



Communication

The Anthropological Process of Identifying Missing Persons as a Teaching Method for Increasing Awareness in Legal and Forensic Dentistry in the Republic of Cyprus

Kostis Giannakopoulos ^{1,*}, Persefoni Lambrou ¹, Eleftherios G. Kaklamanos ^{1,2,3} and Anna Aristotelous ⁴

¹ School of Dentistry, European University Cyprus, Nicosia 2404, Cyprus; p.lambrou@external.euc.ac.cy (P.L.); e.kaklamanos@euc.ac.cy (E.G.K.)

² School of Dentistry, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

³ Hamdan Bin Mohammed College of Dental Medicine, Mohammed Bin Rashid University of Medicine and Health Sciences, Dubai 505055, United Arab Emirates

⁴ Humanitarian Affairs of Missing and Enclaved People, Nicosia 1082, Cyprus

* Correspondence: k.giannakopoulos@euc.ac.cy

Abstract: Forensic Odontology is a critical field within forensic science, with significant importance in legal contexts and the identification of victims in mass disasters or cases of abuse. This article focuses on the efforts made by the European University Cyprus (EUC) School of Dentistry to raise awareness among dental students regarding legal and forensic dentistry practices. Through voluntary visits to the Anthropological Laboratory of the Committee on Missing Persons (CMP) in Cyprus, students gain firsthand experience and insights into anthropological analysis for identifying missing individuals. These visits provide students with practical application opportunities, emphasizing record-keeping practices, oral tissue morphology analysis, and unique aspects of restorative work during identification processes. Feedback from participating students highlights the value of experiential learning in increasing awareness about forensic odontology's importance and relevance in real-world scenarios. The initiatives undertaken by the EUC School of Dentistry contribute to enhancing legal and forensic dentistry awareness among future dental professionals in Cyprus.

Keywords: forensic odontology; forensic dentistry; missing persons; anthropological laboratory; teaching methods; human remains identification



Citation: Giannakopoulos, K.; Lambrou, P.; Kaklamanos, E.G.; Aristotelous, A. The Anthropological Process of Identifying Missing Persons as a Teaching Method for Increasing Awareness in Legal and Forensic Dentistry in the Republic of Cyprus. *Forensic Sci.* **2024**, *4*, 598–603. <https://doi.org/10.3390/forensicsci4040041>

Academic Editors: Hiroshi Ikegaya and Hugo Cardoso

Received: 30 August 2024

Revised: 31 October 2024

Accepted: 5 November 2024

Published: 8 November 2024



Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Communication

Forensic Odontology constitutes a rapidly developing branch of forensic science and holds significant importance in scrutinizing dental evidence in legal contexts and identifying victims in mass disasters or cases of abuse [1,2]. For over a century, formal education in forensic odontology has been a fundamental component of undergraduate dental training [3]. However, in the Republic of Cyprus, a member state of the European Union since 2004, there has been a notable absence of formal education for dentists until the inception of the School of Dentistry at the European University Cyprus (EUC). This School, accredited by the European Union in 2017, and listed in the Internal Market Information System (IMI) of the European Commission in 2023, stands as the sole academic institution in Cyprus offering a Bachelor of Dental Surgery program. The Program is English-speaking and is offered to a diverse student population from 33 countries. Within this program, a fourth-year elective course titled “Legal and Forensic Dentistry” serves as the primary educational avenue for enhancing knowledge and awareness in this field within Cyprus.

Cyprus, the third largest island in the Mediterranean Sea, holds a strategic geographical position at the crossroads of Europe, Asia, and Africa [4]. Governed by the United Kingdom, Cyprus was formally annexed in 1914, gaining independence on 16 August 1960, as the Republic of Cyprus. The constitution of the Republic of Cyprus outlines the

establishment of two elected Communal Chambers, Greek and Turkish, with provisions for intervention by Britain, Turkey, and Greece in case of treaty violations [5].

In 1963–1964, inter-communal military conflict arose, resulting in casualties and disappearances, leading to the establishment of a United Nations Peacekeeping Force in Cyprus. However, on 15 July 1974, turmoil escalated as a military junta in Greece orchestrated a coup in Cyprus, that led to Turkey's invasion on July 20 of the same year. This invasion led to the occupation of 37% of Cyprus's territory and the displacement of around 200,000 Greek Cypriots from the northern region [6–9]. Subsequently, due to the conditions created by the Turkish invasion and various oversights, a number of individuals who lost their lives were buried without identification.

The Committee on Missing Persons in Cyprus (CMP) was established in 1981 by agreement between the Greek Cypriot and Turkish Cypriot communities, with the support of the United Nations, to ascertain the fate of those reported missing during both the 1960s and the events of 1974. Officially, 493 Turkish Cypriots and 1508 Greek Cypriots were reported missing to the CMP by both communities [10]. However, other sources claim that the number of missing Greek Cypriots is 1619, encompassing not only soldiers but also civilians [11].

The CMP comprises three members: one from the Greek Cypriot community, one from the Turkish Cypriot community, and a third member chosen by the International Committee of the Red Cross (ICRC) and appointed by the UN Secretary-General. The CMP's role does not involve investigating or assigning responsibility for the deaths of missing persons or determining the cause of their deaths. Instead, its humanitarian mandate focuses on "bringing closure to thousands of affected families through the return of the remains of their missing relatives".

The CMP engages in archaeological endeavors related to the exhumation of the remains of missing persons, conducts anthropological examinations of these remains, and has embraced a DNA-centered approach to identification since 2012, following an agreement with the International Commission on Missing Persons (ICMP) [10].

Although in 1997 an agreement was signed between the Republic of Cyprus official government and the Turkish-Cypriot side to resolve the longstanding issue of missing persons, the agreed-upon obligations for implementing this accord were not fulfilled [12]. Consequently, in 1999, the Republic of Cyprus took the initiative to launch a program of exhumation and identification of remains within the territory under its jurisdiction. Genetic examinations and analyses were undertaken by a team of geneticists from the Cyprus Institute of Neurology and Genetics, and anthropological analyses, as well as the subsequent release of identified remains to the families, were conducted at an anthropological laboratory in Nicosia, specifically established by the Republic of Cyprus for this noble purpose [13].

A recent study conducted to assess the level of awareness of forensic odontology among dental students and faculty in Cyprus concluded that while respondents displayed a commendable level of awareness, there remains a necessity for further initiatives to enhance awareness, improve record-keeping practices, and address other critical aspects essential for forensic odontology [14]. In response to this need, the EUC School of Dentistry, in collaboration with the Office of the Presidential Commissioner for missing and enclaved persons, has undertaken as from June 2023, measures to raise awareness among dental students and faculty. As part of the "Legal and Forensic Dentistry" and "External Rotations" courses, the School has implemented voluntary visits to the Committee on Missing Persons (CMP) and the Anthropological Laboratory of the Republic of Cyprus. During these visits, students, accompanied by EUC faculty, have the opportunity to observe firsthand the scientific anthropological analysis conducted by a qualified anthropologist, to establish the identity of missing persons. This is very important and increases awareness even more, through exposure to real human remains, as the EUC School of Dentistry students have been following a contemporary, non-cadaveric teaching method of Anatomy and never had contact with cadavers before this activity. These analyses follow specific Standard

Operating Procedures aimed at upholding the highest standards of scientific competence and ethical integrity throughout the process. Among others, the anthropologist explains the sexual dimorphism representing a group of morphologic characteristics that differentiate a male from a female, as there are morphological differences of the teeth between sexes, with mandibular canines showing the greatest dimensional difference with larger teeth in males than in females, and premolars, first and second molars, and maxillary incisors presenting significant differences as well. The early permanent dentitions provide the best sample for tooth size measurements because early adulthood dentition has less attrition in most individuals [15,16]. Furthermore, it is emphasized that permanent canine teeth and their inter-canine distance contribute to sex identification through the dimorphism [17].

As part of their forensic odontology training, dental students at the EUC School of Dentistry participate in anthropological analysis sessions to understand how biological profiles of unidentified individuals are established. This experience is important for students, as it allows them to appreciate the significance of skeletal and dental traits in human identification—skills that are increasingly relevant in forensic science.

The anthropological analysis conducted aims to establish a biological profile of the individual, encompassing factors such as sex, height, age at death, and any distinctive characteristics that could aid in identification, referring to unique physical traits of an individual's skeleton, including the teeth, that can provide important clues. These traits can generally be categorized into two main groups: 1. Pathological changes are alterations to the skeleton or teeth that occur due to disease, injury, or other health-related conditions. Examples include arthritis or joint damage that can be visible in the bones as changes in the joint surfaces, healed fractures or bone trauma indicating previous injuries, infections which can leave marks on bones, such as periostitis, dental diseases like cavities, tooth loss, abscesses, or other conditions affecting the teeth and jaw. 2. Congenital Abnormalities that are structural deviations present from birth. Some examples include cranial deformities like craniosynostosis that affects the skull shape, skeletal dysplasia such as achondroplasia which results in shorter limb bones and other changes, dental anomalies like supernumerary teeth, malformations in tooth structure, or misalignment of the teeth and jaw. These distinctive characteristics, whether pathological or congenital, play a significant role in anthropological analysis by providing evidence about the individual's life history, health, and potential identity. For example, unique dental patterns or congenital skeletal deformities can help investigators compare the remains to medical or dental records, aiding in identification [16,18].

Dental age estimation also plays a crucial role in forensic investigations, particularly when establishing the identity of unknown individuals, determining the age of living persons in legal or immigration cases, or identifying human remains in mass disasters. Dental age estimation is based on the development and maturation of teeth, which follows a relatively predictable pattern, making it a reliable indicator of age in both children and young adults. While there are challenges due to variability in tooth development and population differences, advancements in technology and interdisciplinary collaboration with fields like anthropology have enhanced the accuracy and applicability of dental age estimation in forensic contexts [19].

Furthermore, this analysis determines the provenance of the exhumed remains and verifies whether they belong to a single individual, two individuals, or multiple individuals. In cases of mass graves, the recovery, identification, and re-association of commingled remains are critically important processes governed by internationally recognized guidelines and protocols. These efforts aim to return as complete sets of remains as possible to the victims' families, adhering to both humanitarian principles and forensic standards. Efforts to re-associate commingled remains in mass grave investigations are aligned with several international frameworks and guidelines, including the International Committee of the Red Cross (ICRC) Guidelines on Missing Persons (2003) and the Minnesota Protocol on the Investigation of Potentially Unlawful Death (2016, updated 2017) [20]. These principles emphasize the need for thorough investigations, proper handling of remains, and the pro-

vision of information to families. They also encourage international cooperation in forensic efforts. They outline the ethical responsibility to restore the identity of the deceased and return their remains to their families with dignity. The guidelines stress a multidisciplinary approach combining forensic anthropology, archaeology, and genetics to achieve this. They also lay out specific guidelines for investigating mass graves, from recovery through the identification process, including steps to avoid contamination and ensure the re-association of commingled remains [20–22].

The anthropological process of identifying missing persons can be an invaluable teaching method in legal and forensic dentistry, as it fosters an interdisciplinary understanding of forensic casework and enhances skills relevant to both fields. Integrating anthropological techniques with dental identification methods provides dental students with a comprehensive appreciation of the complexity involved in forensic identification, particularly in challenging cases such as mass disasters or commingled remains. Forensic anthropologists focus on the examination of skeletal remains to determine characteristics such as age, sex, ancestry, stature, and trauma, information essential for narrowing down potential identities and guiding the forensic dental analysis. Forensic dentists then analyze dental records and restorations to match ante-mortem dental data with post-mortem findings, leveraging the resilience of dental structures even in decomposed or burned bodies. This interdisciplinary approach shows dental students how anthropological and dental data align, strengthening the overall identification process [23].

Mass grave excavations are carried out following archaeological methods to preserve the context and spatial relationships between remains, which are crucial for re-association. Students learn how anthropologists adhere to international forensic standards and guidelines such as those from the ICRC, while re-associating bones based on factors like size, age, and biological profile, using advanced DNA techniques, including Short Tandem Repeat (STR) analysis and mitochondrial DNA (mtDNA) sequencing. International standards and forensic practice underscore the importance of providing families with the most complete remains possible, a principle embedded in the right to truth and the families' right to proper mourning and burial [20–22].

Subsequent to the anthropological analysis, small bone samples are extracted and forwarded to a DNA laboratory for genetic analysis, with successful identification requiring a match at a statistical threshold of 99.95% [24]. In addition to these aspects covered, dental students are taught to consider ante-mortem, peri-mortem, or post-mortem changes on skeletal or other human tissue remains, particularly when bodies are discovered in varying stages of decomposition, such as mummification which may, for example, demonstrate a tooth loss during the skeletonization process or damage caused by inadequate recovery, transport, and storage of the skull.

Various methodologies exist for integrating legal and forensic odontology into dental program curricula [25–27]. Visits to anthropological laboratories provide hands-on experience in the field, and feedback from EUC dental students and faculty has been overwhelmingly positive. They appreciate the high level of engagement with the identification process and recognize the practical application of proper record-keeping and comparisons, particularly concerning the unique characteristics of oral hard tissue morphology. In addition, as restorative materials have resistance to extreme conditions, as future dental professionals, students understand the importance of the uniqueness of the restorative work during identification [28].

Anthropological processes provide a biological profile that can be cross-referenced with dental findings. Anthropology plays a major role in resolving cases of commingled remains, particularly in mass graves or disasters. Legal and forensic dentistry students learn the importance of context (from anthropological excavation) to avoid mismatches in dental data, especially when skeletal elements from different individuals may be mixed. Both anthropology and forensic dentistry emphasize the ethical responsibility to accurately identify individuals and inform families. Understanding the complexities of the anthropo-

logical process (in cases of mass graves) helps students appreciate the emotional and legal gravity of identification work, guiding their approach in sensitive cases [29].

Anthropologists often rely on DNA analyses for identification in cases of fragmented remains, which complements dental identification. Forensic dental students learn how to collaborate in such multidisciplinary investigations, ensuring both genetic and dental information is utilized to its fullest potential. Teaching the anthropological process encourages future forensic dentists to think beyond isolated dental evidence, considering broader forensic inputs like trauma analysis or skeletal pathology, which ensures more holistic identification reports in legal cases.

This approach profoundly impacts legal and forensic dentistry by fostering interdisciplinary collaboration, enhancing identification accuracy, and providing a deeper understanding of the broader forensic and legal context. As a teaching method, it promotes a comprehensive, evidence-based approach, preparing dental students to tackle complex cases and contribute effectively to both legal and humanitarian contexts [16,23,30].

2. Conclusions

Engaging in extracurricular activities such as visits to anthropological laboratories, particularly in contexts involving missing persons due to conflicts, is a powerful way to deepen students' awareness and empathy. Through firsthand experience with human remains, often from recent conflicts, students connect their technical skills with the real-world challenges of forensic identification. They gain insight into the complex processes of reuniting remains with families, understanding not only the scientific rigor required, but also the profound emotional and ethical significance of this work. These experiences allow students to appreciate the responsibility forensic professionals carry in supporting closure for loved ones, and they draw meaningful parallels to the role of forensic odontology in ongoing and future global conflicts.

Author Contributions: K.G., P.L. and E.G.K. contributed equally to the preparation of this manuscript. A.A. assisted in all aspects of the described educational activity. A.A. also reviewed and contributed to this manuscript. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Dineshkumar, T. Role of Forensic Odontologist in Dentistry. *Oral. Maxillofac. Pathol. J.* **2017**, *8*, 136–138.
2. Bhadauria, U.S.; Dasar, P.L.; Sandesh, N.; Mishra, P.; Godha, S. Medico-legal aspect of dental practice. *Clujul Med.* **2018**, *91*, 255–258. [[CrossRef](#)] [[PubMed](#)]
3. Acharya, A.B. Teaching forensic odontology: An opinion on its content and format. *Eur. J. Dent. Educ.* **2006**, *10*, 137–141. [[CrossRef](#)] [[PubMed](#)]
4. Pariona, A. Biggest Islands In The Mediterranean Sea By Area. *WorldAtlas*. 4 August 2017. Available online: <https://www.worldatlas.com/articles/biggest-islands-in-the-mediterranean-sea.html> (accessed on 8 May 2024).
5. Available online: <https://www.parliament.cy/en/general-information/historical-review> (accessed on 8 May 2024).
6. Available online: <https://www.visitcyprus.com/index.php/en/practical-info/about-cyprus> (accessed on 3 May 2024).
7. Johnston, B.R.; Slyomovics, S. *Waging War, Making Peace: Reparations and Human Rights*; American Anthropological Association Reparations Task Force; Routledge: London, UK, 2009; p. 211.
8. Morelli, V. *Cyprus: Reunification Proving Elusive*; DIANE Publishing: Collingdale, PA, USA, 2011; p. 10.
9. Borowiec, A. *Cyprus: A Troubled Island*; Greenwood Publishing Group: Westport, CT, USA, 2000; p. 125.
10. Available online: <https://www.icmp.int/where-we-work/europe/cyprus/#:~:text=CMP%20continues%20to%20coordinate%20efforts,and%20the%20events%20of%201974> (accessed on 8 May 2024).
11. Available online: <http://www.kypros.org/CyprusPanel/cyprus/missing.html> (accessed on 8 May 2024).

12. Available online: [https://www.pio.gov.cy/en/agreements-clerides-denktash-agreement-on-missing-persons-\(31-july-1997\).html](https://www.pio.gov.cy/en/agreements-clerides-denktash-agreement-on-missing-persons-(31-july-1997).html) (accessed on 8 May 2024).
13. Available online: https://www.presidentialcommissioner.gov.cy/anthropos/anthropos.nsf/pc09_en/pc09_en?opendocument (accessed on 8 May 2024).
14. Giannakopoulos, K.; Lambrou-Christodoulou, P.; Kaklamanos, E.G. Awareness of Forensic Odontology among Dental Students and Faculty in Cyprus: A Survey-Based Study. *Dent. J.* **2023**, *12*, 6. [[CrossRef](#)] [[PubMed](#)]
15. Herrera-Escudero, T.M.; Toro, D.A.; Parada-Sanchez, M.T. How teeth can be used to estimate sexual dimorphism? A scoping review. *Forensic Sci. Int.* **2024**, *360*, 112061. [[CrossRef](#)] [[PubMed](#)]
16. Gupta, S.; Agnihotri, A.; Chandra, A.; Gupta, O.P. Contemporary practice in forensic odontology. *J. Oral Maxillofac. Pathol.* **2014**, *18*, 244–250. [[CrossRef](#)] [[PubMed](#)]
17. Kaushal, S.; Patnaik, V.; Agnihotri, G. Mandibular canines in sex determination. *J. Anat. Soc. India* **2003**, *52*, 119–124.
18. Márquez-Grant, N.; Roberts, J. Redefining forensic anthropology in the 21st century and its role in mass fatality investigations. *Eur. J. Anat.* **2021**, *25*, 19–34.
19. Espinoza-Silva, P.V.; López-Lázaro, S.; Fonseca, G.M. Forensic odontology and dental age estimation research: A scoping review a decade after the NAS report on strengthening forensic science. *Forensic Sci. Med. Pathol.* **2023**, *19*, 224–235. [[CrossRef](#)] [[PubMed](#)]
20. *The Minnesota Protocol on the Investigation of Potentially Unlawful Death (2016)*; Office of the United Nations High Commissioner for Human Rights: New York, NY, USA; Geneva, Switzerland, 2017; ISBN 978-92-1-154220-2. eISBN: 978-92-1-060582-3.
21. Baranowska, G. The Rights of the Families of Missing Persons: Going Beyond International Humanitarian Law. *Isr. Law Rev.* **2022**, *55*, 25–49. [[CrossRef](#)]
22. Trizzino, A.; Messina, P.; Sciarra, F.M.; Zerbo, S.; Argo, A.; Scardina, G.A. Palatal Rugae as a Discriminating Factor in Determining Sex: A New Method Applicable in Forensic Odontology? *Dent. J.* **2023**, *11*, 204. [[CrossRef](#)] [[PubMed](#)]
23. Mânica, S.; Gorza, L. Forensic odontology in the 21st century—Identifying the opinions of those behind the teaching. *J. Forensic Leg. Med.* **2019**, *64*, 7–13. [[CrossRef](#)] [[PubMed](#)]
24. Available online: <https://www.cmp-cyprus.org/phase-3-anthropological-analysis/> (accessed on 8 May 2024).
25. Felipe, R.M.; da Rosa, P.R.; Ouriques, C.S.; Irfan, M.; Conceição, L.D.; Lund, R.G. Legal and Forensic Dentistry in the formation of dental students: An experience report of a multidisciplinary learning project. *Rev. Da ABENO* **2020**, *20*, 111–118. [[CrossRef](#)]
26. Stoeckel, D.C.; Merkley, P.J.; McGivney, J. Forensic dental training in the dental school curriculum. *J. Forensic Sci.* **2007**, *52*, 684–686. [[CrossRef](#)] [[PubMed](#)]
27. Hermsen, K.P.; Johnson, J.D. A model for forensic dental education in the predoctoral dental school curriculum. *J. Dent. Educ.* **2012**, *76*, 553–561. [[CrossRef](#)] [[PubMed](#)]
28. Conceição, L.D.; de Pereira, C.M.P.; Forgie, A.H.; Leite, F.R.M. Staining protocols to improve the detection of composite restorations in human identification. *Forensic Sci. Int.* **2019**, *297*, 198–203. [[CrossRef](#)] [[PubMed](#)]
29. Jayakrishnan, J.M.; Reddy, J.; Vinod Kumar, R.B. Role of forensic odontology and anthropology in the identification of human remains. *J. Oral. Maxillofac. Pathol.* **2021**, *25*, 543–547. [[CrossRef](#)] [[PubMed](#)]
30. Debnath, N.; Gupta, R.; Nongthombam, R.S.; Chandran, P. Forensic odontology. *J. Med. Soc.* **2016**, *30*, 20–23. [[CrossRef](#)]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.