, thus facilitating the procedures in mass disasters and routinary identifications. [14-16]

Nonetheless, when AM (antemortem) radiographs are

available, their heterogeneity towards the PM (postmortem) images is still an issue for the forensic odontologist who sometimes has nothing else to do than comparing PM intra-oral radiographies with AM extraoral x-rays or dental images occasionally taken from x-rays originally taken for investigation of different anatomical districts (skull, cervical spine or chest). [5, 17,18]

These radiological findings could indeed still represent a relevant source of dental data for body ID, when dental files or dental X-rays are not available after the AM data collection.

Two cases are reported here in which the body ID was achieved through the comparison of PM dental X-rays with very different dental images extracted by non-dental X-rays of the skull or cervical spine. The cases highlight therefore the importance of a complete collection of all the AM radiological data and of their careful review by a forensic odontologist to obtain dental images taken from radiological exams of the head, neck or chest.

CASE REPORTS

Case 1

One unidentified body in an advanced state of skeletonization was found in a wooded area. The identification team consisted of two forensic odontologists and a forensic pathologist.

The dental data were collected according to the INTERPOL DVI forms and a complete set of intraoral x-rays was taken.

Thirteen teeth were missing ante-mortem (already ossified alveolus), the remaining teeth presented multiple dental fillings, endodontic and prosthetic treatments and the upper left third molar semi-inclusion with a disto-vestibular tilting.

Some circumstantial data further oriented the search of the missing person but no direct relatives were found for DNA ID and no specific AM dental data or dental x-rays were available. Some AM clinical information and exams of the missing person were obtained by local hospitals. Two years old skull and chest CT scans, X-rays of the chest and cervical spine were collected. The skull CT scan showed an overall image of the maxillaries (scout view) and some upper molars (sagittal scans), whilst the transoral radiography originally taken to exclude fractures of the epistropheus and the lateral radiography of the cervical spine displayed some useful images of the teeth and dental treatments. With these AM radiographies the forensic odontologists were anyway able to fill the DVI Interpol AM dental form.

The comparison of the AM and PM charts revealed some consistencies (Fig. 1), but some AM evidence was missing and some others were regarded as possibly biased by the use of non-dental radiographies for AM dental charting and coding. Therefore, the forensic odontologists turned to a detailed comparison of the radiological images of the dental treatments retrievable by the AM and PM radiographies (Figg. 2-3). Relevant morphological similarities emerged for some dental traits and conservative and prosthetic treatments from the comparison of the AM non-dental radiographies and the PM intra-oral dental radiographies. The comparison of the images of the teeth 16, 26, 34 and 35 revealed the consistency of the type of treatments displayed by the AM and PM X-rays (fillings, crowns, etc) and a meaningful morphological similarity. The impacted upper left third molar was detected in both the AM and PM X-rays, with similarities for position and tilting of the tooth.

Figure 1. AM Dental charting (left) and PM (right) according to the Interpol DVI forms and coding - FDI numbering.

INTERPOL DVI Form - Missing Person					INTERPOL DVI Form - Unidentified Human Remains			
ODONTOLOGY					ODONTOLOGY			
630	Dental findings (for primary teeth change specific FDI code)				630	Dental findings (for primary teeth change specific FDI code)		
11	NON	NON	21		11	MPM	NAD	21
12	NON	NON	22		12	TCFOD	MPM	22
13	NON	NON	23		13	NAD	MPM	23
14	NON	NON	24		14	MAM	MAM	24
15	NON	NON	25		15	MAM	MAM	25
16	AMFO	AMFO	26		16	AMFO	AMFO	26
17	NON	AMFO	27		17	MAM	MPM	27
18	NON	IMX	28		18	MAM	IMX	28
48	NON	NON	38		48	MAM	MAM	38
47	NON	NON	37		47	MAM	MAM	37
46	NON	NON	36		46	MAM	MAM	36
45	NON	MCC	35		45	NAD	MCC	35
44	NON	RFX-MCC	34		44	NAD	RFX-MCC	34
43	NAD	NAD	33		43	ABR	ABR	33
42	NAD	NAD	32		42	ABR	ABR	32
41	NAD	NAD	31		41	MAM	ABR	31

Figure 2. AM radiological images useful for a comparison with PM dental X-Rays. a) lateral X-rays of the cervical spine, b). trans-oral X-rays of the cervical spine; c) scout view of the skull CT; d) sagittal CT view of the skull. The dental treatments of teeth no. 16, 26, 27, 34 and 35 are displayed. An impacted 28 is detected.

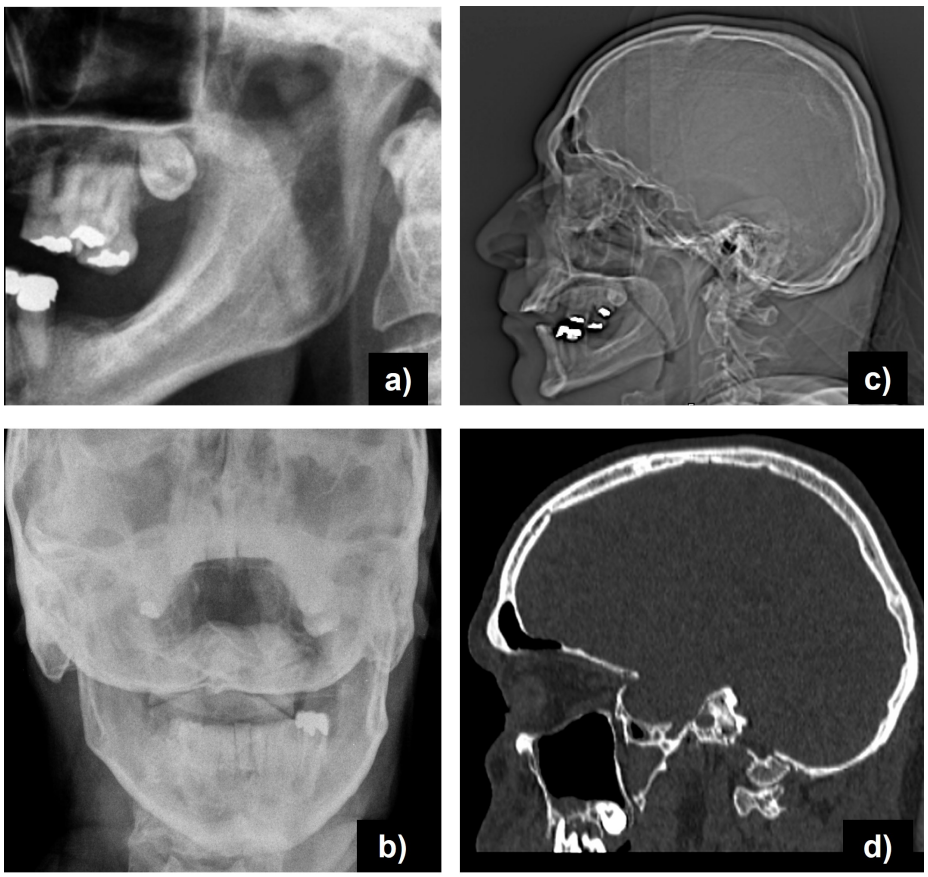
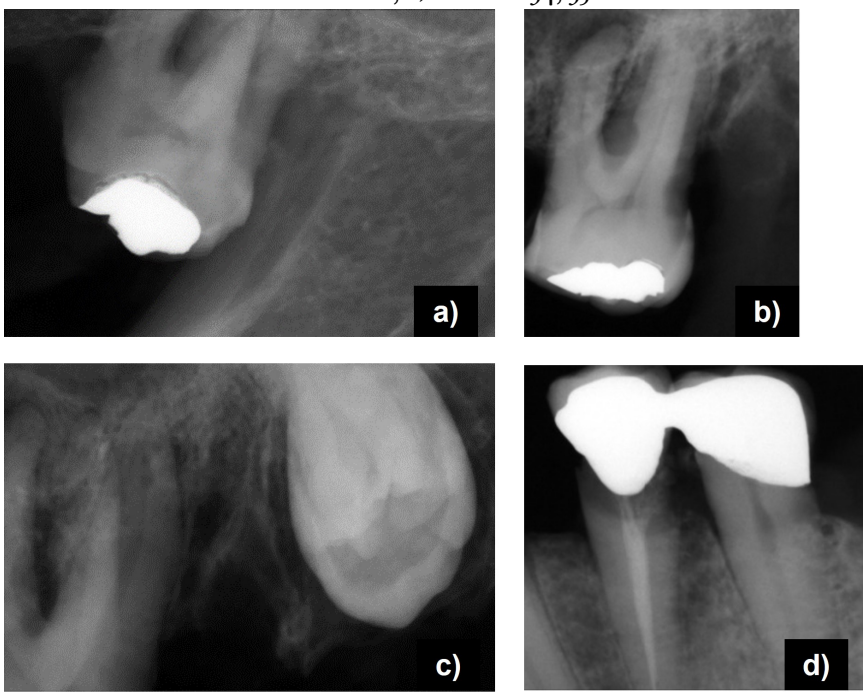


Figure 3. PM intraoral X-Rays used for comparison with AM images (Fig.2). a) tooth n. 16; b) tooth n. 26; c) tooth n. 28; d) teeth n. 34, 35.



Case 2

A deep charred corpse (Fig. 4) was found in a burned car. The body examination and ID procedures were performed according to the INTERPOL DVI protocol by two forensic odontologists and a forensic pathologist.

The post-mortem dental data were collected by a physical examination of the oral cavity, intraoral X-rays and a CT DentaScan. As usual, the carbonization far greater affected the facial tissues than the intra-oral ones. The tongue protruded between the arches and showed teeth marks. [19]

The oral autopsy and the dental X-rays revealed six ante mortem missing teeth with ossified alveoli, the presence of multiple dental fillings and endodontic treatments and the mesially impacted left mandibular third molar. The cross-sectional views of the DentaScan confirmed these findings, showing the vestibular-mesial impaction of the tooth n.38

The first hypothesis was that the dead man was the owner of the car. The AM data search revealed only one lateral radiography of the cervical spine, lateral and antero-posterior radiographies of the skull and a head CT, all dating back fourteen years.

No AM dental files or X-rays were retrieved.

First, the AM dental charting and coding resulted quite challenging and eventually deemed less reliable since the dental arches appeared partially or completely overlapped in the AM-X-rays originally taken for the detection of skull or cervical spine pathologies. Therefore, the comparison of the AM and PM dental charts, pursued with caution, revealed few consistencies (Fig. 5) and some discrepancies (teeth n. 34,35,36,47,15,26,27 e.g.). The latter were considered explainable given the long time (14 years) past from the day the AM radiographies were taken and the day of the death, meanwhile some dental treatments could have been changed or teeth extracted.

The limited evidentiary value of these findings demands that a detailed comparison of the AM and PM radiographic images of the teeth and dental treatments be made.

Despite the heterogeneity of the compared PM (Figg. 6-7) and AM (Fig. 8) imaging and the poor quality of the dental traits and treatments taken from the non-dental AM radiographies, some useful morphological similarities emerged from the matching.

Figure 4. Charred body, skull and intra-oral pictures. Tongue protrusion with teeth marks.

Figure 5. AM Dental charting (left) and PM (right) according to the Interpol DVI forms and coding - FDI numbering system.

INTERPOL DVI Form - Missing Person				600's
ODONTOLOGY				
630	Dental findings (for primary teeth change specific FDI code)			
11	NAD	NAD	21	
12	NAD	NAD	22	
13	NAD	NAD	23	
14	NON	NAD	24	
15	RFX-AMF O	NAD	25	
16	TCF M	TCF M	26	
17	NAD	RRX-RFX	27	
18	NON	NON	28	
48	NON	IMX	38	
47	AMF V	AMF O	37	
46	AMF O	RFX-AMF	36	
45	NAD	NAD	35	
44	NAD	RFX-AMF D	34	
43	NAD	NAD	33	
42	NAD	NAD	32	
41	NAD	NAD	31	

INTERPOL DVI Form - Unidentified Human Remains				600's
ODONTOLOGY				
630	Dental findings (for primary teeth change specific FDI code)			
11	NAD	NAD	21	
12	NAD	NAD	22	
13	NAD	NAD	23	
14	MAM	NAD	24	
15	RFX-TCF MOD	NAD	25	
16	TCF M	TCF OM-TCF D	26	
17	NAD	MAM	27	
18	MAM	MAM	28	
48	MAM	IMX	38	
47	RFX-TCF OD	AMF O	37	
46	AMF O-CAR D	MAM	36	
45	NAD	TCF M-CAR M	35	
44	NAD	RFX-TCF OD	34	
43	NAD	NAD	33	
42	NAD	NAD	32	
41	NAD	NAD	31	

Fig. 6 PM intraoral X-rays taken from the unknown dead body.

Figure 7. Some views taken from the PM DentaScan of the dead body. The tongue protruded between the incisors.

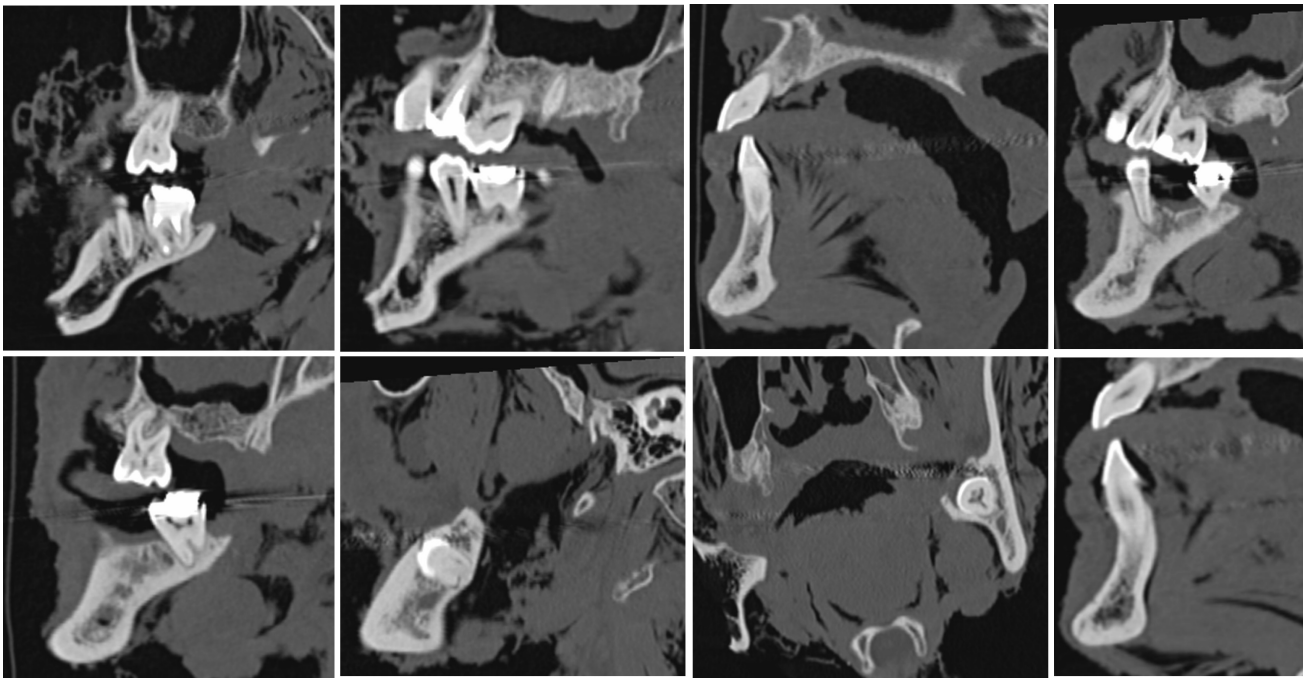
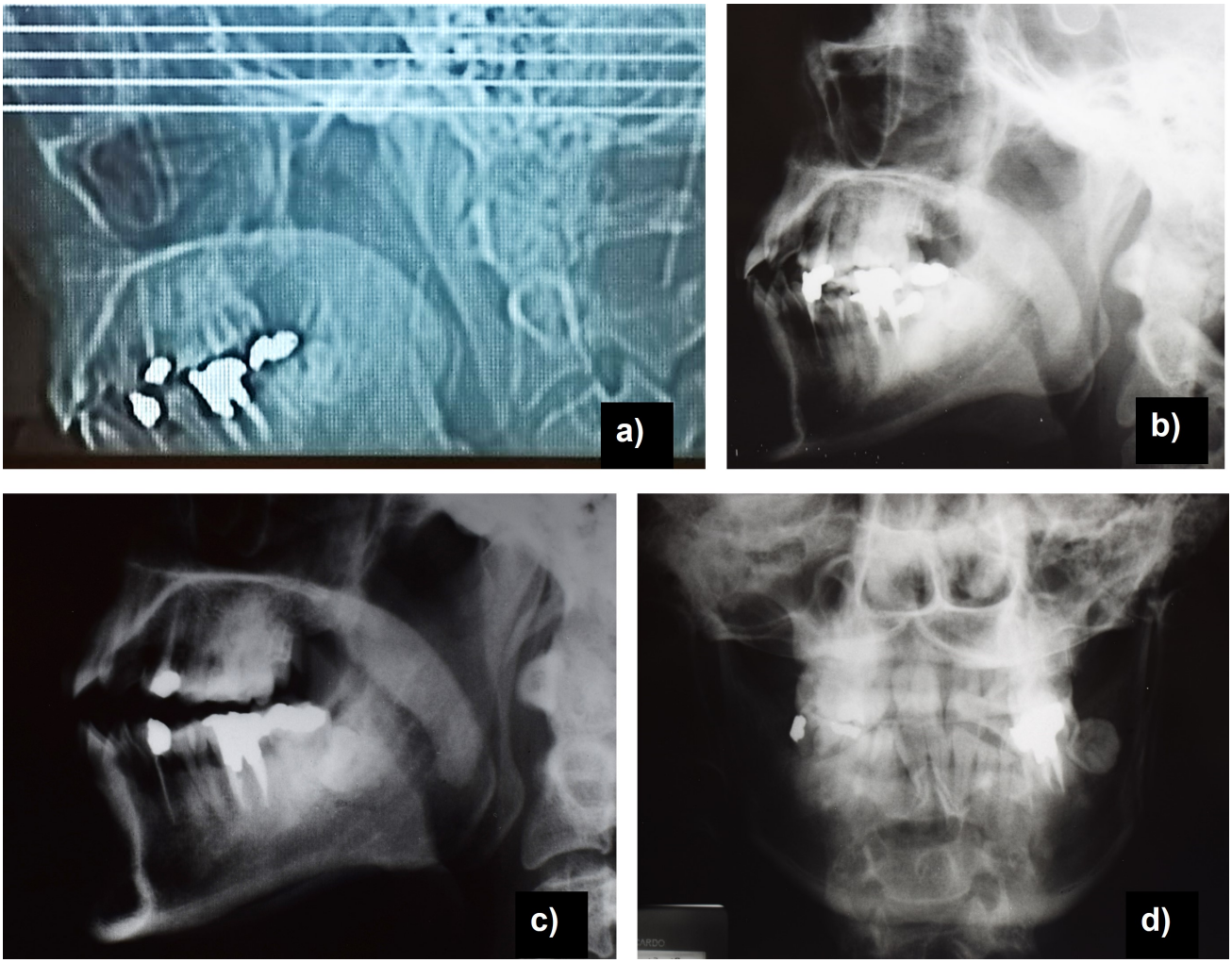


Figure 8. Dental traits and treatments taken from the AM radiographies and used for the ID procedure. a) scout view of the skull CT; b) and d) x-ray lateral and anteroposterior view of the skull respectively; c) x-ray lateral view of the cervical spine.



The comparison of the AM and PM radiological images of the teeth n.15, 34, 37, 46 and 26 revealed the consistency of the type of treatments (fillings and endodontic treatments). The impacted lower left third molar showed relevant similarities in shape and position. The PM DentaScan provided more accurate information about the position and shape of the impacted third molar.

DISCUSSION

Few cases are reported In the Literature about body identification obtained through the casual retrieval of useful dental images in radiographies originally taken for investigation of the chest [17] or skull structures [5,18].Being such radiographies taken for investigation of structures other than the teeth or dental arches, the resulting "dental" images are far to be considered ideal and the matching with PM data is therefore challenging. Nonetheless, the radiopacity of the dental materials, the peculiar shape of some treatments or the occurrence of unusual dental traits can be detected and effectively used for ID purposes, despite the mis-projections, the overlapping and the poor quality of some AM images. [20,21]

The limits of the AM dental data proved to be important in both the reported cases and the comparison of the AM teeth images taken from the skull or spine X-rays even long before the death, represented the unique chance to identify the bodies. The lack of more reliable sources of dental data of missing people jeopardized the AM dental charting and coding, which could be performed merely looking at those non specific X-rays.

The anteroposterior views of the AM X-rays [Fig. 2 b); Fig. 8 d)] resulted actually useless in both the reported cases for the matching of the shape of

the fillings, but they anyway helped to solve some doubts about the distribution of the treatments per side that appeared overlapped in the lateral views [Fig. 2 a)- c; Fig. 7 a)-c)].

Franco et al [22] found the CBCT scans to be as effective as the OPGs to perform a proper dental charting and coding according to the Interpol DVI recommendations for ID procedures. The strongest associations in 2D and 3D-xrays were especially detected between the INTERPOL "non-erupted", "partially erupted" and "impacted" third molar codes.

An antemortem CT scan was found in both the reported cases, but it was a skull CT. The head CTs resulted useless for dental charting and coding since the scans represented very few and incomplete dental images while only the scout images could be used for the dental ID,

Therefore, the AM dental charts obtained from antemortem 2D or 3D X-rays of the skull or cervical spine were regarded as probably biased in both cases, and consequently the comparison of the PM and AM odontograms devalued in their evidentiary role. This problem led the forensic odontologists to perform a radiological comparison of the dental traits and treatments of the non specific AM X-rays.

It is widely renown that a great reliability in the human identification procedures is attributed to some peculiar dental traits when compared on AM and PM dental X-rays, [23-24] and especially dental treatments such as root canal therapies [25] and amalgam [26] and/or composite fillings [27] are endowed with highly-specific morphological features. The peculiar shape of these treatments is reported to be highly recognizable on two-dimensional radiographies even if they are taken with a different angulation [28] and the matching of the dental radiographies is considered a more reliable item for identification than written dental records. [29] Forrest AS [30] reported that visual comparison or superimposition of "plain film radiographs" are the best methods for the recognition of similarities in the morphology of conservative treatments, and especially of the metallic ones. The maxillary CTs offer more 3D information about the extension of the dental treatments, but they inherently allow a scarce discrimination among the different dental materials. Moreover, the comparison of the 3D imaging of the teeth are more useful in the case of unrestored teeth.

In our Case 2, the findings detected by the intraoral X-rays compared with the AM data would have still been sufficient to identify the subject, but the Dentascan PM projections made it possible to add information about the position the position of the impacted third molar (Fig. 7).

In both cases, the lateral and antero-posterior x-rays of the cervical spine and skull allowed the detection of some treatments in the premolars and molars of the arches and some useful consistencies emerged from the comparison with the PM intraoral radiographies of the body. Relevant findings emerged about the type of the treatments (fillings, crowns, endodontic treatments), whilst shape similarities were detected only for some fillings and few dental traits. Only very few previous reports discussed about similar ID circumstances and provided variable conclusions. Minaguchi K et al [17] compared an AM chest x-ray which included only the frontal part of the two arches with the dental PM intraoral x-rays and found congruences between the conservative treatments detected. However, they concluded that similar findings are normally not sufficient to define a reliable dental ID and the body ID was obtained after additional genetic examinations.

On the contrary, Campobasso et al [5] identified a badly charred body from an anterior-posterior skull radiography taken 8 years earlier. The AM and PM dental data matching was limited to few dental treatments, being the other teeth in the PM data missing or with different treatments due to the long time past. Nevertheless the findings were sufficient for the establishment of a positive ID of the unknown body.

Pinchi et al [18] identified a case of a skeletonized body mainly thanks to the concordance of the position and morphology of an included upper third molar detected on a single scan of an AM skull CT.

As an interesting clue, in both cases an impacted third molar was found in the AM radiographies and in the unknown corpses. The peculiar type of impaction and some consistencies about the third molar traits retrieved in the AM X-rays of the skull and cervical spine and those found in the intra-oral radiographies of the bodies provided relevant evidence for the identification assessment.

Previous literature has shown that the position and shape of the impacted teeth, other than the impaction in itself, provide a strong evidence for the dental ID. [21] Pinchi et al [18] and Campobasso

et al [5] achieved a body ID by an effective comparison of radiographic images of impacted third molars found in aged unknown bodies and in AM radiographies of the skull of missing people respectively.

CONCLUSIONS

Dental data represents one of the primary identifiers according to DVI Interpol and the comparison of AM and PM dental records can effectively lead to a positive identification of an unknown or unidentifiable dead body. The antemortem dental radiographies of missing people have proven to be a reliable source of data when any other AM dental records lack. Two cases of body identification are presented in which no AM dental records or radiographies were available and a quite challenging dental charting was performed with dental traits or treatments captured just by AM radiographies of the skull or the cervical spine. The overlapping and misprojection of teeth represented in these non-dental AM radiographies and the relevant time past between AM and PM radiographies jeopardized the evidence obtained by the AM and PM odontograms matching. Despite the relevant diversity of the AM and PM radiographies, a comparison of dental traits and treatments images could be performed and provided an useful evidence in both cases. Occasional dental findings detectable in non-conventional radiographs may get sufficient evidence for a body identification, especially some dental treatments or impacted third molars.

The collection of Ante Mortem data of missing people should consider all the available records and radiographies of the head, neck and chest which should be carefully reviewed by the forensic odontologists in the search for AM radiographic dental data.

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