Utilisation of non-dental radiographs in forensic dental identification of unknown human remains: a Queensland case series

Jane Kim[1], Neil Evans[1], Hai Jiang[1], Nathan Milne[1-6], Alistair Soon[1,7]

[1] Forensic Pathology and Coronial Services, Queensland, Australia. [2] University of Queensland, Queensland, Australia. [3] Bond University, Queensland, Australia. [4] Griffith University, Queensland, Australia. [5] University of Melbourne, Victoria, Australia. [6] Monash University, Victoria, Australia. [7] Joint Health Command, Australia

Corresponding author:
jane.kim@health.qld.gov.au

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KEYWORDS

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ABSTRACT

Forensic odontology is one of INTERPOL's three primary identifiers for Disaster Victim Identification (DVI). Forensic dental identification relies on the availability of antemortem dental radiographs, such as orthopantomogram (OPG), dental cone beam computed tomography (CBCT) scanned images, bitewing, and periapical (PA) views. These antemortem dental radiographs are used for comparison with postmortem dental radiographs. However, there are other types of non-dental medical radiographs that also capture dental structures. These medical radiographs are proven to be useful in forensic dental identification. This Queensland case series highlights the importance of non-dental radiographic images for the purpose of forensic dental comparison including the first published forensic dental identification involving comparison of a postmortem computer tomography (PMCT) multiplanar reformat (MPR) image with non-dental antemortem radiography. This case series also highlights the benefits of a collaborative working relationship between the forensic odontologist, forensic pathologist, police, and Coroner, in antemortem data collection.

INTRODUCTION

A mass casualty incident is when the incident overwhelms conventional emergency service resources.[1] Disaster Victim Identification (DVI) is the structural evidence-based forensic process to identify the deceased victims in a mass casualty incident. The INTERPOL DVI Guide states that forensic odontology is one of the three primary identifiers along with deoxyribonucleic acid (DNA) studies, and fingerprints.[2] Forensic dental identification, one aspect of forensic odontology, involves the use of both antemortem and postmortem dental data to reach a dental identification conclusion. Dental radiography is one of the many types of dental data,[3] and it is the preferred data due to its objectivity, unlike written dental records, which can be quite subjective. There are several medical radiographs that capture oral and dental structures, such as skull radiographs including antero-posterior (AP), postero-anterior (PA) and lateral views, and cervical spine view radiographs.[3-5] Generally medical radiographs may not provide close-up views of the oral and dental structures, however some of these captured features can be used for forensic dental identification as described in this Forensic Pathology and Coronial Services (FPaCS) case series.

CASE SERIES

Case 1:

A deceased adult male was found incinerated in a vehicle with no identifiable features due to severe charring and blackening across most of the body. The body was transported to the mortuary for coronial identification. The antemortem dental data consisted of written dental records. The written dental records indicated only teeth 18, 38, and 48 had been extracted and that a filling had been placed on tooth 47. A postmortem computed tomography (PMCT) scan was carried out as part of the mortuary standard operating procedure (SOP). The FPaCS Computed Tomography (CT) Scan is the Siemens SOMATOM Definition AS Open (Siemens Medical Solution, USA), and as part of the mortuary SOP, all remains received by the mortuary will require a PMCT scan. The PMCT showed that teeth 18, 38 and 48 were absent and tooth 47 was absent, although there were some similar features with the dental records, the information was insufficient for any meaningful dental comparison. The forensic odontologists located medical CT images of the person believed to be the deceased adult male from one of the private radiology centres. The mid-face CT of the head was taken to investigate intracranial lesions. There were distinctive tooth root forms in the upper left quadrant of the antemortem mid-face CT image which were comparable to the root forms in the upper left quadrant of the PMCT image. The roots of the upper left dental quadrant of the antemortem mid-face CT image were superimposed over the image of the roots of the teeth of the upper left dental quadrant of the PMCT image (Figure 1(a)-(f)). This method along with the findings of the dental records was sufficient to complete the forensic dental identification of the deceased adult male.

Figure 1. (a)-(f) shows the superimposition of the upper left teeth roots of the antemortem mid-face CT image over the PMCT image

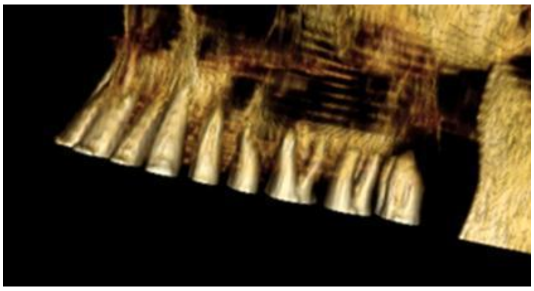


Figure 1. (a) upper left teeth roots of the antemortem mid-face CT with 100% opacity over upper left teeth roots of PMCT.

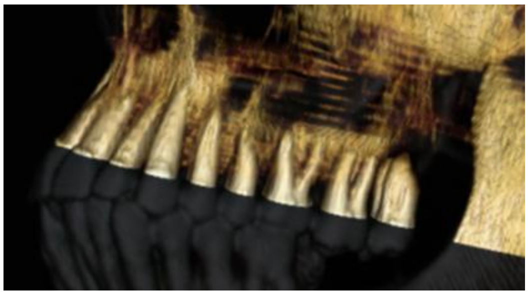


Figure 1. (b) upper left teeth roots of the antemortem mid-face CT with 80% opacity over upper left teeth roots of PMCT.

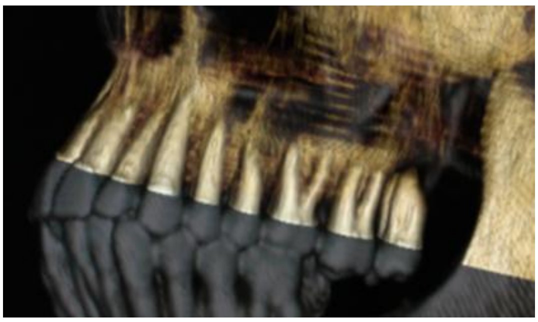


Figure 1. (c) upper left teeth roots of the antemortem mid-face CT with 60% opacity over upper left teeth roots of PMCT.

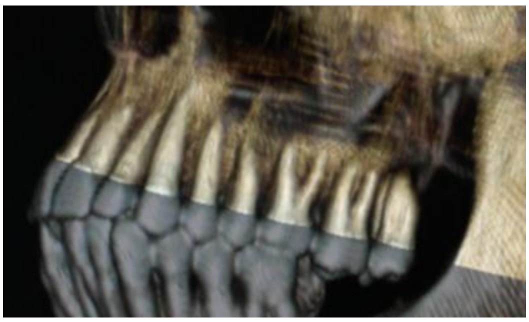


Figure 1. (d) upper left teeth roots of the antemortem mid-face CT with 40% opacity over upper left teeth roots of PMCT.

Figure 1. (e) upper left teeth roots of the antemortem mid-face CT with 20% opacity over upper left teeth roots of PMCT.

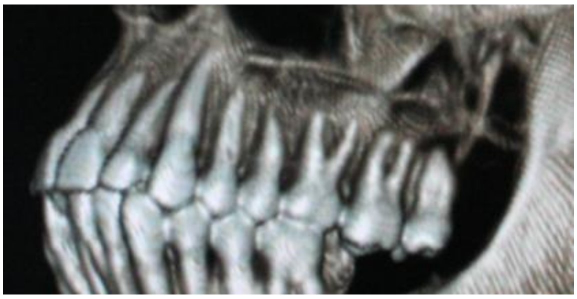


Figure 1. (f) upper left teeth roots of the antemortem mid-face CT with 0% opacity over upper left teeth roots of PMCT.

Case 2:

A 23-year-old deceased male was involved in a motor vehicle crash. The male was ejected from the vehicle resulting in death due to major body and skull trauma. The body was transferred to the mortuary for coronial identification. Antemortem dental data consisted of two lateral cephalogram radiographs and written dental records, however, these radiographic images provided minimal dental information that could be used for forensic dental identification. The written dental records noted that the person believed to be the deceased male had undergone jaw surgery. With this information, the forensic odontologists conducted a search of one of the private radiology centres and retrieved postoperative CT images of the person believed to be the deceased male (Figure 2(a), and Figure 3(a)). The postoperative CT images showed placements of multiple metal surgical plates in the body and ramus of the right mandible, and in the zygomatic and frontal process of the maxilla. PMCT of the deceased male was taken as part of the mortuary SOP (Figure 2(b), and Figure 3(b)). 3D CT images from the postoperative CT, and the PMCT were compared. Both 3D images showed multiple concordant features such as the locations of the surgical metal plates, and dental root morphologies. This method along with the findings of the dental records was sufficient to complete the forensic dental identification of the deceased adult male.

Figure 2. Comparison of Figures 2(a), and 2(b): there is complete correspondence in the placement of the surgical metal plates in both images. There is also concordance of the dental root morphologies. There are no unexplained discrepancies. Orthodontic brackets are present in the antemortem postoperative image but not present in the PMCT image. The removal of orthodontic brackets was documented in the antemortem dental records.

Figure 2(a): Antemortem postoperative CT image.

Figure 2(b): PMCT image.

Figure 3. Comparison of Figures 3(a), and 3(b): there is complete correspondence in the placement of the surgical metal plates in both images. There is also concordance of the dental root morphologies. There are no unexplained discrepancies. Orthodontic brackets are present in the antemortem postoperative image but not present in the PMCT image. The removal of orthodontic brackets was documented in the antemortem dental records.

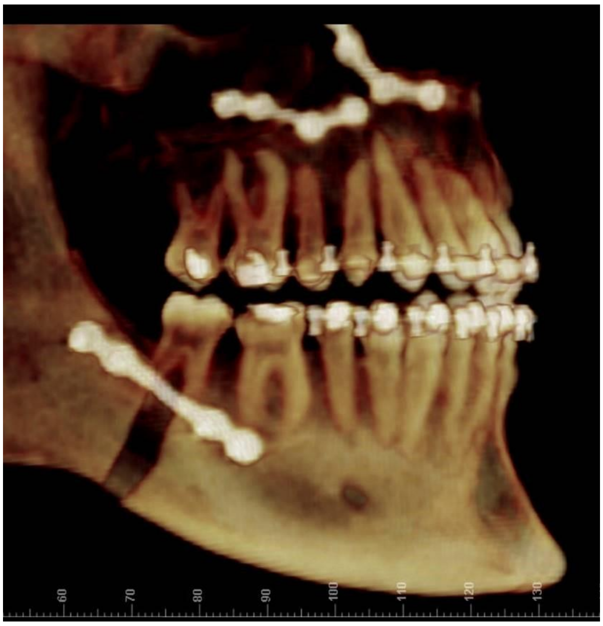


Figure 3. (a) Antemortem postoperative CT image.

Figure 3. (b) PMCT image.

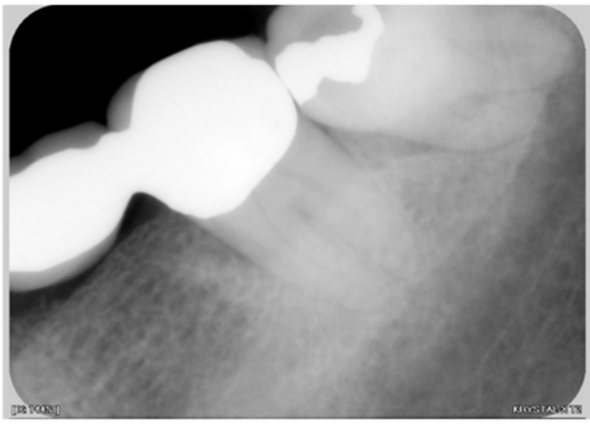
Case 3:

The remains of a deceased person were recovered following a light aircraft crash. No antemortem dental imaging was available. However, a series of cervical spine radiographs was located including antero-posterior, lateral, oblique, and odontoid views. Multiple distinctive dental features were visible on the oblique view including multiple metallic restorations, teeth 35-37 bridge, teeth 25, 26 and 27 crowns, and root canal treatment (RCT) of teeth 26, and 27 (Figure 4). PMCT multiplanar reformat (MPR) images were produced from the PMCT scanned data of the deceased. Due to artefacts precluding detail within the images, postmortem plain film dental radiographs were taken (Figures 5(a), and 5(b)), and compared to the antemortem oblique cervical spine radiograph. Multiple concordant features with no unexplainable discrepancies were noted, and this comparison was found to be sufficient to establish the identity of the deceased.

Figure 4. Antemortem oblique cervical spine radiograph of person believed-to-be the deceased. Multiple distinctive dental features are noted including multiple metallic restorations, a lower posterior bridge and upper posterior crowns and root canal treatments.

Figure 5. (a) Upper left side PA radiograph of deceased's dentition. The pattern of metallic restorations, crowns and RCT corresponds to the antemortem radiograph, except for the tooth 28 restoration, which has been replaced since the antemortem radiograph was taken.

Figure 5. (b) Lower left side PA radiograph of deceased's dentition. The teeth 35-37 bridge, and the distinctive morphology of the tooth 38 metallic restoration correspond to the antemortem radiograph.



Case 4:
The remains of an adult male were recovered following a motor vehicle crash. No dedicated antemortem dental imaging was available, however, a cervical CT scan taken for a non-dental indication was located at a private radiology provider. Multiple distinctive dental features were visible on the antemortem CT including multiple missing teeth, and RCT of teeth 31 and 41 (Figures 6(a), and 6(b)). Axial sections and PMCT MPR images were produced from the PMCT data of the deceased (Figures 7(a)–(c)), and compared to antemortem CT axial sections and written dental records. Multiple concordant features with no unexplainable discrepancies were noted, and this comparison was found sufficient to establish the identity of the deceased.

Figure 6. (a) Antemortem CT axial section of upper teeth demonstrating multiple missing teeth.

Figure 6. (b) Antemortem CT axial section of lower teeth demonstrating RCT of teeth 31 and 41 and missing teeth 36, 38, 46 and 48.

Figure 7. (a) PMCT axial section of upper teeth demonstrating multiple missing teeth. The pattern of missing teeth, as well as the positions and dispositions of remaining teeth, are concordant with the antemortem CT images.

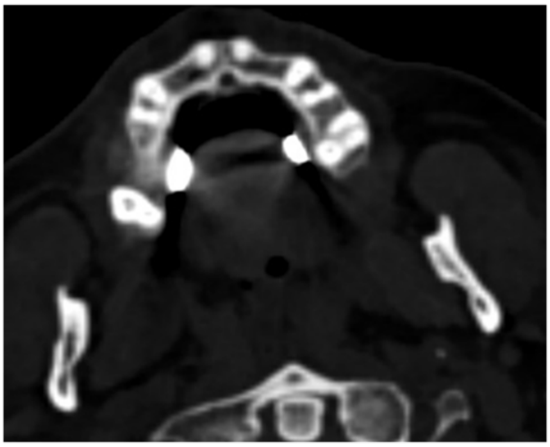


Figure 7. (b) PMCT axial section of lower RCT of teeth 41, 31 and 32. Teeth 36, 38, 42, 46 and 48 are missing. Written clinical dental notes confirm that the RCT of tooth 32 and the removal of tooth 42 were performed after the antemortem CT was taken.

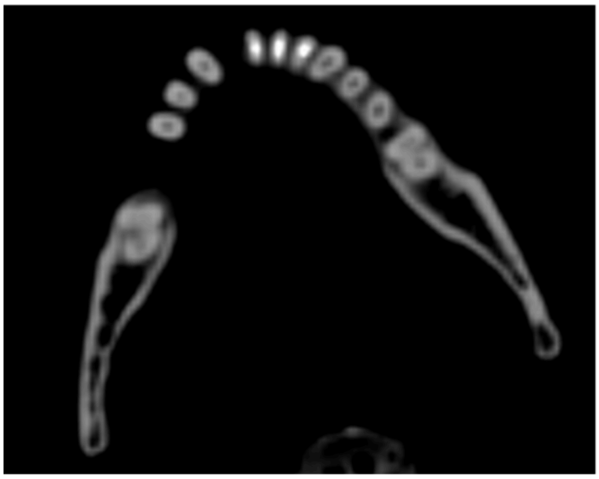
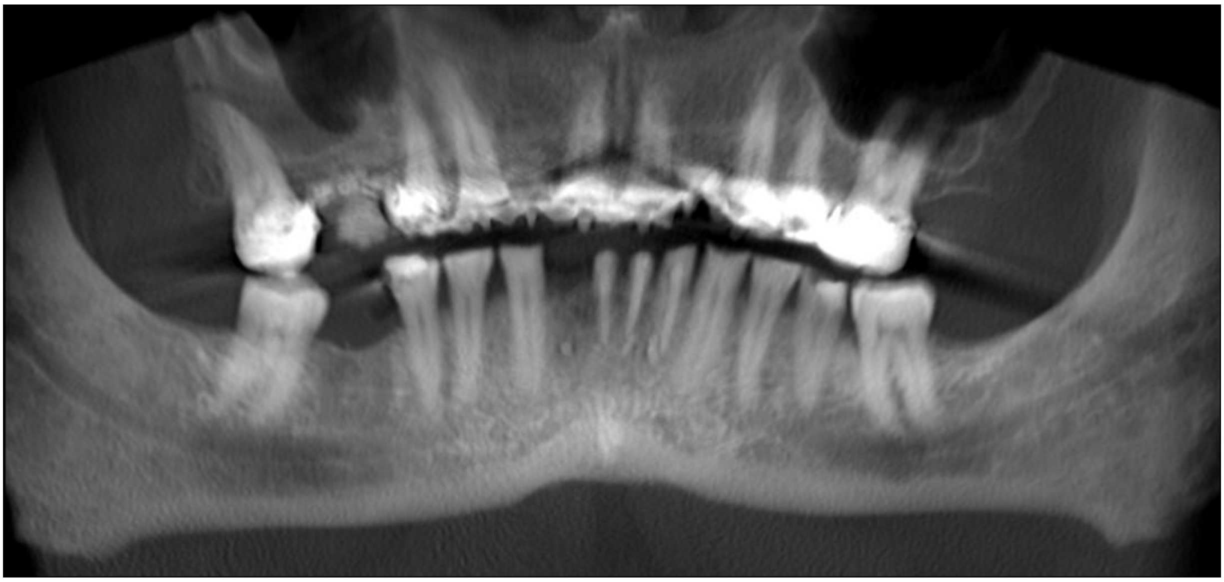


Figure 7. (c) PMCT MPR image of the upper and lower jaws demonstrating those features noted in 7(a) and 7(b). Note that the deceased was wearing a partial upper metal-based denture when the PMCT was taken.



DISCUSSION

Forensic dental identification involves the comparison and reconciliation of antemortem and postmortem dental data to reach a conclusion; antemortem and postmortem dental comparison could be as simple as comparing written dental records or as complex as utilising microscopy and elemental analysis.[6-9] Useful antemortem dental data includes: written dental records, dental radiographs, dental casts, and dental prostheses. It is important to note that having minimal or no antemortem dental data means it can be difficult or impossible to provide a meaningful forensic dental comparison.

A literature review was completed on 30 March 2025 in the use of non-dental radiographs or x-rays on PubMed using the terms: non-dental, medical, identifications, identification, radiographs, radiograph, x-ray, and x-rays.

Three articles that were related to this topic were identified.[3-5] The antemortem medical radiographs that were used for forensic dental identification in these articles were lateral cervical spine, trans-oral cervical spine, scout view of skull CT, sagittal CT view of skull, and anteroposterior view of skull. All cases in these articles led to a successful outcome in identification of the unknown human remains. This Queensland case series also demonstrated successful outcomes of identification of deceased persons using non-dental antemortem radiographs. Both the located articles and the Queensland case series show the usefulness of medical radiographic images in forensic dental identification.

Medical radiographs, particularly AP and PA skull views, lateral skull view, and cervical spine view radiographs are often prescribed by medical clinicians for investigation of skull fractures, neoplastic changes, or Paget's disease.[10,11] Often these radiographs will show dental structures. The deceased person's medical condition or history are good indicators of potential medical radiographs that they may have had taken in the past. The forensic pathologist is essential in the death investigation of the deceased person.[12] The coronial investigation process often involves the autopsy of the deceased person. Based on the autopsy findings, the forensic pathologist could advise the forensic odontologist of the possible medical radiographs, related to the head and neck region, that the deceased person may have had in the past.

Since 1895, medical imaging has come a long way, evolving from the first medical radiograph taken by Roentgen, to CT scanning in 1971, and nuclear magnetic resonance (NMR) imaging in 1973.[13] In the forensic pathology and medicine context, plain film medical radiography was first used in 1896 involving a gunshot wound investigation, and in 1921, medical radiographs were first used for forensic identification.[14,15] FPaCS acquired its first Multi-Slice Computed Tomography (MSCT) scanner in 2009. Since then, all deceased persons who require coronial investigation, were PMCT scanned as part of the mortuary SOP. FPaCS forensic odontologists have routinely conducted forensic dental identification utilising PMCT including its MPR and 3D reconstruction images since 2011. In the earlier years, postmortem dental data retrieved from PMCT was used in conjunction with the postmortem dental records and intraoral dental radiographs. Since 2019, FPaCS forensic odontologists have regularly completed forensic dental identification casework using PMCT MPR without the need to take postmortem dental records and intraoral dental radiographs. The forensic odontologists work closely with FPaCS forensic radiographers in producing these MPR and 3D reconstruction images to simulate the antemortem dental radiographic images for dental radiographic comparison. Notably, this Queensland case series is the first to demonstrate the comparison of non-dental antemortem radiographs to MPR images derived from PMCT data to achieve a dental identification outcome. The utility of PMCT MPR dental images in personal forensic dental identification has been demonstrated in the literature.[16]

Many countries do not have a centralised dental records repository, hence it can be a challenge to source and collect antemortem dental records, especially if there is no lead or indication of the potential resources.[17] Some countries, like Australia, have several private radiology centres. Forensic odontologists (with approval from the Coroner or Medical Examiner) can search within these radiology centres' central image repositories for any potential antemortem dental and medical radiographic images which could be used for forensic dental identification. With the Queensland Coroner's permission, FPaCS forensic odontologists are able to access the radiology repositories of private radiology centres and Queensland Health (government) facilities to locate the person's medical or dental radiographic images. The availability of the radiographic images in digital format is useful, as they can be easily retrieved and transmitted, whilst maintaining their quality. If digital radiographic images are not available, the forensic odontologist can liaise and guide the police to assist with retrieving antemortem hardcopy film data. Antemortem data collection is a team effort.

This case series from Queensland highlights the importance of forensic teamwork and looking outside the norm of antemortem dental data collection to achieve an outcome in forensic dental identification.

CONCLUSION

Forensic dental identification regularly uses antemortem dental radiographs, such as orthopantomogram (OPG), dental cone beam computed tomography (CBCT), bitewing, and periapical (PA) views, for comparison with postmortem dental radiographs. However, as demonstrated in this article, forensic odontologists have to be aware of non-dental radiographs that could potentially have captured the oral and dental features of the person, such as medical radiographs of the head and neck region. This Queensland case series demonstrates the usefulness of antemortem non-dental radiographic images for forensic dental comparison, notably being the first to highlight their comparison to MPR images produced from PMCT data. This article also highlights the importance of collaboration within the forensic team which includes forensic odontologists, forensic pathologists, police, and coroners. Effective collaboration allows the location and collection of the antemortem data necessary to achieve an identification of the deceased person.

ETHICS APPROVAL

Authorisation provided by the State Coroner, Chief Forensic Pathologist, and Coronial and Public Health Sciences - Human Ethics Committee.

REFERENCES

1. Mackway-Jones K, Carley S. The epidemiology and incident of major incidents. In: Advanced Life Support Group, editor. Major Incident Medical Management and Support: The Practical Approach in the Hospital. 2nd ed. Chichester (UK): John Wiley & Sons; 2019. p. 3–9.
2. International Criminal Police Organization (INTERPOL). Disaster Victim Identification (DVI) [Internet]. Lyon: INTERPOL; [cited 2025 Oct 11]. Available from: https://www.interpol.int/How-we-work/Forensics/Disaster-Victim-Identification-DVI
3. Fischman SL. The use of medical and dental radiographs in identification. Int Dent J. 1985 Dec;35(4):301-6. PMID: 3867636.
4. Pinchi V, Zei G. Two positive identifications assessed with occasional dental findings on non-dental x-rays. J Forensic Odontostomatol. 2008 Dec 1;26(2):34-8. PMID: 22717787.
5. Bianchi IA, Focardi MB, Grifoni R, Raddi S, Rizzo A, Defraia B, Pinchi V. Dental identification of unknown bodies through antemortem data taken by non-dental X-rays. Case reports. J Forensic Odontostomatol. 2021 Dec 30;39(3):49-57. PMID: 34999580; PMCID: PMC9343057.
6. Brown KA. Procedures for the collection of dental records for person identification. J Forensic Odontostomatol. 2007 Dec;25(2):63-4. PMID: 18183690.
7. Wood RE. Forensic aspects of maxillofacial radiology. Forensic Sci Int. 2006 May 15;159 Suppl 1:S47-55. doi: 10.1016/j.forsciint.2006.02.015. Epub 2006 Mar 10. PMID: 16529896.
8. Forrest A. Forensic odontology in DVI: current practice and recent advances. Forensic Sci Res. 2019 Nov 6;4(4):316-330. doi: 10.1080/20961790.2019.1678710. PMID: 32002490; PMCID: PMC6968523.
9. Soon AS, Bush MA, Bush PJ. Complex layered dental restorations: Are they recognizable and do they survive extreme conditions? Forensic Sci Int. 2015 Sep;254:1-4. doi: 10.1016/j.forsciint.2015.06.016. Epub 2015 Jun 26. PMID: 26151675.
10. Theodorou DJ, Theodorou SJ, Kakitsubata Y. Imaging of Paget disease of bone and its musculoskeletal complications: review. AJR Am J Roentgenol. 2011 Jun;196(6 Suppl):S64-75. doi: 10.2214/AJR.10.7222. PMID: 21606236.
11. Cortis K, Micallef K, Mizzi A. Imaging Paget's disease of bone--from head to toe. Clin Radiol. 2011 Jul;66(7):662-72. doi: 10.1016/j.crad.2010.12.016. Epub 2011 Apr 27. PMID: 21524738.
12. Pounder D. Forensic pathology services. BMJ. 2002 Jun 15;324(7351):1408-9. doi: 10.1136/bmj.324.7351.1408. PMID: 12065251; PMCID: PMC1123371.
13. Bercovich E, Javitt MC. Medical Imaging: From Roentgen to the Digital Revolution, and Beyond. Rambam Maimonides Med J. 2018 Oct 4;9(4):e0034. doi: 10.5041/RMMJ.10355. PMID: 30309440; PMCID: PMC6186003.
14. Carvalho SP, Silva RHA, Lopes-Júnior C, Peres AS. Use of images for human identification in forensic dentistry: A utili-zação de imagens na identificação humana em odontologia legal. *Radiologia Brasileira*. 2009 Mar/Apr;42(2):125-130. doi: 10.1590/S0100-39842009000200014.
15. Decker SJ, Braileanu M, Dey C, Lenchik L, Pickup M, Powell J, Tucker M, Probyn L. Forensic Radiology: A Primer. Acad Radiol. 2019 Jun;26(6):820-830. doi: 10.1016/j.acra.2019.03.006. Epub 2019 Apr 17. PMID: 31005405.
16. Evans N, Soon A, Forrest A, Meredith M, Harris P. E-dentification, the use of teledentistry for remote personal forensic identification in forensic odontology: a Queensland experience. Forensic Sci Res. 2025 Jul 2;10(3):owaf016. doi: 10.1093/fsr/owaf016. PMID: 40822626; PMCID: PMC12356368.
17. Walji MF, Spallek H, Kookal KK, Barrow J, Magnuson B, Tiwari T, Oyoyo U, Brandt M, Howe BJ, Anderson GC, White JM, Kalenderian E. BigMouth: development and maintenance of a successful dental data repository. J Am Med Inform Assoc. 2022 Mar 15;29(4):701-706. doi: 10.1093/jamia/ocac001. PMID: 35066586; PMCID: PMC8922177.