



Triennial Congress of the International Organization for Forensic Odonto- Stomatology

PROCEEDINGS BOOK

IMPRESSUM

Triennial Congress of International Organization for Forensic Odonto-Stomatology (I.O.F.O.S),
September 9-11, 2026, Lisbon, Portugal

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IOFOS 2026 Meeting President Welcome Message



Dear Societies Members of the IOFOS, Dear Delegates, Dear Colleagues, and Dear Friends,

I am honored to invite you to the Triennial Meeting of the International Organization for Forensic Odonto-Stomatology (IOFOS 2026), held in Lisboa, Portugal, from September 9 to 11, 2026.

The IOFOS 2026 Triennial Meeting theme is “**Digital Workflow and Artificial Intelligence in Forensic Odontology: A Path to the Future**”. This is an excellent theme for the next IOFOS 2026 Triennial Meeting since today’s obstacles represent tomorrow’s opportunities. The meeting aims to embrace this theme by highlighting conferences emphasizing the dual nature of Digital Workflow and Artificial Intelligence in forensic odontology. We will explore how Digital Workflow and Artificial Intelligence transform Forensic Odontology practices while addressing potential ethical concerns and challenges. Thus, the scientific program will reflect this theme, allowing you to cover a broad spectrum of relevant subjects from the latest advances in forensic odontology.

One of my main goals as IOFOS President is to promote excellence in forensic odontology practice, education, and research. This meeting aims to strengthen the integration between Forensic Odontology and other forensic sciences. I am committed to fostering membership engagement and involving the young generation.

The IOFOS 2026 meeting will have a program incorporating one day of workshops and two days of conferences, oral communications, and posters. The three days of the scientific program will be complete with a social program.

With this meeting in Lisboa, we are visiting one of the oldest cities in Western Europe, rich in culture and history. I hope you will take the opportunity to explore the beautiful city of Lisboa and Portugal.

I encourage you to actively participate in the workshop, oral communications, and poster program and fully engage in the networking opportunities offered by the IOFOS 2026 meeting and the beautiful city of Lisboa.

I welcome all Forensic Odontology practitioners and all other Forensic Sciences practitioners, as well as researchers, academics, and students from scientific institutions and universities around the world, and promise that you will increase your knowledge in forensic odontology, as well as the evidence-based practices, to make more informed decisions.

I look forward to welcoming you to Lisboa sharing with you the enormous enthusiasm with which we are hosting this event and wishing to see you all very soon in Lisboa.

Welcome to Lisboa for our IOFOS 2026 triennial meeting.

Warmest regards,
Cristiana Palmela Pereira
IOFOS President



President of the Portuguese Dental Association Welcome Message



Dear members of the IOFOS, dear delegates, dear colleagues, and dear friends,

It is with great satisfaction that Lisbon welcomes you for the Triennial Meeting of the International Organization for Forensic Odonto-Stomatology (IOFOS 2026), held in the capital of Portugal, between September 9 and 11, 2026.

The chosen theme for The IOFOS 2026 Triennial Meeting, “**Digital Workflow and Artificial Intelligence in Forensic Odontology: A Path to the Future**”, could not be more timely. We live in a period

of rapid technological evolution that presents us with great challenges. More than ever, it is essential to keep up with this evolution, but also to discuss what it may entail.

The use of digital workflows and artificial intelligence has been drastically changing the practices of forensic odontology. Today, it is faster, more accurate, and operates at a much higher level of efficiency than it did in the past. This progress is justified by possibilities that, a few years ago, were unimaginable. Just think about the precision with which we can now obtain data, make comparisons, establish patterns, and reach scientifically well-founded conclusions.

However, technological disruptions are always accompanied by challenges, both of a technical kind and of an ethical nature. On one hand, technological advancements happen at a pace that requires a lot from us; on the other hand, they raise entirely new ethical questions, adding to those already inherent in the practice of such a sensitive profession as forensic odontology. In this context, this meeting is particularly relevant, and I am certain that it will be of great value to all who participate.

We feel honoured that you have chosen our country for this important event, and we are confident that you will have an excellent experience.

Miguel Pavão

President of the Portuguese Dental Association



Message from the Mayor of Lisbon Municipality for IOFOS Triennial Meeting 2026 (in Lisbon)



Dear members of IOFOS, dear delegates, dear friends,

Welcome to Lisbon!

It is an honor for us in Lisbon to host such a prestigious event as the Triennial Meeting of the International Organization for Forensic Odonto-Stomatology, which will make the city the global hub for forensic odontology from September 9 to 11, 2026. As Mayor of Lisbon, I'm glad we will be meeting in such interesting times like those we're living in. Times in which advances in artificial intelligence are making the headlines in a way that will decisively change our lives – whether it be in broad dimensions

such as the way we communicate with each other and the way we do our jobs, or in more specific tasks, such as analyzing dental X-rays or detecting oral diseases. The fact is that AI and digitalization are changing the world. That's why it is so important for IOFOS to open the debate on its effects on forensic odontology – and Lisbon is the perfect place for doing it. Not only was the city elected European Innovation Capital for 2024, but it is also a city where innovation translates into social welfare. We are, above all, a city with a distinctive social sensibility, where our citizens over 65 years old have a healthcare plan guaranteeing them free access to medical appointments.

I know you will be quite busy during the meeting, in between conferences and workshops. Nevertheless, just make sure you'll find time to discover the city. Lisbon is one of the world's oldest cities, with a history stretching back to more than two millennia. Make the best of this city by visiting the beautiful castle of São Jorge, by walking through the Belém area where you'll find the best of Portuguese maritime architecture, by feeling the cultural landscape while listening to our traditional fado shows in Alfama or Bairro Alto.

Lisbon will be waiting for you.

Warm regards,
Carlos Moedas
Mayor of Lisbon



PREFACE IOFOS 2026 PROCEEDINGS BOOK

It is with great honour and profound satisfaction that we present the Proceedings Book of the Triennial Congress of the International Organization for Forensic Odonto-Stomatology (IOFOS 2026), held in Lisbon, Portugal, from 9 to 11 September 2026.

Under the theme “Digital Workflow and Artificial Intelligence in Forensic Odontology: A Path to the Future”, this congress reflects the ongoing transformation of forensic odontology in an era increasingly shaped by digital technologies, artificial intelligence, advanced imaging systems, and multidisciplinary scientific collaboration. The scientific programme was carefully designed to address not only the technological advances currently redefining forensic odontology, but also the ethical, legal, methodological, and educational challenges arising from these innovations.

The IOFOS 2026 scientific programme brought together an outstanding international community of forensic odontologists, forensic scientists, academics, forensic experts, researchers, students, and institutional representatives from across the world. The programme included:

6 international workshops;

9 invited lectures;

34 oral presentations;

10 student oral presentations in competition;

32 e-poster presentations.

In total, the congress gathered more than 90 scientific contributions from approximately 40 countries across Europe, Asia, Oceania, North America, South America, Africa, and the Middle East, demonstrating the global dimension of forensic odontology.

The abstracts and scientific communications presented in this Proceedings Book illustrate the remarkable diversity and quality of current research and professional practice in forensic odontology. The scientific contributions address a wide spectrum of themes, including:

Forensic dental age assessment in children, adolescents, and adults;

Artificial intelligence and machine learning applications;

Digital workflows for human identification and disaster victim identification (DVI);

Multimodal imaging and radiographic analysis;

Forensic dental identification in challenging environments, including thermally altered remains and mass fatality incidents;

Bite mark analysis and digital comparison science;

Craniofacial morphometrics and sex estimation;

Forensic toxicology involving dental tissues;

Medico-legal evaluation of dental negligence and professional liability;

Forensic odontology education and training models;

Ethical, legal, and quality assurance frameworks in forensic sciences.

A particularly significant aspect of this congress is the strong integration of digital sciences and artificial intelligence into forensic odontology. Numerous presentations explored deep learning models, convolutional neural networks, automated radiographic analysis, digital comparison systems, semantic ontologies, virtual modelling, structured digital workflows, and explainable artificial intelligence approaches applied to forensic decision-making. These contributions demonstrate that forensic odontology is entering a new scientific era



in which digital technologies increasingly support evidence interpretation, standardisation, reproducibility, and judicial transparency.

The congress also highlighted the importance of maintaining scientific rigour, ethical responsibility, and evidence-based practice in the development and implementation of emerging technologies. Several lectures and communications addressed critical topics such as validation of artificial intelligence systems, methodological limitations, observer reliability, explainability, professional accountability, and international quality assurance recommendations.

Special recognition must be given to the student oral presentations and poster sessions, which showcased the scientific excellence and innovation of younger generations of researchers. The high methodological quality and originality of these contributions clearly demonstrate the promising future of forensic odontology worldwide.

The IOFOS 2026 congress further reinforced the importance of international collaboration and interdisciplinary cooperation between forensic odontology and related scientific disciplines, including forensic medicine, anthropology, radiology, computer science, engineering, statistics, and digital health technologies.

We would like to express our sincere gratitude to all authors, speakers, reviewers, session chairs, workshop instructors, scientific committee members, organising committee members, institutions, sponsors, and delegates whose dedication and scientific contributions made this congress possible.

We also acknowledge the continuous support of the International Organization for Forensic Odonto-Stomatology (IOFOS), the Portuguese Dental Association (OMD), the University of Lisbon, academic institutions, forensic institutions, and all international collaborators who contributed to the success of this meeting.

We hope that this Proceedings Book will constitute an important scientific reference for forensic odontologists, researchers, academics, students, and forensic practitioners worldwide, while also encouraging future research, innovation, international cooperation, and evidence-based forensic practice.

Lisbon, September 2026
Cristiana Palmela Pereira
President of IOFOS 2023–2026
President of the IOFOS 2026 Triennial Congress



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PROGRAMME OVERVIEW

WEDNESDAY, September 9, 2026

9:30 - 12:30

WORKSHOP 1 Practical introduction to supervised learning with Python

Rui Santos, *Polytechnic University of Leiria*

WORKSHOP 2 Forensic odontology meets digital comparison science: a 3D digital workflow approach

Diogo Caldeira, *Education Committee of Straumann*

WORKSHOP 5 Mass fatality incidents – recovery and recording of humans remains

Howard Way, *Director DVI Resilience*

14:00 - 17:00

WORKSHOP 3 Digital photography in forensic odontology

Bruno Seabra, *School of Dental Medicine University of Lisbon*

WORKSHOP 4 Image J usage for analysis and measuring lengths and areas on dental and conventional X-rays

Ivan Galić, *School of Medicine University of Split*

WORKSHOP 6 Digital DVI dental matching: hands-on interpretation and reporting with KMD

PlassData

René Pape, *Company KMD PlassData DVI System*

18:30 WELCOME RECEPTION

18:30 Cultural Tour

Portuguese Maritime Museum

20:00 Welcome Drink

Portuguese Maritime Museum, Pavilhão das Galeotas



THURSDAY, September 10, 2026

Auditorium 2

8:45-10:00 OPENING CEREMONY

10:00- 10:45 Coffee Break

10:45- 13:00 INVITED LECTURES I

Chairs: Cristiana Palmela Pereira (Portugal) and Hrvoje Brkić (Croatia)

11:00-11:18 IL1 The "Kvaal Method" from analogue radiographs to AI
Sigrid Kvaal, Norway

11:20-11:38 IL2 The evolution and current role of forensic odontology in France
Gwénola Drogou Saout, France

11:40- 11:58 IL3 From scan to stand: converting dentomaxillofacial imaging into legal evidence
Anastasia Mitsea, Greece

12:00-12:18 IL4 Started with identification on paper to end up with identification through AI? The forensic odontologist in the year 2026
Christl Verbiest, Belgium

12:20- 12:38 IL5 Preserving dental evidence in incinerated human remains: building the foundations for digital and AI-enabled forensic identification
Denice Higgins, Australia

12:40-12:58 IL6 From dental evidence to defensible conclusions: understanding the technology, controversies, limits, responsibilities, and standards in artificial intelligence
Kenneth Aschheim, USA

13:00-14:00 Lunch time

14:00 -15:40 ORAL PRESENTATIONS I

Chairs: Rebecca Gahn (Sweden) and Tore Solheim (Norway)

14:00-14:08 O1 Timeliness and pertinence of interpreting oral injuries during medicolegal autopsies: a report of two cases
Gabriel Fonseca, Chile

14:10-14:18 O2 A preliminary aesthetic-functional damage assessment scale for facial harmonization procedures in civil lawsuits: a forensic odontological proposal from Brazil
Adriana de Macedo, Brazil



14:20-14:28 **O3** AIdentifyAGE ontology: a semantic framework for standardized forensic dental age assessment integrating AI

Cristiana Palmela Pereira, Renato Marcelo, Ana Rodrigues, Rui Santos, Alexandre Francisco, Cátia Vaz, *Portugal*

14:30-14:38 **O4** The Marcinelle mine disaster 1956: cold case operation BDZ - a multidisciplinary approach for DVI

Eddy De Valck, *Belgium*

Chairs: Simen Kopperud (Norway) and Vilma Pinchi (Italy)

14:40-14:48 **O5** Age estimation based on dental characteristics observed in panoramic radiographs of Japanese population - comparison with Korean age estimation formulae

Akiko Kumagai, Maho Sato, Sang-Seob Lee, *Japan & South Korea*

14:50-14:58 **O6** Toothmark examination and comparison may not be so difficult as you believe

Tore Solheim, *Norway*

15:00-15:08 **O7** Dental identification in multiple fatalities involving severely charred bodies: forensic challenges and multi-modal approaches

Giulia Vitale, Ilenia Bianchi, Francesco Pradella, Beatrice Defraia, Martina Focardi, Vilma Pinchi, *Italy*

15:10-15:18 **O8** Restricted oral access in forensic dental identification: case management in thermally damaged and embalmed remains

Maya Awada, *United Kingdom*

15:20-15:40 **Discussion**

15:40-16:00 **Coffee break**

16:00-17:10 **ORAL PRESENTATIONS II**

Chairs: Rüdiger Lessig (Germany) and Helen M. Liversidge (United Kingdom)

16:00-16:08 **O9** The CASES framework: a systematic approach to evaluating educational technology in forensic odontology

Hemlata Pandey, Scheila Mânica, *United Kingdom*

16:10-16:18 **O10** Development and diagnostic performance of the D6V3 method for age estimation at the 14-year threshold in a Brazilian population

Pedro C. Mollo Filho, Mariana C. S. de Novaes, Camila L. Azevedo, Israel Chivarquer, Edgard M. Crosato, *Brazil*

16:20-16:28 **O11** Vulnerable individuals and dental negligence: two case studies from Croatia

Jelena Dumančić, *Croatia*



16:30-16:38 **O12** A 73-Year-old cold case: the identification of Adolf Hitler

Jean Proot, *Belgium*

16:40-16:48 **O13** When dentistry meets the courts: the rise of judicialization in Brazil

Ricardo H A Silva, *Brazil*

16:50-17:10 **Discussion**

17:15-17:30 **All together photo**

Room 2

14:00-15:40 **STUDENT ORAL PRESENTATIONS - COMPETITION**

Chairs: Svend Richter (Iceland) and Ilenia Bianchi (Italy)

14:00-14:08 **SP1** Evaluation of palatal morphology for forensic identification using 3D model comparison

Thao L. Chiam, Denice Higgins, Toby E. Hughes, Lyle J. Palmer, *Australia*

14:10-14:18 **SP2** Sexual dimorphism in fingerprints by evaluation of ridge density: systematic review and meta-analysis

Karla V. Mergulhão, Isabela S. Moreira, Paulo H. V. Pinto, Ricardo H. A. Silva, *Brazil*

14:20-14:28 **SP3** The impact of photo manipulation on forensic identification: a review of individual and professional role

Sofia Viegas, Rodrigo Azenha-Gomes, João Mendes-Abreu, Tiago Nunes, Ana Corte-Real, *Portugal*

14:30-14:38 **SP4** Cause of death analysis on Indonesian filicide cases: a review on Indonesian supreme court verdicts

Niswa I. Faisal, Indah L. Vidyahayati, Yoghi B. Prabowo, Nikolaos Angelakopoulos, Rizky M. Boedi, *Indonesia*

14:40-14:48 **SP5** Sex estimation based on maxillary sinus analysis using Cone-Beam Computed Tomography in an adult Greek population

Iason Tsangas, Nikolaos Christoloukas, Anastasia Mitsea, Christos Angelopoulos, *Greece*

14:50-14:58 **SP6** Machine learning approach to establishing legal adulthood in a Portuguese population: a retrospective study

Silvina M. Moura, Áurea Madureira-Carvalho, Álvaro F. Azevedo, Inês M. Caldas, *Portugal*

15:00-15:08 **SP7** Houston, we have a prosthesis: achieving human identification, by a single center experience

Ginevra Malta, Simona Pellerito, Giuseppe Lo Re, Manfredi Rubino, Stefania Zerbo, Antonina Argo, *Italy*



15:10-15:18 **SP8** Multi-threshold legal age classification on OPG using transfer learning CNN: support for judicial decision-making (AIdentifyAGE)

Cristiana Palmela Pereira, Valon Nushi, António Figueiras, Ana Rodrigues, Mohamed Elbawab, Arlindo Oliveira, Cátia Vaz, Rui Santos, Alexandre Francisco, Hrvoje Brkić, Andreas Schmelling, *Portugal*

15:20-15:28 **SP9** Dental age assessment from OPG using transfer learning CNN regression: a tool for judicial decision-making (AIdentifyAGE)

Cristiana Palmela Pereira, Ana Rodrigues, Valon Nushi, António Figueiras, Mohamed Elbawab, Arlindo Oliveira, Cátia Vaz, Rui Santos, Alexandre Francisco, *Portugal*

15:30-15:38 **SP10** Can the mandible predict sex? A CBCT-based forensic anthropometric study in a Greek adult population

Nikolaos Christoloukas, Anastasia Mitsea, Leda K. Kovatsi, Christos Angelopoulos, *Greece*

15:40- 16:00 **Coffee break**

16:00-17:00 **e-POSTER PRESENTATIONS I**

Chairs: Denice Higgins (Australia) and Kenneth Aschheim (USA)

16:00-16:03 **PP1** Multifactorial age estimation of third molars and clavicle to determine majority in a German population – a retrospective CT scan-based study

Isabel Fritzen, Samir Abou-Ayash, Sebastian R. Reder, Marc A. Brockmann, Katja Petrowski, Monika Bjelopavlovic, *Germany*

16:05-16:08 **PP2** AI-assisted radiographic identification of original vs. replica dental implants: comparing accuracy of human experts vs. probabilistic and deterministic AI

Mark K Bremer, Maximilian Blume, Samir Abou-Ayash, Muhammad Naseer Bajwa, Sheraz Ahmed, Jochen Hardt, Katja Petrowski, Monika Bjelopavlovic, *Germany*

16:10-16:13 **PP3** Forensic age estimation of third molars: a comparison of OPT, CBCT, and CT using the Olze method

Keywan Kianusch, Stjepana Jelonic, Barbara Fliß, Samir Abou-Ayash, Katja Petrowski, Monika Bjelopavlovic, *Germany*

16:15-16:18 **PP4** Automated 3D comparison of palatal rugae for forensic identification – a proof of concept

Monika Bjelopavlovic, Fabian Schmeisser, Christina Erbe, Samir Abou-Ayash, Andreas Dengel, Sheraz Ahmed, Katja Petrowski, *Germany*

16:20-16:23 **PP5** Reframing adult age determination in forensic odontology: from the 18-year threshold to a certainty-based 20-year biological standard (MIDAS)

Emilio Nuzzolese, Mario Torreggianti, *Italy*

16:25-16:28 **PP6** Conventional 3D registration methods are unsuitable for automatic bite mark matching in foodstuffs

Anika Kofod Petersen, Signe Klitgaard Bitsch, Line Staun Larsen, *Denmark*



16:30-16:33 **PP7** An analysis of forensic odontological identification cases
Asta Teilum, Niels Dyrgaard Jensen, Niels Lynnerup, Christina Jacobsen, *Denmark*

16:35-16:38 **PP8** Forensic odontology education in Finland
Sanna K. Johansson, Jaana H. Hurnanen, Mari J. Metsäniitty, *Finland*

16:40-16:43 **PP9** Intraoral digital scanning of the dentition: a step-by-step guideline and its relevance for human identification
Isabella K. Andersen, Niels Lynnerup, Chiara Villa, Sara T. Larsen, Asta Teilum, Niels D. Jensen, *Denmark*

16:45-16:48 **PP10** Sex estimation in a Brazilian population based on lateral telerradiographic measurements
Daniely A. Meireles, Bianca M. Domingues, Paulo H. V. Pinto, Antonio R. Castelo-Branco, Ricardo H. A. Silva, *Brazil*

16:50-16:53 **PP11** A retrospective analysis of the pink teeth phenomenon prevalence and potential associations with forensically relevant parameters
Christoph Reisinger, Miriam Ranftl, Fabian Kanz, Klara Janjic, *Austria*

16:55-16:58 **PP12** Direction of head deviation from the reference lines on postmortem panoramic radiographs
Maki Ohtani, Yuhei Matsuo, Kie Horioka, Akira Hayakawa, *Japan*

17:15-17:30 All together photo in the main entrance



FRIDAY, September 11, 2026

Auditorium 2

09:00- 09:40 INVITED LECTURES II

Chairs: Sigrid Kvaal (Norway) and Priyanka Kapoor (India)

9:00-9:18 **IL7** Dental age assessment in adult cadavers and archaeological remains
Hrvoje Brkić, Croatia

9:20-9:38 **IL8** Which dental age estimation method in children is best - evaluating the evidence
Helen M. Liversidge, UK & South Africa

9:40- 11:00 ORAL PRESENTATIONS III

9:40-9:48 **O14** The TabPFN system enhances multimodal age estimation in children: dental and bone maturation integrated through advanced machine learning
Vilma Pinchi, Ilenia Bianchi, Giorgio Oliva, Giulia Vitale, Francesco Pradella, Martina Focardi, Italy

9:50-9:58 **O15** Mapping of root-periodontium complex approach for rapid AI-supported search during orthopantomograms matching: impact during war conditions in Ukraine
Yevhen Kostenko, Myroslav Goncharuk-Khomyn, Ukraine

10:00-10:08 **O16** Forensic dentistry and medico-legal education in Italy as a cornerstone for the training of an expert in dental damage assessment
Francesco Pradella, Ilenia Bianchi, Giulia Vitale, Vilma Pinchi, Italy

10:10-10:18 **O17** Tooth modification probability analysis for dental identification in a Brazilian cohort
Rizky Merdietio Boedi, Nikolaos Angelakopoulos, Priscilla Bortolami, Juliano Bueno, Ademir Franco, Indonesia & Russia

10:20-10:28 **O18** Artificial intelligence for detection and classification of radiographic dental identifiers in panoramic radiographs
Nils Gustafsson, Lydia Thuuri, Signe Svensson, Rebecca Gahn, Sweden

10:30-10:38 **O19** AI-based adult age threshold modelling using orthopantomographs for forensic and judicial applications
Devansh Sharma, Suraiya Jabin, Mandeep Kaur, Deepa Anand, Virender Gombra, India

10:40-11:00 Discussion

11:00- 11:20 Coffee Break

11:20- 13:00 ORAL PRESENTATIONS IV

Chairs: Ricardo da Silva (Brazil) and Eddy De Valck (Belgium)



11:20-11:28 **O20** Forensic human identification using smile photographs and digital dental casts: a semi-quantitative superimposition technique combined with deep learning
Jeyaseelan Augustine, Sourendra Nath Basu, Anil K. Saini, Ruchi Sehrawat, Amit Prakash Singh, Mahesh Verma, *India*

11:30-11:38 **O21** Minor or adults? A different approach in the Nordic countries vs Europe
Svend Richter, *Iceland*

11:40-11:48 **O22** Comparative evaluation of Demirjian's Indian-specific regression formula and the London atlas for dental age estimation in North Indian children and adolescents
Aman Chowdhry, Priyanka Kapoor, Fona Rao, *India*

11:50-11:58 **O23** Occlusal tooth wear for bioarchaeological and forensic reconstruction: evidence from antique period human remains in Kosovo
Ferit Kocani, Jeta Kelmendi, *Kosovo*

Chairs: Ashith B. Acharya (India) and Gwénola Drogou Saout (France)

12:00-12:08 **O24** Use of dental restorations to determine when a deceased person may have lived
Simen E. Kopperud, Sandra E. Floberg, Dalia Shwan, Thuyen Michelle Tran, Jon E. Dahl, Sigrid I. Kvaal, *Norway*

12:10-12:18 **O25** Accuracy and confidence in human dental identification using panoramic radiographs: the role of observer experience
Rebecca Gahn, Tilde Tarberg, Ida Lörup, Nils Gustafsson, *Sweden*

12:20-12:28 **O26** From concept to code: generative AI as a tool for custom software development in forensic odontology research environment
Thiago Leite Beaini, Janaina Paiva Curi, *Brazil*

12:30-12:38 **O27** Alternative matrices for post-mortem forensic toxicology: an in vitro investigation of methadone, cocaine, and THC penetration patterns in dental tissues
Ilenia Bianchi, Emma Croce, Alexandra Dimitrova, Guido Mannaioni, Martina Focardi, Fabio Vaiano, Vilma Pinchi, *Italy*

12:40-12:48 **O28** Postgraduate specialist training in forensic odontology: the Indonesian model
Nurtami Soedarsono, Masniari Novita, Eko Prastyo, Andi NST. Meilana, Mindya Yuniastuti, *Indonesia*

12:50-13:00 **Discussion**

13:00-14:00 **Lunch time**

14:00-15:10 **ORAL PRESENTATIONS V**

Chairs: Ditor Haliti (Kosovo) and Anastasia Mitsea (Greece)



14:00-14:08 **O29** Age estimations: my experiences and some recommendations

Tore Solheim, *Norway*

14:10-14:18 **O30** AI-based comparison of intraoral scans: what factors are significant for dental identification?

Myroslav Goncharuk-Khomyn, Emilio Nuzzolese, Yevhen Kostenko, *Ukraine*

14:20-14:28 **O31** Has the advent of fully automated age estimation made conventional dental methods redundant?

Ashith B. Acharya, *India*

14:30-14:38 **O32** Structured digital forensic dentistry for identification and age estimation

Salem Altalie, *United Arab Emirates*

14:40-14:48 **O33** COST Action CA24147 (AID-AgE): artificial intelligence driven dental age estimation network – scientific rationale, objectives and strategic impact

Roberto Cameriere, *Italy*

14:50-14:58 **O34** Effect of incineration on ante-mortem to post-mortem tooth matching

Warwick J. Duncan, Annemarie Spannenberg, Kathryn Newsham-West, Stephanie Baylis, Christopher J Brooks, Angela Clark, *New Zealand*

15:00-15:10 **Discussion**

15:10- 15:30 **INVITED LECTURES III**

15:10-15:30 **IL9** Forensic and humanitarian challenges in the identification of missing persons in Kosovo

Ditor Haliti, *Kosovo*

15:40-16:00 **Coffee break**

16:00-17:15 **GENERAL ASSEMBLY**

Awards to the First Forensic Odontologists IOFOS

Sakher Alqahtani Awards IOFOS 2026

Ferdinand Strøm Award 2026

Report of the President for the period from 2023-2026

Financial report for the period from 2023-2026

JFOS editor's report for the period from 2023-2026

Presentation of the report programme of the candidate for the new President

Election of the new President of IOFOS

A message of the new President

Closing of the Congress



Room 2

14:00-15:40 e-POSTER PRESENTATIONS II

Chairs: Tore Solheim (Norway) and Hemlata Pandey (UK)

14:00-14:03 **PP13** Accuracy of sex estimation using the Saini method in cone beam CT scans of Peruvian adults

Javier R. Arias-Ureta, Ymelda W. Velezmoro-Montes, Pedro L. Tinedo-Lopez, Annushka Malpartida Caviedes, Ann R. Chanamé-Marín, *Peru*

14:05-14:08 **PP14** A 13-year review of dental disciplinary proceedings in Singapore: trends, outcomes and implications for practice

Haoyuan Iris Meng, Scheila Mânica, Hemlata Pandey, *UK*

14:10-14:13 **PP15** Assessment of majority legal age using second lower molars according to Olze's method in a Brazilian population

Flávia F. Afonso, Nathália A. Silva, Paulo C. F. Silva, Mirela C. Silva, Juliana M. Brassarola, Paulo H. V. Pinto, Ricardo H. A. Silva, *Brazil*

14:15-14:18 **PP16** Learning outcome using virtual models of human teeth in dental anatomy education

Linda Steurer, Robin Ristl, Christoph Kurzmann, Anita Holzinger, Andreas Moritz, Klara Janjic, *Austria*

14:20-14:23 **PP17** Domestic violence against minors: forensic odontology evidence in judicial cases under article 152 of the Portuguese criminal code

Beatriz Serra, Guilherme Borges, Inês Marques, Ana Rodrigues, Cristiana Palmela Pereira, *Portugal*

14:25-14:28 **PP18** Estimation of the age of a sub-adult Portuguese population: analysis of the body of the fourth cervical vertebra

Inês Marques, Rebeca Bonvini, Beatriz Serra, Ana Rodrigues, Rui Santos, Roberto Cameriere, Cristiana Palmela Pereira, *Portugal*

14:30-14:33 **PP19** Crimes against sexual self-determination of minors under 16 years of age: a retrospective study in Lisbon and Lisbon North (2021–2024) and the role of forensic odontology

Ana Rodrigues, Tatiana Major, Beatriz Serra, Inês Marques, Paulo Guerra, Cristiana Palmela Pereira, *Portugal*

14:35-14:38 **PP20** Foreign materials in the oral cavity during medicolegal autopsy with forensic odontologist participation: a 14-year case series from the Dominican Republic

Lourdes Gómez-Jiménez, Antonia P. Ibarra-Núñez, Santo Jiménez Páez, Gabriel M. Fonseca, Michael J. Shkrum, *Dominican Republic*

14:40-14:43 **PP21** AIUDF - Artificial Intelligence Unidentified Dental Form - the new approach in DVI

La Salete Alves, Helder R. Pinto, Fernando Duarte, Esi Sharon-Sagie, *Portugal*

14:45-14:48 **PP22** Multidisciplinary age assessment in Finland

Jaana H Hurnanen, Anna-Maija K Sulonen, *Finland*



14:50-14:53 **PP23** Sex-related morphological trends of palatal rugae in adolescents and their forensic identification value

Miranda Sejdiu Abazi, *Kosovo*

14:55-14:58 **PP24** Impact of restorative and prosthetic interventions on the accuracy of YOLOv5x6-based tooth detection in OPGs

Ivana Savić Pavićin, Denis Milošević, Marko Subašić, Ajla Zymber Česhko, Marin Vodanović, *Croatia*

15:00-15:03 **PP25** Age estimation using pulp/tooth volume ratio of canines on CBCT: a digital workflow approach

Belma Muhamedagić, *Bosnia and Herzegovina*

15:05-15:08 **PP26** Dental professional liability in Brazil: a preliminary analysis of 2024 court rulings using artificial intelligence

Mariana C. S. Novaes, Flavia V. G. Fugiwara, Patricia N. Kondo, Rodolfo F. H. Melani, *Brazil*

15:10-15:13 **PP27** Sex estimation from mandibular measurements: a retrospective Cone Beam Computed Tomography (CBCT) study using discriminant function analysis

Rathin Narayan, Archana Muralidharan, Arsh Kalia, Ceena Denny, *India*

15:15-15:18 **PP28** Evaluating ChatGPT-5.2 as an AI-assisted tool for dental age estimation using orthopantomograms: a comparative study with conventional forensic methods

Ariana Shoshi, Jeta Kelmendi, *Kosovo*

15:20-15:23 **PP29** Digital CBCT analysis of canine pulp/tooth volume ratio in sex estimation

Belma Muhamedagić, *Bosnia and Herzegovina*

15:25-15:28 **PP30** Craniofacial morphometric and morphological analysis of human skulls for forensic profiling and human identification: foundations for future digital workflows

Priyanka Kapoor, Aman Chowdhry, Deepika B Popli, Sanjeev Synghal, *India*

15:30-15:33 **PP31** Exploring machine learning approaches for precise dental age estimation in forensic odontology: focus on children and adolescents in Bosnia and Herzegovina

Anida Nezović, Kenan Šehić, Emina Dervišević, Aida Selmanagić, Nejra Aljukić, Aida Branković, *Bosnia and Herzegovina*

15:35-15:38 **PP32** Enhancing disaster victim identification training in Indonesia through collaboration between higher education institutions and the Indonesian National Police

Gelar S. Ramdhani, Ahmad Fauzi, Ika Rachmawati, Debby Yatma, *Indonesia*

15:40-16:00 **Coffee break**

20:45 **WELCOME DRINK**

Darwin's Café, Champalimaud Foundation Restaurant

21:15 **GALA DINNER**

Darwin's Café, Champalimaud Foundation Restaurant



PRESENTER INSTRUCTIONS

The official congress language is English.

ORAL PRESENTATIONS

- Time limit for each presentation: 8 minutes maximum, with slides.
- Your presentation will be cut off by the session chair at 8 minutes to ensure the schedule and time for other presenters.
- The discussion will take place at the end of each session. Please do not leave the room after your presentation until the end of the session.
- All oral presenters must check in at the Speaker Ready Room prior to their presentations. Any PowerPoint presenter who has not pre-submitted his/her presentation must bring it, on a USB drive to the Speaker Ready Room, at least 24 hours prior to the presentation to have it uploaded onto the server.
- Your presentation will be sent to your assigned meeting room from the Speaker Ready Room. DO NOT plan to download your presentation directly in your assigned meeting room. To avoid waiting in the Speaker Ready Room, you may wish to avoid peak times.
- The uploaded slides from the Speaker Ready Room will automatically be in the room before the session start.
- The Speaker Ready Room is not intended for designing or creating a PowerPoint but a place to double-check how things are showing. If you need to make changes to the presentation you uploaded, bring the new presentation on a flash drive to be uploaded to replace the earlier version no less than 24 hours before their scheduled presentation.
- The date and time for your presentation will be specified by the congress organizer before 15 august 2026.
- A separate notification will be sent until 15 august 2026 with upload instructions for the required presentation preview PDF. The upload your PDF presentation preview by 3 September 2026.
- Powerpoint required size is panoramic screen (16:9).

STUDENT ORAL PRESENTATIONS

- Time limit for each presentation: 8 minutes maximum, with slides, followed by 2 minutes maximum of Questions and Answers.
- Your presentation will be cut off by the session chair at 8 minutes to ensure the schedule and time for other presenters.
- All student oral presenters must check in at the Speaker Ready Room prior to their presentations. Any PowerPoint presenter who has not pre-submitted his/her presentation must bring it, on a USB drive to the Speaker Ready Room, at least 24 hours prior to the presentation to have it uploaded onto the server.
- Your presentation will be sent to your assigned meeting room from the Speaker Ready Room. DO NOT plan to download your presentation directly in your assigned



meeting room. To avoid waiting in the Speaker Ready Room, you may wish to avoid peak times.

- The uploaded slides from the Speaker Ready Room will automatically be in the room before the session start.
- The Speaker Ready Room is not intended for designing or creating a PowerPoint but a place to double-check how things are showing. If you need to make changes to the presentation you uploaded, bring the new presentation on a flash drive to be uploaded to replace the earlier version no less than 24 hours before their scheduled presentation.
- The date and time for your presentation will be specified by the congress organizer before 15 august 2026.
- A separate notification will be sent until 15 august 2026 with upload instructions for the required presentation preview PDF. The upload your PDF presentation preview by 3 September 2026.
- Powerpoint required size is panoramic screen (16:9).

The student oral communications competition at the Triennial IOFOS Congress of Forensic Odonto-Stomatology in Lisbon 2026 will be awarded with **Sakher Alqahtani Award IOFOS 2026** for the **Best Student Oral Communication**.

The Student Oral Communications are open to PhD students, postgraduate students, Master's students, and other students in the field of forensic odontology, and the submitted communication must fall within the research area of forensic odontology. The Scientific Committee appointed by IOFOS evaluates submissions based on scientific quality, methodology, results, and relevance to forensic odontology.

e-POSTER PRESENTATIONS

- Time limit for each e-poster presentation: 3 minutes maximum, with slides, followed by 2 minutes maximum of Questions and Answers.
- Your poster presentation will be cut off by the session chair at 3 minutes to ensure the schedule and time for other presenters.
- All oral poster presenters must check in at the Speaker Ready Room prior to their presentations. Any PowerPoint presenter who has not pre-submitted his/her presentation must bring it, on a USB drive to the Speaker Ready Room, at least 24 hours prior to the presentation to have it uploaded onto the server.
- Your presentation will be sent to your assigned meeting room from the Speaker Ready Room. DO NOT plan to download your presentation directly in your assigned meeting room. To avoid waiting in the Speaker Ready Room, you may wish to avoid peak times.
- The uploaded slides from the Speaker Ready Room will automatically be in the room before the session start.
- The Speaker Ready Room is not intended for designing or creating a PowerPoint but a place to double-check how things are showing. If you need to make changes to the presentation you uploaded, bring the new presentation on a flash drive to be uploaded to replace the earlier version no less than 24 hours before their scheduled presentation.



- The date and time for your poster's presentation will be specified by the congress organizer before 15 august 2026.
- A separate notification will be sent until 15 august 2026 with upload instructions for the required posters presentation preview PDF and e-posters PDF (with specifically dimensions of the e-posters to be in the exposition). The upload your PDF posters presentation and PDF e-posters (with specifically dimensions of the e-poster) by 3 September 2026.
- E-poster required size is A0 (84.1 cm width × 118.9 cm height) and must be prepared in vertical (portrait) orientation.

The poster presentation at the Triennial IOFOS Congress of Forensic Odonto-Stomatology in Lisbon 2026 will be awarded with **Sakher Alqahtani Award IOFOS 2026** for the **Best Poster Presentation**.

The Scientific Committee appointed by IOFOS evaluates submissions based on scientific quality, methodology, results, and relevance to forensic odontology.

CONFERENCE

- Time limit for each presentation: 18 minutes maximum, with slides.
- Your presentation will be cut off by the session chair at 18 minutes to ensure the schedule and time for other presenters.
- All oral presenters must check in at the Speaker Ready Room prior to their presentations. Any PowerPoint presenter who has not pre-submitted his/her presentation must bring it, on a USB drive to the Speaker Ready Room, at least 24 hours prior to the presentation to have it uploaded onto the server.
- Your presentation will be sent to your assigned meeting room from the Speaker Ready Room. DO NOT plan to download your presentation directly in your assigned meeting room. To avoid waiting in the Speaker Ready Room, you may wish to avoid peak times.
- The uploaded slides from the Speaker Ready Room will automatically be in the room before the session start.
- The Speaker Ready Room is not intended for designing or creating a PowerPoint but a place to double-check how things are showing. If you need to make changes to the presentation you uploaded, bring the new presentation on a flash drive to be uploaded to replace the earlier version no less than 24 hours before their scheduled presentation.
- The date and time for your presentation will be specified by the congress organizer before 15 august 2026.
- A separate notification will be sent until 15 august 2026 with upload instructions for the required presentation preview PDF. The upload your PDF presentation preview by 3 September 2026.
- Powerpoint required size is panoramic screen (16:9).



AWARDS CEREMONY

Sakher Alqahtani Award IOFOS 2026

The winners of the **Student Oral Communication** and **Poster Communication** categories will be presented with their awards during the awarding ceremony held in memory of Dr. Sakher Alqahtani, which will take place on the final day of the conference, along with the closing session.

Ferdinand Strøm Award 2026

This year, the Ferdinand Strøm Award will be reinstated after having been discontinued for several years, thereby restoring an important tradition in recognition of excellence in forensic odontology. The Ferdinand Strøm Award was instituted by the IOFOS general assembly in 2001. It is named after a Norwegian dentist, Ferdinand Strøm (1904-1990), who was one of the international pioneers in forensic odontology. The family has kindly given their permission to IOFOS to name the scientific prize after him. The purpose of this award is to encourage young people to carry out research in forensic odontology. The applicant must be a registered dentist in his/her own country and younger than 40 years and the scientific work shall be within the field of forensic odontology. The Scientific Committee appointed by IOFOS evaluates submissions based on scientific quality, methodology, results, and relevance to forensic odontology. The winner will receive the award during the ceremony held in memory of Dr. Sakher Alqahtani, taking place on the final day of the conference in conjunction with the closing session.

Awards Selection Committee

- Professor Dr. Cristiana Palmela Pereira
- Professor Dr. Hrvoje Brkić
- Professor Dr. Vilma Pinchi



WORKSHOPS

WORKSHOP 1 Practical introduction to supervised learning with Python

Rui Santos^{*1,2}



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Rui Santos's ORCID iD is <https://orcid.org/0000-0002-7371-363X>

Keywords: Classification; Data Science; Python; Regression; Supervised Machine Learning.

Objective: This workshop focuses on the practical application of introductory supervised learning models using Python, a powerful and widely adopted language in data science and machine learning. Participants will learn how to build, interpret, and evaluate predictive models in a hands-on environment.

Discussion: Attendees will begin by exploring essential techniques for data visualization and descriptive analysis to better understand and interpret the characteristics of a dataset. Using a fictitious dataset related to dental scoring systems, participants will gain practical experience implementing basic binary classification models (e.g., predicting whether an individual is below or above a legally relevant age threshold, such as 18 years) as well as simple regression models for age estimation. The workshop will also introduce key performance metrics used to assess both classification and regression models, enabling participants to critically evaluate model accuracy, robustness, and overall suitability for decision-making.

Conclusions: This workshop is designed for beginners in machine learning or individuals looking to strengthen their foundational skills in Python for data exploration and predictive modeling. By the end of the session, participants will be equipped with the fundamental tools needed to apply elementary supervised learning techniques to real-world problems.

Conflicts of interest: The author declares no conflict of interest.

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Fundação para a Ciência e a Tecnologia I.P. (FCT), as intermediary beneficiary.
<https://doi.org/10.54499/2024.07444.IACDC>

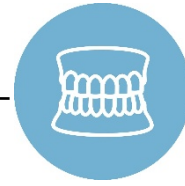
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WORKSHOP 2 Forensic odontology meets digital comparison science: a 3D digital workflow approach

Diogo Caldeira*¹



1. Field Sales Trainer at Straumann

*Corresponding Author: Diogo Caldeira, Email: diogo.caldeira@straumann.com;

Keywords: Dental Evidence; Suspected Bite mark pattern; Human Identification; Codiagnostix; Sirios; Straumann.

Introduction: The use of planning software and data capture for image acquisition and analysis is widely applied in different areas of digital dentistry. Due to their functionality and practicality nowadays, these same tools are gradually being introduced into Forensic Odontology, aiming at the production of dental technical and scientific evidence, in cases such as human identification or suspected bite mark pattern analysis.

Objective: This workshop focuses on the practical application and use of the coDiagnostiX planning program and the Sirios intraoral scanner for digital appliances in forensic contexts. Participants will learn how to use a tool commonly available in dentistry, applied to oral cavity for forensic human identification by dental evidence and suspected bite mark pattern analysis.

Discussion: The workshop will be divided into two forensic practical case experiments. In the first part, attendees will perform a comparative analysis between suspected bite mark patterns identified on a piece of cheese and dental records from three different suspects, using digital tools to support the decision-making process regarding a possible matching dental pattern. The second practical exercise will focus on the application of these digital tools in a forensic human identification case, such as in autopsy room. These activities will enable the development of practical skills in the use of technological resources applied to forensic investigations.

Conclusions: Digital solutions developed by Straumann, originally designed for clinical practice, demonstrate substantial potential for application in Forensic Odontology by enhancing the accuracy, reproducibility, and objectivity of dental analyses. The integration of digital workflows allows for improved documentation, data storage, and comparison of forensic evidence, contributing to greater transparency and scientific reliability in expert reports. Furthermore, these technologies represent a foundation for future innovations, highlighting the opportunity for Straumann to develop dedicated forensic-oriented platforms tailored to the specific needs of forensic experts.

Conflicts of interest: The author declares no conflict of interest.

Acknowledgements: Education Committee of Straumann Group.

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WORKSHOP 3 Digital photography in forensic odontology

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Keywords: Photography; Dental Photography; Dental Records; Dentistry; Oral Diagnostic Techniques; Oro-Maxilo-Facial Imagiology.

Introduction: Photography has become an indispensable tool in modern Dentistry, playing a decisive role in both clinical excellence and medico-legal documentation. Its importance continues to expand, not only due to the need for rigorous records of clinical cases, but also because of its proven value in diagnosis, communication, and treatment planning. High-quality dental photographs allow clinicians to analyse details that are not always visible in real time, facilitating more accurate evaluations and enabling more predictable interdisciplinary discussions.⁽¹⁻¹¹⁾

Objective: This workshop aims to provide participants with a comprehensive and practical understanding of dental photography, ensuring that clinicians - regardless of their prior experience- acquire the ability to confidently control their camera settings and photographic workflow in daily clinical practice. The objective is to empower participants to capture consistent, reproducible, high-quality images that support diagnosis, documentation, patient communication, and collaboration with dental laboratories and colleagues.

Discussion: Throughout the workshop, all essential equipment and accessories required for successful clinical photography will be carefully presented, including camera bodies, lenses, lighting systems, retractors, mirrors, contrastors, and auxiliary tools that optimise intra-oral and extra-oral image capture. Emphasis will be placed on understanding how each component influences the final image, enabling participants to make informed decisions when selecting and adjusting their photographic setup. A complete step-by-step protocol for clinical photography will be explored in detail. This includes ideal camera configurations, exposure settings, focusing techniques, positioning of the patient and operator, and standardised photographic sequences that guarantee uniformity across different clinical cases. Practical demonstrations will allow participants to immediately apply these concepts, ensuring that the learning process is both intuitive and aligned with real clinical scenarios.

Conclusions: By the end of the workshop, participants will have acquired a solid foundation in dental photography and will be capable of implementing standardised photographic protocols immediately in their clinical routine. They will understand how to select appropriate equipment, adjust and control their camera, and capture reliable clinical images that enhance diagnosis, treatment planning, communication, and documentation. This course aims not only to improve individual technical skills but also to promote a culture of precision, consistency, and visual communication within the dental profession, leading to better clinical outcomes and greater patient satisfaction.

Conflicts of interest: The author declares no conflict of interest.

Acknowledgements: None.



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WORKSHOP 4 ImageJ usage for analysis and measuring lengths and areas on dental and conventional X-rays



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Keywords: Age Estimation; Cameriere Method; Developing Teeth; Dental Age; ImageJ.

Objective: Determining optimal biological age remains a persistent challenge in biomedicine, while dental age assessment is a key focus of dental forensics.

Discussion: The application of simple, accessible tools to the analysis of imaging data, including radiographic images, has become a standard in dental forensics education and everyday practice.

This workshop aims to introduce participants, step by step, to the use of ImageJ for the analysis of dental images, including the measurement of projected lengths and surface areas of permanent teeth and hand bones, and the use of the resulting variables to calculate biological age using various methods.

Conclusions: Through a theoretical introduction and practical exercises, students will acquire the competencies to apply the presented methods.

Conflicts of interest: The author declares no conflict of interest.

Acknowledgements: None.

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WORKSHOP 5 Mass fatality incidents – recovery & recording of human remains



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Keywords: Disaster; Documentation; Investigation; Identification; Training.

Introduction/Background/Objective: The workshop will provide an overview of up-to-date standards, procedures & training for capabilities to deal with Mass Fatalities Management & Disaster Victim Identification.⁽¹⁻⁶⁾

Suggested minimum standards of investigation at the scene in relation to:

- Documenting, numbering and photographing human remains at the scene.
- Forensic and other evidential considerations.
- Activity by responders at the scene that can support Forensic Odontology
- Handling intelligence of identity at the scene.
- Keeping standard operating procedures for responders as simple and understandable as possible, whilst maintaining evidential integrity.

Conflicts of interest: The author declares no conflict of interests.

Acknowledgements: None.

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WORKSHOP 6 Digital DVI dental matching: hands-on interpretation and reporting with KMD PlassData

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2. KMD PlassData DVI System trainer

This workshop offers forensic odontologists practical training in the use of the KMD PlassData DVI system for Disaster Victim Identification. Participants will learn to digitize antemortem and postmortem dental records, generate and interpret automated match results, and apply expert judgment in confirming identifications. Through hands-on exercises and case-based discussion, the session will cover best practices for managing dental data, resolving uncertain matches, and reporting findings clearly and consistently in line with international DVI protocols.

Open to all experience levels, this workshop equips attendees with essential tools and skills to support victim identification in mass fatality events.

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INVITED LECTURES I

IL1 The "Kvaal Method" from analogue radiographs to AI

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Keywords: Age Assessment by Teeth; Pulp; Adult; Human.

Introduction and objective: In 1995 Kvaal et al. proposed a method to assess age in adults which is still widely used and commonly referred to as the "Kvaal method"¹. This dental method uses linear measurements of the pulp and the tooth on periapical radiographs on 6 selected single rooted teeth. The method has been tested in many countries in different parts of the world. The purpose of this presentation is to explore how the method has developed over the past 30 years from 2D to 3D radiographic methods and if applications of AI improve on the accuracy of the results.

Methods: Search was made in ResearchGate, Pubmed, Scopus, Google Scholar and Web of Science with the aim to find the number of citations in publications. Research articles using linear, area and volumetric measurements were categorised. Any results from the use of AI were explored.

Results: The article has according to ResearchGate 630 citations, Google Scholar 480 and Web of Science 353 and Scopus showed 479 citations of which 452 were categorised. Analogue and digital radiographs have been used to test the method on both periapicals and OPGs. It has also resulted in linear and area measurements on radiographs, and linear and volumetric measurements on CT and CBCT but so far not on MR. Other single rooted teeth other than those in the original "Kvaal method" have also been recommended. CT and CBCT have made it possible to expand the measurements. Calculation using neural network began in 2017 and AI has slightly improved the multiple regression analysis.

Conclusions: The "Kvaal Method" has attracted worldwide interested. It has inspired testing on independent material, use of other radiographic techniques and measurements. Different AI methods have also been explored.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

Acknowledgements: None.

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[https://doi.org/10.1016/0379-0738\(95\)01760-g](https://doi.org/10.1016/0379-0738(95)01760-g).



IL2 The evolution and current role of forensic odontology in France

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Keywords: Forensic; Identification; Odontogram; Odontology.

Introduction: Forensic odontology has gradually developed in France as an essential discipline within the medico-legal field. Its real expansion began at the end of the 19th century, particularly following major disasters such as the fire at the Bazar de la Charité, which highlighted the need for reliable methods of victim identification. Subsequently, dramatic events such as the Beaune motorway accident led to the first official requisitions of dental surgeons, marking the formal entry of odontology into the judicial and medico-legal sphere.

Background: The role of the forensic odontologist is multifaceted today. The identification of bodies is a crucial step when human remains are discovered and often represents a major challenge. The forensic odontologist is involved in individual identifications as well as in mass disasters to collect and compare Ante-Mortem and Post-Mortem data. Their expertise is also sought for the assessment of damages in cases of personal injury, age estimation — particularly for unaccompanied minors — and the analysis of bite marks. We will then discuss the role of the forensic odontologist within Medico-Legal Institutes and AM/PM teams during Disaster Victim Identification procedures, as well as the evolution of identification methods driven by the development of digital technologies and artificial intelligence. We will also present the systems established in collaboration with the National Council of the Order of Dental Surgeons to provide regulated access to dental records kept in private practices, which constitute a valuable database for identification purposes. The teaching of forensic odontology in France has gradually become more structured, incorporating university modules and specialized training programs for both students and practicing dentists. This evolution reflects dentists' growing interest in forensic science as well as the need to train professionals capable of operating in complex technical, legal, psychological and human contexts.

Conclusions: The French Association for Forensic Odontology (AFIO) plays a central role in disseminating knowledge, providing initial and continuing training, and promoting the discipline. It contributes to the institutional recognition of forensic odontology and to maintaining a high level of professional competence, which is essential in the face of the growing challenges of medico-legal identification.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

Acknowledgements: None.

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1.INTERPOL. Disaster Victim Identification Guide [Internet]. Lyon (FR): International Criminal Police Organization; 2023 [cited 2026 May 14]. Available from: <https://www.interpol.int/en/How-we-work/Forensics/Disaster-Victim-Identification-DVI>.



IL3 From scan to stand: converting dentomaxillofacial imaging into legal evidence

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Keywords: Dentomaxillofacial Imaging; Dental Radiology; Forensic Odontology.

Introduction: Dental radiographs are essential adjuncts to the clinical examination in the diagnostic process. The continuous technological development has opened up unexpected possibilities for dentomaxillofacial imaging. Therefore, it is now more practical than ever to convert dentomaxillofacial imaging into legal evidence.

Methods: The workflow that should be followed to convert dentomaxillofacial imaging into legal evidence will be highlighted by an overview of the literature and the presentation of relevant cases.

Results: Other than 2D radiographs, 3D images, and intraoral scans may serve as legal evidence. In order to transition from scan to stand, a sequence of procedures is necessary. Raw data preservation is required subsequent to image acquisition. Authenticity is guaranteed by the clarity of image processing. Then Digital analysis is mandatory. A rigorous chain of custody is necessary, followed by an expert analysis. Dentomaxillofacial imaging's credibility as legal evidence is additionally reinforced by the aforementioned procedures.

Conclusions: Dentomaxillofacial imaging may serve as legal evidence in circumstances such as identification, dental age estimation, biological profile determination, trauma, bite mark cases, and dental malpractice.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

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IL4 Started with identification on paper to end up with identification through AI? The forensic odontologist in the year 2026

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Keywords: Forensic Dentistry; Historical Evolution; Dental Identification; Artificial Intelligence.

In the field of forensic odontology, human identification using dental evidence has emerged as a critical component of criminal investigations and mass disaster responses. This abstract explores the modern methodologies employed in forensic practices, emphasizing the integration of digital workflows and artificial intelligence (AI) to enhance accuracy and efficiency in the identification process. Traditionally, forensic odontology relied heavily on manual techniques for analyzing dental records, requiring a thorough understanding of dental anatomy and experience in identifying unique dental characteristics. However, this process often faced challenges, such as time constraints, human error, and inconsistencies in record-keeping. The advent of digital technology has transformed this landscape, allowing for the systematic digitization of dental records, radiographs, and case histories. Digital workflows facilitate seamless data collection, enabling forensic odontologists to access and analyze vast databases of dental evidence more efficiently. The integration of AI into forensic odontology can further revolutionize human identification practices.

Introduction: The world of forensic dentistry is fascinating and full of surprises; This branch of science has developed over the years into an indispensable part of criminal law. The evolution of forensic dentistry shows how important it is to use teeth as evidence in lawsuits. We explore the historical development of forensic dentistry and highlights how this discipline has changed the way crimes are solved.

Dental identification: Ancient civilization (500 B.C.-1000A.D.) early forms of dental identification emerged in ancient cultures, such as the Egyptians, who used dental features to identify individuals⁽¹⁻⁴⁾ and in Chinese medicine where teeth were noted for health and identification.⁽⁵⁾

14th-17th Century: advancements in anatomy and dental studies, leading to greater understanding and documentation of individual dental characteristics.

19th Century: the formalization of dental records began in 1800s. Notable criminal cases such as that of Georges Parkman in 1849, utilized dental records for human identification, establishing dentistry as a critical part of forensic science.⁽⁶⁾

1893: G.H.E.Moore introduced the first dental charting system, allowing for consistent documentation of dental conditions and features, facilitating identification.⁽⁷⁾

The mid-20th century: bite mark analysis as a method for identification in criminal case

1980- present: digital imaging, 3D modeling and databases in the late 20th century advanced dental identification.⁽⁸⁾

21st century now dental identification is a sophisticated blend of traditional methods and modern technology.⁽⁹⁾

Artificial Intelligence: There is an emerging role of AI in analyzing dental images and records to assist in identifying patterns that might be overlooked by human analysts, improving efficiency and accuracy. These technological advancements have significantly



improved the capabilities of forensic dentistry, enhancing the accuracy, speed and reliability of dental identification processes in forensic investigations.⁽¹⁰⁾

Conclusions: In conclusion, the evolution of dental identification reflects a journey towards greater accuracy, reliance on scientific principles, and the integration of technology, all of which contribute to the credibility and effectiveness of forensic dentistry in both legal and health-related contexts.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

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IL5 Preserving dental evidence in incinerated human remains: building the foundations for digital and AI-enabled forensic identification

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Keywords: Identification; Incineration; Odontology.

Introduction/ Objective: In the aftermath of severe fire events, forensic identification is often reduced to its most resilient remaining evidence. Facial features, fingerprints, soft tissues, and frequently DNA are lost, leaving dental structures as the primary pathway to identity.⁽¹⁻⁴⁾ Past mass fatality incidents, including the 2009 Victorian bushfires and the 2017 Grenfell Tower fire, have repeatedly demonstrated the central role of dental evidence in these circumstances. Yet incineration fundamentally alters teeth and surrounding structures, rendering them extremely fragile and vulnerable to loss at precisely the point where their evidentiary value is greatest. This keynote examines preservation of dental evidence at the scene not merely as a technical necessity, but as the critical first step in a digitally driven and AI-enabled future for forensic odontology.

Methods: This presentation synthesises operational experience from disaster victim identification (DVI) deployments, experimental stabilisation testing, and published forensic literature to outline a practical framework for preserving incinerated dental structures. Scene-based stabilisation methods, including clear enamel spray, diluted wheat paste (Clag®), and gelatin solutions, are evaluated with respect to effectiveness, environmental constraints, forensic compatibility, and occupational safety. Standardised operating procedures (SOPs) for documentation, stabilisation, packaging, and transport are presented as essential mechanisms for protecting evidentiary integrity. Postmortem computed tomography (PMCT) is incorporated as a core digital workflow, enabling non-invasive capture of dental, maxillofacial, and implant data prior to physical manipulation.

Results: Consistent across materials and scenarios, stabilisation markedly improves retention of fragile dental structures compared with untreated remains. Gelatin-based stabilisation offers rapid setting and reliable support across a range of environmental conditions without compromising radiographic or CT imaging. PMCT produces high-resolution, three-dimensional digital records that preserve morphology, spatial relationships, and internal structures. These datasets are durable, shareable, and scalable, forming the evidentiary backbone required for automated comparison systems, machine learning-based pattern recognition, and future AI-assisted identification tools.

Conclusion: Effective forensic identification in incineration cases begins at the scene. Scene-based stabilisation of dental evidence is not merely a protective measure but a prerequisite for reliable digital imaging and future AI-enabled identification systems. By linking traditional forensic principles with modern digital workflows, this keynote outlines a pathway for the evolution of forensic odontology toward more robust, reproducible, and technologically integrated identification practices.



Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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IL6 From dental evidence to defensible conclusions: understanding the technology, controversies, limits, responsibilities, and standards in artificial intelligence

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Keywords: Forensic Dentistry; Artificial Intelligence; Machine Learning; Data Integrity; Technology Standards.

Introduction/Objective: Artificial intelligence (AI) and Augmented Intelligence (Aul) are increasingly used in forensic odontology to interpret and compare dental images, assist in dental age determination, and support routine review and verification. However, these tools are being adopted faster than clear standards are being developed to ensure they are dependable, secure, and properly understood. This generates doubts about the accuracy of the algorithms being relied upon, whether digital records could be unintentionally altered in ways that affect conclusions, and whether the resulting findings will withstand scrutiny in court. This lecture provides a practical, standards-based overview of these issues and discusses ways to validate AI-assisted findings, reduce security risks, and ensure conclusions can be legally defended. It also argues that AI and Aul should be viewed as tools that assist the forensic odontologist and that, under current laws and standards, responsibility for the findings remains entirely with the human expert.

Methods: The presentation looks at how AI and Aul tools are being used in forensic odontology. It starts with the basics of image recognition, focusing on the importance of training data and how its quality and composition can influence system performance, helping explain both favorable results and failures. It will continue by describing how these ideas are then carried into published standards that cover intended use, data quality, and provenance, appropriate benchmarking standards, and precise documentation of errors and limitations. The presentation will also cover another key forensic concern, cybersecurity. It will address core concerns, such as protecting images and results from alteration. It will also account for risks, including deliberate manipulation of training data (data poisoning), interference with analytical tools (model tampering), and unauthorized release of information. The presentation will conclude with an examination of legal and admissibility issues concerning the use of AI and Aul, explaining how testing, documentation, and human review affect how evidence is evaluated in court and how responsibility is divided among practitioners, agencies, and vendors.

Results: Attendees will leave with a clear understanding of the challenges in deploying AI and Aul, as well as the critical factors to consider when evaluating, using, and explaining these tools, and will become familiar with several emerging ISO and ANSI/ADA white papers, standards, and guidelines being created to tackle these issues. Finally, the presentation will provide helpful guidance on how to describe results in reports and testimony in a way that is accurate, measured, and transparent, while anticipating common questions about limitations, bias, and data quality.



Conclusions: The use of standards for AI and Aul in forensic odontology can improve support for professional judgment by enabling validated methods, secure handling of evidence, clear documentation, and clearly defined responsibilities for both vendors and business users. Understanding and integrating scientific, cybersecurity, and legal requirements when using AI and Aul is essential to protect the reliability of conclusions and retain public confidence.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The presenter serves on multiple committees, boards, advisory groups, and consultancies related to forensic odontology and artificial intelligence, in both paid and unpaid roles. The lecture content is presented objectively and is not influenced by these relationships, and no technologies, products, or organizations are included or excluded based on compensation.

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INVITED LECTURES II

IL7 Dental age assessment in adult cadavers and archaeological remains

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Keywords: Forensic Odontology; Dental Anthropology; Dental age; Artificial Intelligence.

Background: Human teeth are composed of hard tissues with a high content of the mineral calcium hydroxyapatite and remain unchanged for a long time after death. For this reason, they are used for numerous anthropological, archaeological, and forensic purposes, including the assessment of origin and the creation of a dental profile. When post-mortem documentation such as dental charts, X-rays, photographs, impressions, and models is available, it is possible to establish the identity of unknown human remains. Numerous practical examples of this process have been published in scientific journals and books.

Purpose: To present different methods and results that have been applied at the Department of Dental Anthropology, School of Dental Medicine, University of Zagreb over the past five years for the assessment of dental age in adult cadavers and archaeological remains.

Methods: The estimation of dental age is an important procedure carried out on living individuals, deceased persons, and human remains. Today, numerous scientifically validated methods are used in practice and can be divided into those applied to children, subadult populations, and adults. This presentation will demonstrate the most widely used invasive and noninvasive methods for dental age assessment in adults, including Cameriere's method, Johanson's method, Lamendin's method, and the method according to Olze and Schmeling. The possibilities of applying artificial intelligence and deep learning for the assessment of dental age, which we used, will also be presented.

Results: Research conducted on the mineralized tissues of human teeth: enamel, cementum, and dentine within the project Analysis of Teeth in Forensic and Archaeological Research, supported by the Croatian Science Foundation from 2021 to 2025, makes an important contribution to forensic and archaeological research. The results of this research will be presented to the public.

Conclusion: Scientific results obtained through the analysis of hard dental tissues and the morphology of human teeth are applicable in practical work and can be effectively used in forensic and archaeological research to estimate dental age. Integration of AI models into clinical and forensic radiology platforms with real-time decision support capabilities represents a promising translational goal.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.



Conflicts of interest: The author declares no conflict of interest.

Acknowledgements: COST Action CA24147 Artificial Intelligence Driven Dental AgeEstimation Network (AID-AgE).

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IL8 Which dental age estimation method in children is best - evaluating the evidence

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Keywords: Age Estimation; Demirjian's Method; Dental Maturity.

Background: Forensic odontologists should use methods that are accurate and reliable and that provide appropriate age variation given the dental development. The aim of this study was to examine the published methods that estimate age using developing teeth and explain which factors to assess to choose the best method.

Methods: The test sample was dental radiographs of 946 children aged 3-16 years. Dental age was calculated with Demirjian et al. 1973 (D73), 1976 (D76) and Chaillet et al. 2005. Mean difference and absolute mean difference between dental and chronological ages was calculated and results illustrated.

Results: Desirable features include a large reference sample, a uniform age distribution, a wide age range, appropriate statistical approach, and a dental age with a measure of variation. Few methods provide dental age with a measure of variation. Mean difference for D73 and D76 were similar at 0.25 and 0.23 years but Chaillet underestimated age by 0.32 years. The SD were 0.84, 0.83 and 0.88 years respectively. The absolute mean difference values were also similar at 0.70, 0.69 and 0.72 years. A single measure of performance hides considerable information and assessing these results visually shows that Chaillet overestimated younger children and underestimated older children. Chaillet is one of the few methods that provide tabulated percentiles of age given dental maturity, although D76 values were illustrated.

Conclusions: Dental age estimation methods need to provide age ranges given tooth maturity. A single measure of performance of dental age estimation from developing teeth is inadequate. Scrutiny of how methods are derived is important and 5th to 95th percentile values of age given dental maturity from D76 are recommended.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

Acknowledgements: None.

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INVITED LECTURES III

IL9 Forensic and humanitarian challenges in the identification of missing persons in Kosovo

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Keywords: Missing Persons; Kosovo; Forensic Anthropology; Misidentification.

Introduction: Twenty-seven years after the 1998–1999 war and its consequences, the issue of missing persons in Kosovo remains a major humanitarian and forensic challenge. Despite extensive efforts by international and domestic actors, including the International Criminal Tribunal for the former Yugoslavia (ICTY), United Nations Interim Administration Mission in Kosovo (UNMIK), European Union Rule of Law Mission in Kosovo (EULEX), and the International Committee of the Red Cross (ICRC), over 1,500 individuals remain unaccounted for. Early post-war identification processes relied largely on traditional methods, raising concerns regarding long-term accuracy and the need for systematic review.⁽¹⁻⁹⁾

Methods: This study draws on a comprehensive review of forensic practices and institutional mechanisms implemented in Kosovo since 1999. It includes analysis of exhumation and identification procedures conducted by ICTY (1999-2001), the introduction of DNA-based identification under UNMIK's Office on Missing Persons and Forensics (2002-2008), and subsequent casework carried out by EULEX and the Institute of Forensic Medicine (IFM). Particular emphasis is placed on the ongoing multidisciplinary review of approximately 300 unidentified (NN) human remains, incorporating anthropological re-examination, archival research, and reconciliation of forensic documentation.

Results: The findings highlight persistent structural and operational challenges. Approximately 2,000 identifications conducted using traditional methods remain susceptible to potential misidentification, particularly in cases lacking biological reference samples. The presence of around 300 unidentified remains reflects issues such as poor preservation, incomplete ante-mortem data, and limited family engagement. Furthermore, restricted access to military and police archives, declining witness reliability, and political barriers continue to impede progress. Ongoing forensic reviews and ICRC-led archival analyses have proven essential in reassessing unresolved cases and identifying discrepancies in earlier identifications.

Conclusions: Addressing the legacy of missing persons in Kosovo requires a sustained, multidisciplinary approach grounded in forensic science and international humanitarian law. A depoliticized, victim-centered framework, prioritizing the right of families to know the fate and whereabouts of their relatives is essential. Strengthening institutional cooperation, enhancing access to information, and integrating forensic processes within broader transitional justice mechanisms remain critical for achieving durable and credible resolutions.

Ethics committee and informed consent: Not applicable.



Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

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ORAL PRESENTATIONS I

O1 Timeliness and pertinence of interpreting oral injuries during medicolegal autopsies: a report of two cases

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Keywords: Forensic Odontology; Medicolegal Autopsy; Pertinent Evidence; Oral Injuries; Oral Trauma.

Aim: This report elucidates two cases highlighting the critical need for forensic odontologists to perform intraoral examinations in a timely and pertinent manner, particularly during the external examination phase of a medicolegal autopsy.⁽¹⁾

Background: The interpretation of oral injuries is a recognized focus area within forensic odontology⁽²⁾; however, it is noted that this task is not routinely conducted on the autopsy table, specifically during the external examination of a medicolegal autopsy.⁽³⁾

Case report: This study delineates two instances of intraoral autopsy examinations, resulting in markedly different outcomes. Case 1 details an intraoral examination conducted by three forensic odontologists post-medicolegal autopsy, where postmortem artifacts were erroneously identified as injuries related to the cause of death in a suspected case of child sexual abuse. Case 2 describes an intraoral examination performed by a forensic odontologist during the external examination, where a lesion indicative of an asphyxial cause of death was identified, which had not been detected by the coroner.

Discussion: It is acknowledged that forensic odontology extends beyond the identification of human remains, and in an era dominated by dental age estimation and technological advancements⁽⁴⁾, the accurate interpretation of oral injuries necessitates not only expertise but also a distinct sense of pertinence and timeliness during the medicolegal autopsy.⁽⁵⁾

Conclusions: Both cases underscore the imperative for forensic oral pathology to be recognized as a fundamental discipline in the training of qualified forensic odontologists^(5,6), and for the legal system to acknowledge the necessity of interdisciplinary procedures to ensure the quality and pertinence of the evidence collected.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

Acknowledgements: None.



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O2 A preliminary esthetic-functional damage assessment scale for facial harmonization procedures in civil lawsuits: a forensic odontological proposal from Brazil

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Keywords: Body Damage Evaluation; Civil Liability; Esthetic Damage; Facial Harmonization; Forensic Odontology.

Introduction: Facial harmonization procedures have expanded significantly in Brazil and globally, leading to a growing number of civil lawsuits involving esthetic and functional damages. However, there is still no structured and reproducible method specifically designed for the forensic assessment of facial damage in this context.

Methods: Based on previous studies on esthetic damage evaluation, personal injury assessment and facial damage assessment in forensic practice^(1,2,3), key domains relevant to facial harmonization damage were identified. These domains were organized into a structured scale, named the Esthetic-Functional Facial Damage Assessment Scale (EFFDAS), including esthetic impact, functional impairment, anatomical visibility, prognosis, need for treatment or retreatment, and psychosocial impact. Each domain is scored based on predefined criteria, allowing a systematic assessment of damage severity.

Results: The proposed scale provides a structured framework for the assessment of esthetic-functional facial damage in forensic practice. By organizing the evaluation into specific domains and objective criteria, it supports more consistent, transparent, and reproducible expert analysis, reducing subjectivity in forensic decision-making processes.

Conclusions: This preliminary esthetic-functional damage assessment scale has the potential to improve objectivity and consistency in forensic evaluations of facial damage in civil lawsuits, promoting a more structured and less subjective approach. Further studies are recommended to validate its applicability and reproducibility in different forensic contexts.

Ethics committee and informed consent: Not applicable. This work is based on a conceptual proposal and on anonymised material from expert practice.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

Acknowledgements: None.

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O3 AIdentifyAGE ontology: a semantic framework for standardized forensic dental age assessment integrating AI

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Keywords: Forensic Dental Age Assessment; Ontology; Semantic Modelling; Artificial Intelligence; SNOMED CT; ISO Terminology; Medico-Legal Reporting; Decision Support Systems; Third Molar Development; Explainable AI.

Background: Forensic dental age assessment is a goal of forensic odontology practice, supporting human identification, criminal responsibility assessment, migration management, and the protection of minors. Nevertheless, the field remains characterized by terminological heterogeneity, methodological fragmentation, and limited semantic interoperability between clinical documentation, forensic reporting, and artificial intelligence (AI) analytical environments.⁽¹⁻⁷⁾ This limitation becomes particularly critical in judicial settings, where expert conclusions must rely on pre-defined, validated, and internationally harmonized terminology to ensure proportionality, reproducibility, and legal defensibility.⁽⁸⁻¹⁰⁾ Ontological modelling provides a formal mechanism to structure domain knowledge, enabling computable representation, semantic reasoning, and regulatory alignment.⁽¹¹⁻¹³⁾ The AIdentifyAGE ontology was developed to address these needs by modelling forensic dental age assessment within an integrated semantic architecture.⁽¹⁴⁻²⁰⁾

Objectives: This study aimed to design and validate the AIdentifyAGE ontology to:

- (1) standardize terminology and conceptual definitions in forensic dental age assessment;
- (2) structure semantic relationships between biological variables, imaging modalities, and estimation methodologies;
- (3) ensure interoperability with clinical terminologies such as SNOMED CT and normative vocabularies derived from ISO dental and forensic standards;
- (4) support AI-driven analytical and decision-support systems; and



(5) strengthen medico-legal reporting through harmonized terminology applicable in judicial contexts.

Materials and Methods: Ontology engineering followed established biomedical modelling methodologies. Domain knowledge was extracted from peer-reviewed literature, international forensic guidelines, and validated dental age assessment methods, including developmental, third molar, and adult regressive approaches. Conceptual modelling incorporated imaging modalities (OPG), dental maturation markers, anatomical structures, and population variables relevant to forensic interpretation.

The ontology was encoded in OWL and implemented within the NCBO BioPortal repository to ensure accessibility and interoperability. Object properties defined semantic relationships such as assesses anatomical structure, uses imaging modality, and applicable to legal age threshold. Data properties included chronological age ranges, performance metrics, and validation parameters. Cross-mapping procedures aligned ontological entities with SNOMED CT concepts and ISO terminological standards. Logical validation was conducted through ontology reasoners and expert domain review.

Results: The AldentifyAGE ontology establishes a comprehensive semantic model integrating methodological, biological, radiological, and computational domains. It enables structured linkage between dental developmental staging systems, third molar maturity indices, and AI predictive models, including both regression outputs and legal-threshold classification approaches. Interoperability with SNOMED CT enhances clinical data harmonization, while alignment with ISO vocabularies reinforces terminological standardization in forensic documentation.

The ontology supports dataset annotation, explainable AI visualization layers, and standardized medico-legal reporting structures. Structural evaluation confirmed logical consistency, scalability, and suitability for integration into decision-support environments.

Conclusions: AldentifyAGE represents a significant advancement in the semantic standardization of forensic dental age assessment. By aligning ontological modelling with SNOMED CT and ISO terminology, it reinforces the medico-legal requirement that judicially applied concepts be pre-defined, validated, and internationally harmonized prior to expert application. This approach enhances transparency, reproducibility, and legal robustness while enabling interoperable AI deployment. Future developments will focus on regulatory alignment, dataset integration, and expansion toward fully explainable AI ecosystems in forensic age estimation.

Ethics committee and informed consent: The research has been approved by the Ethics Committee of the Faculty of Dental Medicine, University of Lisbon, under the reference CE-FMDUL202516, on March 26th, 2025.

Conflicts of interest: The authors declare no conflict of interest.

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O4 The Marcinelle mine disaster 1956: cold case operation BDZ - a multidisciplinary approach for DVI

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Keywords: Dental Age Estimation; DVI; Interpol; Multidisciplinary Approach.

Introduction: On August 8, 1956, a fire in the Bois du Cazier coal mine in Belgium caused the death of 262 miners, most of them of Italian origin. Only 14 victims could not be identified at the time. Following the evolution of DNA technology, Mr. CICORA, son of one of the unidentified victims, supported by the ASBL du Bois du Cazier, has initiated steps with the Belgian authorities to proceed with the identification of the 14 victims based on DNA. The Belgian DVI unit (Disaster Victim Identification) of the Federal Police responded favorably to this call and surrounded itself with Belgian forensic experts to proceed with an identification attempt of these 14 minors.⁽¹⁻³⁾

Methods: In October 2021, the DVI proceeded to the exhumation operations of the 14 unidentified with the support of the Civil Protection and in the presence of forensic anthropologists. The exhumation was done under archaeological techniques to preserve as much as possible the recovered remains. The post-mortem examinations (PM) were carried out according to INTERPOL DVI standards and the PM findings of the forensic experts (anthropologists, geneticists, odontologists and pathologists) were recorded in the PM INTERPOL DVI forms. Ante-Mortem (AM) data which had been recorded by the judicial authorities at the time of the disaster were provided by the Bois du Cazier and registered on the AM INTERPOL DVI forms. The matching of AM & PM data was done by all specialists (anthropologists, odontologist, DNA and isotopes) based on comparisons of the PM findings and the AM data in our possession. As odontologists we used age estimation techniques and AM-PM comparisons for identification purposes, and teeth were used as a source for DNA and isotope analysis.

Results: Unfortunately, not all the 14 victims have been identified yet

Conclusions: Further identification work will need to be done.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

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Desmyter Stijn, DNA Specialist, National Institute Criminalistics and Criminology, Ministry of Justice
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Ista Colette, Bois du Cazier, Charleroi
Forti Alain, Bois du Cazier, Charleroi
Fontaine Denis, Pompes Funèbres Fontaine, Gilly
Mayence Jean Philippe, Penal Lawyer, Charleroi.

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O5 Age estimation based on dental characteristics observed in panoramic radiographs of Japanese population - comparison with Korean age estimation formulae

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Keywords: Age Estimation; Dental Characteristic; Panoramic Radiograph; Japanese; Forensic odontology.

Objective: In both peacetime and emergencies, rapid identification of deceased individuals is essential, it is necessary to consider all effective age estimation methods to narrow down the list of potentially missing persons.^(1,2) Therefore, in addition to conventional age estimation based on dental morphology, we developed and validated a regression model for age estimation using observable dental characteristics in panoramic radiographs from the Japanese population.

Methods: Panoramic radiographs from 420 Japanese individuals (20-90 years old, 210 males and 210 females) were used for this study. Each tooth was classified into nine codes indicating the presence or absence of the tooth and the type of dental treatment (V: intact; X: missing; I: impacted; D: caries; R: residual root; T: root canal filling; F: restoration; P: full veneer crown; and L: implant). Five dental codes (X, T, F, P, and L) were evaluated for correlation with chronological age and four regression models were developed for age estimation in the Japanese population based on the evaluation of all teeth: whole dentition, maxillary and mandibular premolars and molars, maxillary premolars and molars, and mandibular premolars and molars. The accuracy of the estimated ages was compared with the application of Japanese dental code values to a previously published Korean-derived formula.

Results: Statistically significant correlations were observed between X, T, and P and chronological age, and moderate correlations were observed between F and L. Of the four regression models developed based on these results, the accuracy of age estimation for the maxillary and mandibular premolars and molars achieved a coefficient of determination of 0.58, and root mean square error of 12.77 years, comparable to that of the whole dentition model (0.55, 13.23 years). When these results were compared with the accuracy of age estimation obtained by applying observed Japanese dental code values to a previously published Korean-derived formula, the regression model for mandibular premolars and molars tended to produce larger errors in the estimated age.

Conclusions: These findings suggest the potential applicability of dental treatment codes in panoramic radiographs for forensic age estimation. However, the results showed relatively high errors, and differences between the Japanese and Korean datasets were also



observed. These differences may be attributed to variations in dental treatment practices and differences in health insurance coverage between the two countries. It is expected that such differences in dental treatment methods will be useful for personal identification in the international context.

Ethics committee and informed consent: The current research was approved by the ethics committee of the Iwate Medical University (approval no. MH2025-033). Before the start of the study, participants were given the opportunity to decline the information used in the present study via opt-out.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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O6 Toothmark examination and comparison may not be so difficult as you believe

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Keywords: Controversies; Misunderstandings; Science; Toothmarks.

Background: In the US, there is a lot of discussion and skepticism about the use of tooth marks as evidence in court of law cases. Many are of the opinion that tooth marks should be deleted from a list of acceptable evidence. A public inquiry concluded that tooth marks was not scientifically acceptable as evidence in a court case.⁽¹⁾ A more objective view on tooth mark examination and comparison has also been shown.⁽²⁾

Methods: Tooth marks will be discussed in the light of the inquisitory juridical system that most European countries are practicing as opposed to the Anglo-American adversary system.

Results: It will be shown that the term “tooth marks” is more neutral than “bite marks” as the Americans which immediately indicates how it was made. Not all toothmarks are bitemarks. It will also be shown that tooth mark examination and comparison could be important evidence the inquisitory juridical system. The Americans are mistaken in several aspects such as the potential value of tooth marks, but especially in what is the science in tooth mark examination and comparisons. The bias that the Americans are so afraid of, is worse as a result of the adversary juridical system. No prosecutor or defense attorney want an expert witness who supports the opposing part. An example will be illustrated by a Norwegian case where a well estimated American expert was called for the defense. Tooth mark examination and comparison is to establish facts on the comparable size and position the teeth and the marks have. These facts must be evaluated for how characteristic they are and that must be the basis for an evaluation for how likely it is that the teeth made the marks or if the person can be excluded. The science is not in the study of the marks as the Americans believe, but in studies of how frequent certain changes from “normal” are.

Conclusions: Basically, tooth mark cases consist of establishing certain facts and then assess how frequent these occur in the population and give a conclusion of how likely it is that the suspect's teeth may have set these marks. It should never be absolute as you cannot guarantee that not another person has set the marks. It is up to the court of law to sentence in a criminal case.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

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07 Dental identification in multiple fatalities involving severely charred bodies: forensic challenges and multi-modal approaches

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Keywords: DVI; Dental Identification; Charred Bodies; Post-mortem Radiology; Multiple Deaths.

Background and Objective: In mass fatality incidents involving fire, such as transportation disasters and structural conflagrations, dental identification remains a cornerstone of Disaster Victim Identification (DVI) protocols.⁽¹⁻²⁾ However, extreme thermal exposure presents substantial obstacles to the documentation, comparison, and interpretation of post-mortem dental evidence. This presentation examines the forensic potential and inherent limitations of odontological identification in severely charred victims through a case series.

Methods: Sixteen cases of extensively charred bodies recovered from vehicular accidents and building fires were retrospectively analyzed. Post-mortem computed tomography (PMCT) preceded autopsy in half the cases. Dental examination protocols were adapted to thermal damage constraints: restricted oral aperture and heat-induced tissue rigidity necessitated internal approaches via cervical organ removal and meticulous perioral soft tissue dissection, avoiding mandibular or maxillary resection in any case. Supplementary intraoral radiographic imaging was systematically employed. Multi-modal identification strategies integrated dental comparison, DNA analysis even from dental tissues, and radiographic cross-referencing.

Results: Complete dental identification was achieved in the majority of cases despite severe thermal alteration. In two instances, preserved molar teeth were strategically extracted for toxicological and genetic testing rather than identification purposes. Two cases exhibited catastrophic cranial fragmentation precluding dental comparison; however, one yielded positive identification through a remarkably intact implant-retained prosthesis. DNA extraction from dental structures enabled identification in two additional cases lacking ante-mortem dental records.⁽³⁾ Notably, two victims without formal odontological documentation were successfully identified by exploiting incidental dental details visible in previous medical imaging (spinal or cranial radiographs/CT scans not originally obtained for dental purposes).⁽⁴⁾



Conclusions: This case series demonstrates both the remarkable durability and critical vulnerabilities of dental structures in heavily charred remains within DVI contexts. Successful identification in extreme thermal scenarios demands integrated protocols combining thorough clinical examination, preferably utilizing minimally invasive techniques that preserve mandibular integrity, comprehensive photographic documentation, and crucially, both two-dimensional and three-dimensional radiographic imaging conducted before and throughout autopsy procedures. Even when conventional ante-mortem dental records are fragmentary or absent, systematic multi-modal assessment can provide reliable identification data, supporting DVI operations in mass casualty fire incidents.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

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O8 Restricted oral access in forensic dental identification: case management in thermally damaged and embalmed remains

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Keywords: Access; Embalming; Fire; Forensics; Identification.

Introduction: Forensic odontology is a fundamental primary method of human identification and involves the systematic comparison of postmortem dental findings with antemortem dental records. Adequate access to the oral cavity is therefore essential for the identification process. However, standard dental examination and comparative analysis may be significantly complicated in certain cases. Embalming procedures and extensive thermal exposure can alter oral and maxillofacial structures, impose technical challenges and necessitating modified clinical approaches.⁽¹⁻⁶⁾ This presentation aims to explore the management strategies and complications encountered in such situations through two representative forensic dental identification case analyses.

Methods: Two forensic dental identification cases involving restricted oral access are discussed. In the first case, the deceased was involved in a car collision followed by a fire, resulting in severe thermal damage and complete charring of facial structures. As conventional intraoral examination was not feasible, an extraoral incision approach was undertaken to expose the dentition and jaw structures for documentation and comparison. In the second case, the body had been embalmed in Thailand prior to repatriation to the United Kingdom, resulting in marked rigidity of oral tissues that prevented conventional intraoral access. Following unsuccessful manual manipulation and external relieving incisions, surgical dissection of the mandible with jaw separation was performed to facilitate comprehensive dental examination. Observations focused on procedural challenges, postmortem alterations, and adaptations required for effective dental identification in similar cases.

Results: In the thermally damaged case, severe charring and structural fragility necessitated an extraoral approach to access the dentition. Thermal exposure can be associated with enamel and dentin fractures, displacement or loss of restorations, and distortion or destruction of anatomical landmarks, all of which complicate the identification process. In the embalmed cases, the challenges arise from soft tissue alterations which requires careful management to allow documentation of dental features and antemortem–postmortem comparison.

Conclusions: Restricted oral access due to embalming and thermal damage presents significant technical and interpretative challenges in forensic dental identification. Tailored clinical and surgical approaches, including extraoral access and mandibular dissection, may be necessary to facilitate the comparative analysis of dental records. Awareness of postmortem changes, procedural limitations, and appropriate management strategies is essential to optimize accuracy and maintain the evidential value of dental identification in compromised remains.



Ethics committee and informed consent: In both cases, the coroner was contacted to request their permission to perform the surgical procedures and check whether there is any likelihood of the body being viewed by relatives. A written confirmation of their approval has been obtained.

Clinical study registration number: Not applicable.

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ORAL PRESENTATIONS II

O9 The CASES framework: a systematic approach to evaluating educational technology in forensic odontology

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Keywords: Education; Dental; Educational Technology; Forensic Dentistry; Program Evaluation; Technology Assessment; Biomedical.

Introduction: Digital transformation in forensic odontology has recently accelerated due to improved technology and the need for more accurate and efficient identification in legal cases. Yet the discipline lacks systematic criteria for evaluating which technologies genuinely enhance learning versus those implemented out of necessity, novelty appeal or marketing pressure. High-profile wrongful convictions linked to inadequate forensic training⁽¹⁾ and ongoing concerns from scientific bodies^(2,3) underscore the critical need for evidence-based educational technology evaluation in a discipline where practitioner competence directly influences justice outcomes. Existing frameworks, including the Technological Pedagogical Content Knowledge (TPACK) model⁽⁴⁾ and Kirkpatrick's evaluation hierarchy⁽⁵⁾ provide valuable general guidance but fail to address forensic-specific requirements: preservation of irreplaceable hands-on post-mortem examination skills, cognitive bias mitigation, adversarial courtroom testimony preparation, and accommodation of extreme global resource variation.

Methods: We developed the CASES framework through structured narrative review of educational technology literature, theoretical synthesis of evidence-based education principles, and forensic quality assurance standards, combined with practical insights from virtual learning implementation in postgraduate programs. The framework integrates five essential dimensions: Context Appropriateness (resource and infrastructure compatibility), Alignment with Learning Outcomes (competency mapping), Sustainability (long-term viability without external dependency), Evidence of Effectiveness (rigorous peer-reviewed validation), and Synergy with Existing Methods (complementarity with proven pedagogy). We validated the framework by applying it across diverse educational technologies in forensic dentistry spanning low-resource mobile platforms to high-resource virtual reality systems.

Results: The framework successfully discriminated between technologies meriting adoption (scores 20-25/25), those requiring modification (15-19/25), and those warranting rejection or pilot-only implementation (<15/25). Analysis revealed that technologies scored highest when demonstrating strong performance across all five dimensions rather than excelling in isolated areas. Low-cost, sustainable technologies addressing clear competency gaps often outperform expensive, sophisticated systems lacking evidence or implementation clarity. The framework effectively distinguished innovation-driven from



necessity-driven contexts, with evaluation emphasis appropriately shifting toward sustainability and context appropriateness in resource-limited settings. Critically, several widely marketed technologies scored poorly due to vendor dependency, inadequate empirical evidence, or risks of undermining essential hands-on skills, while lower-profile solutions demonstrated superior overall value.

Conclusions: The CASES framework provides forensic odontology educators with systematic, evidence-based criteria for technology evaluation, explicitly distinguishing innovation from necessity while ensuring technologies serve pedagogy rather than dictate it. By integrating context-appropriateness, learning alignment, sustainability, effectiveness evidence, and synergy with proven methods, CASES addresses critical gaps in existing evaluation frameworks and supports equitable access to effective educational tools across diverse global resource settings.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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O10 Development and diagnostic performance of the D6V3 method for age estimation at the 14-year threshold in a Brazilian population

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Keywords: Dental Age Estimation; Forensic Dentistry; Lateral Teleradiography; Panoramic Radiography.

Background: Dental age estimation methods that classify individuals as older or younger than 14 years support legal proceedings involving matters such as political asylum for undocumented minors, illegal labour practices, and consent for sexual acts when official documentation regarding the minor's age is unavailable.^(1,2) The use of multiple features for age assessment provides superior accuracy and specificity than relying on a single dental feature.⁽³⁻⁶⁾ The objective of this study was to develop a new method to classify Brazilian individuals as older or younger than 14 years, using dental and cervical radiographic features.

Methods: For the development of the 6 Dental Points and 3 Vertebrae (D6V3) method, seven predictors of age over 14 years based on previous reference studies were combined into a composite score.^(1,3-8) The dental predictors consisted of six development and eruption features from mandibular teeth: The complete apical maturation of the first and second premolars and second molars; the complete emergence of the second premolars and second molars; and the completion of the initial third of third molar root development. In addition, one cervical predictor was included, considered positive only when the C2, C3 and C4 cervical vertebrae all showed advanced maturation. Panoramic radiographs and lateral teleradiographs of 247 Brazilian individuals were assessed independently by two examiners, who assigned a value of "0" (negative) or "1" (positive) for each predictive feature. The sum of the positive values constituted the composite score used to classify individuals at the 14-year threshold.

Results: With all seven predictors included in the composite score, the method achieved an overall specificity of 90% (82.4–95.1) at a cutoff of 6. With dental predictors only, the achieved specificity was 84% (75.3–90.6) at a cutoff of 5. Intra- and inter-observer agreement exceeded 90%, except for inter-observer agreement on the cervical vertebrae maturation (74%).



Conclusions: The D6V3 method can reliably classify Brazilian individuals as older or younger than 14 years with a low false-positive rate, though cervical vertebrae assessment requires adequate calibration.

Ethics committee and informed consent: The current research was approved by an independent ethics committee, and subjects gave their informed consent before they were enrolled in the study.

Clinical study registration number: Research Ethics Committee Approval No. 6,928,858 (July 3, 2024).

Conflicts of interest: The authors declare no conflict of interest.

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O11 Vulnerable individuals and dental negligence: two case studies from Croatia

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Keywords: Dental Ethics; Vulnerable Populations; Malpractice.

Background: Vulnerable populations are categories of persons who, due to specific life and health factors, have a higher risk of developing diseases. The right to health is a basic human right protected by the Croatian Constitution. Vulnerable populations are additionally protected by international conventions, namely the Convention on the Rights of the Child and the Convention on the Rights of Persons with Disabilities, ratified in Croatia. Nevertheless, their specific needs are frequently not considered.⁽¹⁾

Methods: The present research analyses two cases of dental negligence affecting individuals from vulnerable populations.

Results: The first case is a 29-year-old male who sought treatment for a loose maxillary central incisor. The tooth was previously endodontically treated, with a 9 mm deep periodontal pocket, gingival recession, pathological mobility, and suppurative exudation. Additionally, there was compression with a palatally positioned lateral incisor. Analysis revealed traumatic occlusion, which was corrected by occlusal adjustment, and the tooth was stabilised by a fibre-reinforced composite splint. As an orthodontic anomaly was the cause of the problems, which should have been treated during childhood, discussion revealed a family history of a child abandoned at the age of 9, who spent the rest of childhood at foster homes and a children's home. Case history showed dental negligence, as the dentist who performed endodontic treatment omitted to find and eliminate the cause of pathology, so it progressed to a stage where the destiny of the tooth is questionable, treatment is complex, and quality of life is impaired.

The second case is a 45-year-old blind male, a participant in the Project for Oral Health Promotion in Blind and Visually Impaired Persons (previously published¹). Examination revealed multiple extremely deep wedge-shaped cervical defects of the teeth and gingival recessions. There was evidence of dental treatment, including fillings and crowns, but defects were left untreated. Wedge defects were caused by improper tooth brushing. This is another case of negligence, where the patient, due to blindness, could not see the problem and the doctor omitted providing oral hygiene instructions and treatment necessary to prevent further tooth abrasion and pulpitis.

Conclusions: The cases revealed a lack of preventive care and a lack of a holistic and professional approach. Dentists must be aware of their primary ethical obligation, which is to care for patients, not just treat the tooth. It is especially important to recognize vulnerable individuals and protect and promote their oral and overall health.



Ethics committee and informed consent: The Project for Oral Health Promotion in Blind and Visually Impaired Persons was approved by the Ethics Committee of the School of Dental Medicine University of Zagreb and subjects gave their informed consent.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

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O12 A 73-year-old cold case: the identification of Adolf Hitler

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Keywords: Forensic Odontology; Dental Identification; Adolf Hitler; World War II.

Introduction: From an early age on, I have been deeply interested in the history of WWII, a conflict in which Belgium (my home country) was severely involved. My fascination stems largely from my father's legacy; a pioneer in anesthesiology in Ghent. He served as a military medical student during the 18-day campaign in May 1940 and later as a military medical doctor in the British 2nd Army following the liberation of Ghent in September 1944. As a forensic odontologist, this background led to sustained interest in the identification of Adolf Hitler, who committed suicide in the Führerbunker in Berlin on April 30, 1945. Despite eyewitness testimony, persistent conspiracy theories regarding Hitler's escape emerged largely driven by the paranoid secrecy of Stalin and the Soviet Union. This presentation aims to review and critically assess the odontological evidence regarding the identification of Adolf Hitler, tracing the scientific evolution towards forensic confirmation.

Methods: A narrative historical and forensic review was conducted based on peer-reviewed scientific articles, publications and odontological records from 1945 to 2024. Particular attention was given to primary odontological comparisons, eyewitness testimonies of dental staff members and analyses of postmortem remains held in Moscow.

Results: Hitler's dental remains were clandestinely transported to Moscow and hidden for decades in the infamous Lubyanka building (KGB). This presentation explores the "rocambolesque" history of this Cold War mystery through the study of various scientific articles and published books.

In 1968, a Soviet journalist Lev Bezymensky first published photos of the extensive dental bridgework, comparing them with antemortem (AM) testimonies from Hitler's dental staff, captured by the Soviets. These initial results could not be classified as scientific evidence. In 1973, Nordic forensic dentists Dr. Reidar Sognnaes and Dr. Ferdinand Strøm conducted the first formal scientific comparison using records from Hitler's dentist, Prof. Dr. SS-Gen. Hugo Blaschke, captured by the Americans. However, it is my contention that the definitive scientific identification only occurred in 2018. Prof. Dr. Philippe Charlier was granted direct access to the remains in Moscow, performing a comprehensive analysis that positively matched the AM and PM data. This study, completed only a few years ago, finally provides the scientific closure to this historic cold case.

Conclusion: Dental identification resolved one of the most enduring historical controversies of the 20th century. The 2018 study represents the definitive forensic



confirmation of Adolf Hitler's death in 1945. This case exemplifies the value of forensic odontology.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

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O13 When dentistry meets the courts: the rise of judicialization in Brazil

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Keywords: Dentistry; Health's Judicialization; Dentists; Liability; Legal.

Background: Dentistry is regulated by moral, ethical, and legal standards that define professional rights and duties and are closely aligned with Brazilian legislation on professional liability. Depending on the dentist's conduct, civil, criminal, and administrative consequences may ensue.⁽¹⁻³⁾

Objective: To contribute to a clearer understanding of dental malpractice litigation in Brazil, this study aims to identify the dental specialties most frequently involved in civil lawsuits and to discuss the associated risks and implications for daily clinical practice, considering different levels of technical intervention and patient expectations.

Results: Evidence from published scientific studies and real cases analysed by the Forensic Odontology Division of the University of São Paulo – Ribeirão Preto School of Dentistry indicates a shift in the profile of dental malpractice claims. Earlier litigation was predominantly associated with procedures of higher technical complexity, elevated patient expectations, and greater perceived damage. In recent years, however, an increasing number of lawsuits have involved low-complexity procedures as well as “new” treatments related to facial aesthetics, and cases in which technical failures were absent, with claims often related to deficiencies in information, communication, and documentation.

Conclusions: The growing judicialization of dental practice in Brazil underscores the need for dentists to develop a deeper understanding of civil liability, legal responsibilities, and risk management strategies. Comprehensive clinical records, effective dentist–patient communication, and properly obtained informed consent are essential to promote safer professional practice and to reduce the likelihood of legal disputes.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

Acknowledgements: None.

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ORAL PRESENTATIONS III

O14 The TabPFN system enhances multimodal age estimation in children: dental and bone maturation integrated through advanced machine learning

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Keywords: Forensic Age Estimation; Machine Learning; Dental Age; Bone Age; Age Estimation Children.

Background: Accurate age estimation in living subadults remains a critical forensic challenge. Current international guidelines (AGFAD-2008, EASO-2018) mandate independent assessment of dental maturation via orthopantomography (OPG) and skeletal maturation via wrist-hand radiographs for individuals under 18 years. However, existing protocols lack validated quantitative methods that allow to integrate the estimates of dental age and bone age in one final estimation. The scarcity of paired same-day radiographies further constrains comprehensive analysis, limiting experts to subjective qualitative assessments of concordance between dental and skeletal maturation.⁽¹⁻⁵⁾

Purpose: This study addresses these gaps by developing and validating advanced machine learning models for integrated multimodal age estimation.

Methods: We analyzed a comprehensive dataset of 456 Italian subadults (230 males, 226 females; aged between 6–20 years) who underwent on the same date a simultaneous OPG and wrist-hand radiographs. Dental age was estimated using three established methods: Demirjian 7-teeth (D-7), Demirjian 8-teeth (D-8), and Willems (W). Skeletal age was determined via TW3-RUS (TW3) and Greulich & Pyle (GP) methods. Two state-of-the-art tabular regression algorithms were trained on 70% of the dataset and validated on a held-out 30% test set: the LightGBM (gradient-boosted decision trees) and the TabPFN (Prior-Data Fitted Network optimized for small-sample generalization). Models' performance was evaluated using mean absolute error (MAE) and prediction intervals at 85%, 90%, and 95% confidence levels. The models' capabilities were tested using the obtained estimates and the assigned maturity stages.

Results: TabPFN significantly outperformed LightGBM using the estimates as predictors, but particularly the maturity stages, achieving a MAE of 191.28 days (0.52 years) compared



to 206.86 days (0.56 years), and 281.05 days (0.77 years) compared to 378.14 days (1.03 years), respectively. TabPFN prediction intervals demonstrated a high accuracy with 85% of estimates fell within ± 0.88 years (324.04 days), 90% within ± 1.08 years (396.6 days), and 95% within ± 1.30 years (475.9 days). These results represent substantial improvements over our previous Boosted model (95% CI: ± 1.48 years) and significantly enhance the accuracy of traditional single-district methods.

Conclusions: This study establishes a validated quantitative framework for integrating dental and skeletal age estimation in subadults using advanced machine learning. The TabPFN model provides a reproducible tool that enhances accuracy while maintaining compliance with international best practices. Thanks to a rare dataset of paired radiographic examinations, this research demonstrates the potential of AI-driven multimodal integration for forensic age assessment, offering significant improvements in accuracy and reliability in legal contexts (unaccompanied minors, asylum seekers, accountability for criminal proceedings).

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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O15 Mapping of root-periodontium complex approach for rapid AI-supported search during orthopantomograms matching: impact during war conditions in Ukraine

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Keywords: Orthopantomography; Contour mapping; Artificial Intelligence; Comparative Identification; Forensic Dentistry.

Introduction: In Ukraine ongoing war conditions significantly increased the demand for efficient forensic dental comparison of antemortem and postmortem records. Orthopantomograms (OPGs) are among the most commonly available radiographic datasets, however, traditional manual comparison of such is time-consuming and highly operator-dependent. Radiological continuous contour of root-periodontium complex represents relatively stable, and highly individualized anatomical structure that may provide robust discriminative impact for automated matching.⁽¹⁻¹¹⁾ Objective of present research was to evaluate the feasibility and performance of an AI-based mapping approach focused on the graphically extracted root-periodontium complex for rapid orthopantomogram comparison under war-related needs in forensic dental identification.

Methods: Dataset of anonymized 168 pairs of digital orthopantomograms (each pair related to the same adult person) was collected from clinical archives of University Dental Clinic (Uzhhorod National University) and randomly allocated in reference and comparison groups. Pairs of OPGs were obtained based on different treatment and diagnostic needs with different time intervals from 2 to 39 months. Postmortem-like variability of OPGs was simulated by introducing controlled image degradation, partial cropping, and contrast alterations. Simplistic deep learning-based detection and matching model was developed (ApexDent, Kostenko-Goncharuk-Khomyn) through iterative manual annotation manner to segment and map continuous radiological contour of root-periodontal complex, including root morphology, periodontal ligament space contours, lamina dura integrity, and periapical bone patterns. Pairwise matching was performed between reference set and test set of OPGs, with performance assessed using identification accuracy, sensitivity, and processing time. Subgroup analysis evaluated the impact of image quality, tooth loss, and periodontal changes on matching reliability.

Results: AI-supported root-periodontal contour mapping approach demonstrated high identification accuracy, particularly when at least 40% of the posterior root structures were preserved (positive identification OR=1.79, 95% CI 1.45-2.19; $p < 0.05$). Root morphology and periodontal ligament space configuration showed the highest discriminative stability, even in cases with significant coronal destruction or restorative modifications. Image degradation reduced accuracy but remained within acceptable threshold providing positive



identification outcome in 89.97% of the cases through automatic iterative comparison workflow. Automated system significantly reduced search time compared to conventional expert-driven comparison ($p < 0.05$).

Conclusions: Mapping of the root-periodontium complex represents a promising strategy for rapid AI-assisted orthopantomogram matching in mass casualty and war-related contexts. Standardization of radiographic acquisition and quality criteria is essential to optimize algorithm performance and support large-scale forensic identification efforts in Ukraine.

Ethics committee and informed consent: The current research was approved by an independent ethics committee of Educational and Scientific Institute of Dentistry and Laboratory Medicine at Uzhhorod National University and subjects gave their informed consent before they were enrolled in the study.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: Not applicable. Research was provided by authors themselves.

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O16 Forensic dentistry and medico-legal education in Italy as a cornerstone for the training of an expert in dental damage assessment

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Keywords: Dental Education; Dental malpractice; Forensic Odontology; Dental damage assessment; Postgraduate Training.

Introduction: Forensic odontology (FO) plays a critical role in personal identification, dental malpractice evaluation, dental damage assessment, and expert testimony in civil and criminal proceedings. In Italy, the educational framework for forensic odontologists has historically lacked standardization and formal residency programs recognition. This presentation discloses the current educational pathways in forensic odontology in Italy, analyzes recent legislative developments, and identifies challenges and opportunities for establishing standardized training programs aligned with European qualification frameworks.⁽¹⁻³⁾

Methods: A comprehensive analysis of existing forensic odontology educational programs in Italy was conducted, including undergraduate curricula, advanced post Master's degree qualifications (EQF8)⁽³⁾, PhD courses, and non-academic training opportunities. Legislative documents, particularly the 2025 Delegation Bill on Healthcare Professions, were reviewed to assess proposed reforms.⁽⁴⁾ Data on program availability, enrollment capacity, and professional registration requirements were collected and analyzed to identify trends and gaps in current training pathways and future perspectives.

Results: At the undergraduate level, forensic odontology education is limited to modules within Legal Medicine courses, providing minimal exposure to personal identification procedures without practical training in malpractice evaluation or court expertise. Postgraduate academic education has expanded significantly with an increased enrollment. Advanced post Master's degree programs (EQF8) are particularly focused on professional liability, dental impairment assessment, and the role of expert witnesses for civil or criminal Courts, including practical training. PhD courses are usually offered in forensic sciences. In 2022, Italy established a specific category for forensic odontologists in the register of expert witnesses, requiring documented training and experience. Most significantly, the 2025 Delegation Bill on Healthcare Professions, approved by the Council of Ministers in September 2025, proposes the establishment of residency programs in forensic odontology within 24 months, marking the first formal recognition of forensic odontology as a distinct specialization in Italy.⁽⁴⁾

Conclusions: Italy is experiencing a transformative period in forensic odontology education, with legislative recognition paving the way for standardized residency programs.



The establishment of specialty training will align Italian educational pathways with European standards, enhance professional competencies, and integrate forensic odontologists into the National Health Service. Key challenges include developing adequate curricula, securing infrastructure for internships, obtaining funding for specialty grants, and ensuring approval by the Chamber of Deputies. This reform represents a historic opportunity to establish high-quality, standardized training for forensic odontology specialists in Italy.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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O17 Tooth modification probability analysis for dental identification in a Brazilian cohort

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Keywords: Forensic Dentistry; Human Identification; Odds Ratios; Radiograph.

Introduction: Forensic science has an increasing demand for empirical data to validate personal identification methods, particularly for dental pattern matching.^(1,2) Dental identification, which typically relies on comparative dental analysis through patterns created by modifications (i.e., fillings, extractions) to reach a positive identification⁽³⁻⁵⁾, presents specific challenges in younger demographics where dentition is often free of such traits. Consequently, establishing a workflow to prioritize teeth with higher variation probabilities is essential for efficiency in mass disaster scenarios. This study aims to analyze dental uniqueness probabilities in young individuals to determine which teeth provide the highest discriminatory power.

Methods: An observational analytical study was conducted using a dataset of 7219 digital panoramic radiographs aged 12-22.9 years (M = 3028, F = 4191) with a total of 202132 permanent teeth analysed⁵. Third molars were excluded from the primary analysis. Teeth were annotated by jaw (Maxillary/Mandibular), side (Left/Right), and type, and classified as either "Unrestored" (non-pathological) or "Modified" (extracted or restored). Chi-square and logistic regression analyses were performed to calculate Odds Ratios (OR) and quantify the likelihood of modification across tooth types, positions, and age.

Results: Most observed teeth were unrestored (90.79%), with only 9.21% classified as modified. Analysis of jaw and side showed no significant difference in the odds of modification. Regarding tooth type, molars were the most likely to present modifications (OR = 41.3), whereas canines were the least likely (OR = 0.007). Specifically, the first molar exhibited the highest probability of modification (OR = 58.4), followed by the second molar (OR = 26.9) and second premolar (OR = 10.5). Furthermore, each one-year increase in age raised the odds of having a modified tooth by 1.23 (95% CI 1.22 – 1.24).

Conclusions: In comparative dental analysis, the observation of molars should be prioritized regardless of quadrant due to their high modification frequency. Conversely, canines offer limited discriminatory value due to their low likelihood of modification. Future research should incorporate a larger number of dataset including individuals above 23 years old.



Ethics committee and informed consent: Ethical approval was obtained from the institutional committee of ethics in human research Faculdade São Leopoldo Mandic (protocol: 67311423.1.0000.5374).

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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O18 Artificial intelligence for detection and classification of radiographic dental identifiers in panoramic radiographs

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Keywords: Artificial Intelligence; Convolutional Neural Networks; Dental Restorations; Forensic Odontology; Panoramic Radiography.

Objective: Artificial intelligence (AI) offers potential for automated analysis of panoramic radiographs (PRs) which could be valuable in both the dental clinic as well as in the field of forensic odontology, yet validation studies using large datasets remain scarce.⁽¹⁻⁷⁾ This study aimed to develop, train, and evaluate two convolutional neural network (CNN) models for detection and classification of radiographic dental identifiers in PRs, comparing their performance with human assessors.

Methods: A total of 1,120 PRs of patients aged 18-70 years from the Malmö Offspring Dental Study were utilized. The radiographic dental identifiers were annotated into seven categories: fillings, crowns, implants, orthodontic appliances, pontics, posts, and root fillings. Two Faster R-CNN models with ResNet-50 FPN v2 backbone were trained using Adam and AdamW optimizers. Model performance was evaluated against a ground truth on 100 PRs derived from consensus of two human annotators. Intersection over Union (IoU) ≥ 0.70 and confidence threshold > 0.30 were required for predictions to be considered valid. Human evaluations were performed on the same 100 PRs and were independently annotated by two dental students and one specialist in oral radiology.

Results: Both AI models achieved mean precision, recall, and F1-scores exceeding 0.80. Model 1 attained mean precision 0.92, recall 0.83, and F1-score 0.87; Model 2 achieved precision 0.90, recall 0.85, and F1-score 0.87. Perfect detection (F1=1.0) was observed for pontics, implants, and orthodontic appliances. Posts demonstrated lowest recall (0.70) with 30% missed detections. Human assessors consistently outperformed AI models, achieving precision 0.96–0.99, recall 0.95–0.97, and F1-scores 0.96–0.98.

Conclusions: CNN-based AI models demonstrate moderate to high accuracy in detecting and classifying radiographic dental identifiers in PRs, though performance remains below both experienced and unexperienced human assessors. In forensic odontology, such AI systems could facilitate rapid evaluation of PRs in mass disaster victim identification and improve speed of transcription radiographic dental identifiers in mainly ante-mortem but also post-mortem radiographs. Further development with larger, balanced datasets may enhance clinical and forensic applicability.

Ethics committee and informed consent: This study was approved by the Swedish Ethical Review Authority (Dnr. 2012/595 and 2013/761) and conducted in accordance with the Declaration of Helsinki. All participants provided informed consent.



Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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O19 AI-based adult age threshold modelling using orthopantomographs for forensic and judicial applications

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Keywords: Orthopantomography; Forensic Dentistry; Artificial Intelligence; Deep Learning; Adult.

Objective: Dental development visible in OPG is considered one of the most reliable biological indicators for age estimation for persons.⁽¹⁻⁵⁾ This is the most legally sensitive age group in India: 17 or 18 years can change court jurisdiction, determines juvenile vs adult trial, impacts sentencing severity, etc. Therefore, OPG-based AI-assisted adult/non-adult classification constitutes a scientifically valid, ethically sound, and legally relevant tool to aid forensic age determination in India.

Methods: The evolution of deep convolutional networks; from residual learning (ResNext), through efficiency-driven scaling (EfficientNet), to modernized CNN architectures inspired by Transformers (ConvNeXt); reflects a paradigm shift from merely deeper models to computationally efficient and structurally optimized networks suitable for real-world and medical imaging applications. Efficient Net emphasizes efficiency through compound scaling, jointly optimizing network depth, width, and input resolution, resulting in exceptional accuracy; efficiency trade-offs using MBConv blocks and squeeze-and-excitation attention. We fine-tuned these variants of deep convolution networks viz. EfficientNet_b0, ResNext50_32X4d, ConvNext_base using 6860 OPG collected from Faculty of Dentistry with meta data towards computational modelling of age threshold. We followed standard practices of Train/Test splits (85:15), judging performance of all models on the same independent Test data set of size 1029 OPGs. After Train/Test split, data augmentation with random horizontal flip, random rotation, and color jitters, etc were added on the fly to the Train dataset. As only less than 20% of samples belong to non-adult class, special set of hyper-parameters such as weighted loss, OPG reliant image shape (384X768), performance-based scheduler, etc. were incorporated while training of models.

Results: An ensemble of Efficient Net_b0 outperformed all other models with F1 score of 0.890 for non-adult class, F1 score of 0.985 for adult class, and F1 macro of 0.937 on an independent Test dataset of size 1029. We deployed the proposed model on a dynamic web server publicly available at: <http://115.241.23.53:8000/> under tab "OPG Forensics" for



radiologists to upload their OPG data and get results and Grad-CAM visualization within a few seconds.

Conclusions: In many rural or socio-economically disadvantaged regions of India birth registration may be delayed or absent, school records may not be accurate, Aadhaar data may rely on self-reported age. With our highly accurate model (F1macro of 0.937), we aim to reduce the workload of forensic experts and support more efficient and objective judicial decision-making. This contribution marks an early and significant step toward AI-driven mathematical modeling of adult age threshold classification.

Ethics committee and informed consent: Ethical approval for the collection and use of Orthopantomogram (OPG) data was obtained from the Institutional Ethics Committee (IEC) of Jamia Millia Islamia University, under approval number 27/8/563/JMI/IEC/2025. Data was anonymised for the study.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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ORAL PRESENTATIONS IV

O20 Forensic human identification using smile photographs and digital dental casts: a semi-quantitative superimposition technique combined with deep learning.

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Keywords: Artificial Intelligence; Deep Learning; Dental Identification; Forensic Identification; Smile Photograph.

Background: Forensic identification of deceased individuals largely relies on fingerprints, facial recognition, DNA analysis and dental records.⁽¹⁾ Various destructive stimuli like thermal assault, chemical exposure, biological decomposition, severe trauma, or attack from carnivorous animals can hinder facial recognition, fingerprinting or DNA analysis.^(2,3) Non-clinical digital smile photographs with visible dentition obtained from social networking sites or next of kin may be a crucial tool for forensic dental identification in the absence of ante-mortem clinical dental data.⁽⁴⁻⁶⁾ The geometric shape of the teeth, missing dentition, pattern of smile lines, and various morphological developmental anomalies make the dentition unique for each individual.⁽²⁾ The primary objective of this research is to develop a deep learning-based technique for forensic dental identification using non-clinical smile photographs.

Methods: We present a novel deep learning-based method of forensic identification of humans that extracts the geometry of visible human dentition from two-dimensional digital photographs and matches with three-dimensional dental models scanned from dental casts. The proposed method was validated using a paired dataset of two hundred individuals containing smile photographs captured using a digital camera (simulated antemortem data) and 3D-digital dental casts (simulated postmortem data).

Results: Among all the unique features, we found that the smile line in a digital photograph of an individual aligned with the visible anterior dentition in 3D-digital dental casts without statistically significant inter-arch mismatch.



Conclusion: By mapping specific geometry of visible dentition, this method provides a verifiable visual overlay that significantly enhances the reliability of smile photograph as a strong biometric identifier in forensic odontology.

Ethics committee and informed consent: The current research was approved by an institutional ethics committee of Maulana Azad Institute of Dental Sciences, New Delhi (Ethical certificate no: No.F.18/81/MAIDS/Ethical Committee/ 2016/ 1382 dated 08.06.2022) and subjects gave their informed consent before they were enrolled in the study as per the form approved by the aforementioned committee.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare that they have no financial or non-financial interests that are directly or indirectly related to the work submitted for publication.

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O21 Minor or adults? A different approach in the Nordic countries vs Europe

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Keywords: Age assessment; Unaccompanied minors; Nordic countries; Europe.

Introduction: Around 1 out of 5, or 150 million children under the age of 5 worldwide are unregistered or lack a birth certificate. Unaccompanied minor migrants have many benefits, inaccessible to adults. It is evident that the age of migrants is one of the key variables that must be ascertained. Equally, it is important that juveniles are housed under safe conditions, including not with adults stating to be children.

Methods: Only official institutions data were used, as EASO (the European Asylum Support Office), which became EUAA (the European Union Agency for Asylum) in 2022. It offers practical guidance, key recommendations, and tools for the implementation of the best interests of the child. It also provides up-to-date methods used by EU+ states.

Results: In contrast to teeth, bone growth is dependent on nutrition and stimuli. Teeth and bone develop independently, consequently, it might be a good argument for using both dental and bone development in medical age estimation.

The Nordic countries use dental development to estimate the age by staging wisdom teeth from radiographs. All countries, but Norway, also estimate age based on skeletal maturity. In addition, Finland and Denmark use physical maturity criteria and Denmark sexual maturity. Various recognized scientific methods are used by the different countries.

All EU + countries, except Ireland, approve some form of medical age assessment. 21 use dental radiograph analysis and 16 dental observations. 23 countries use carpal (hand/wrist) radiographs, 14 collar bone radiographs and 2 knee MRI and 8 sexual maturity observation.

Conclusions: Accurate age estimation in unaccompanied minor migrants remains a critical yet complex issue, with significant legal, ethical, and social implications. Given the high number of undocumented children worldwide, reliable methods are essential to ensure that minors receive appropriate protection and care. The findings demonstrate that EU+ countries employ a variety of medical age assessment techniques, often combining dental and skeletal indicators to improve accuracy. Since dental and bone development are influenced by different factors and occur independently, their combined use strengthens the reliability of age estimation. However, variations in methods across countries highlight the lack of a standardized approach. This underscores the need for harmonized guidelines and continued research to ensure assessments are both scientifically sound and aligned with the best interests of the child.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.



Conflicts of interest: The authors declare no conflict of interests.

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O22 Comparative evaluation of Demirjian's Indian-specific regression formula and the London atlas for dental age estimation in North Indian children and adolescents

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Keywords: Dental Age Estimation; Dental Radiography; Forensic Dentistry; London's Atlas; Demirjian's Method.

Introduction/Objective: In scientific domains such as pediatric dentistry, forensic dentistry, and medico-legal investigations, dental age estimation (DAE) can be of great use, particularly when it comes to children and adolescents.⁽¹⁾ Due to their practicality and reliability, radiographic DAE techniques like the London Atlas of Human Tooth Development and Eruption (LAHTDE)⁽²⁾ and Demirjian's DAE method⁽³⁾, which was modified using an Indian-specific regression formula⁽⁴⁾, are frequently employed. However, there is a dearth of information comparing the accuracy of these two DAE techniques in Indian children and adolescents. To bridge this gap, this oral presentation will analyse how well these DAE techniques align with the prevalence of sexual dimorphism and chronological age (CA) in a sample of North Indians. We present here Phase One of a broader, multi-phase research initiative to improve dental age assessment techniques, which is represented by this work. In Phase 1, the LAHTDE and Demirjian's Indian-specific regression formula are compared in North Indian children and teenagers. In Phase Two of this project, a novel deep learning-assisted model for DAE using orthopantomograms (OPGs) will be developed. Its accuracy will be evaluated against the most recent web-based version of the LAHTDE and known CA.

Methods: This is a retrospective cross-sectional analytical study which used 100 digital OPG (n=100, i.e. 50 males and 50 girls) of Indian children aged 6 to 16. CA was calculated by subtracting the date of birth from the date of the radiograph. Whereas DAE was calculated using both Demirjian's Indian-specific regression formula⁽⁴⁾ and the LAHTDE method.⁽²⁾ For statistical analysis, Pearson's correlation coefficients and paired t-tests were employed, with $p < 0.05$ being considered statistically significant.

Results: Demirjian's DAE method demonstrated a close approximation to CA with a non-significant deviation from CA ($p = 0.627$). The LAHTDE, on the other hand, greatly overstated age ($p < 0.001$). Both methods demonstrated strong positive correlations with CA (Demirjian: $r = 0.601$; LAHTDE: $r = 0.788$; $p < 0.001$). Sex-wise analysis revealed greater overestimation by the LAHTDE in females, while Demirjian's method remained closely aligned with CA across both sexes. Despite its overestimation tendency, the LAHTDE exhibited superior linear correlation and reproducibility.

Conclusions: Both Demirjian's Indian-specific regression formula and the London Atlas are reliable tools for dental age estimation in Indian children and adolescents. Demirjian's



method provides mean age estimates closer to chronological age, whereas the London Atlas offers higher correlation and consistency. These findings support the complementary use of both techniques in forensic and clinical practice, with consideration of population and sex-specific variations.

Ethics committee and informed consent: The Institutional Ethics Committee approved the study (27/8/564/JMI/IEC/2025). All data were anonymised.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare that they have no conflict of interest.

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This study is respectfully dedicated to the memory of the late Dr. Sakher Jaber AlQahtani, whose *London Atlas of Human Tooth Development and Eruption* has made a lasting contribution to dental age estimation research.

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O23 Occlusal tooth wear for bioarchaeological and forensic reconstruction: evidence from antique period human remains in Kosovo

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Keywords: Bioarchaeology; Dental Wear; Forensic Odontology; Occlusal Wear; Tooth Wear Index.

Introduction/Objective: Evidence regarding dental wear patterns in ancient Balkan populations remains limited, despite their relevance for bioarchaeological and forensic reconstruction. Occlusal tooth wear is a reliable indicator of dietary consistency, masticatory function, and long-term behavioral adaptation in past populations, and represents an important parameter in forensic odontology and bioarchaeological research.⁽¹⁻¹⁵⁾ This study aimed to evaluate the prevalence, severity, and distribution patterns of occlusal tooth wear in human skeletal remains from the Antique period in Kosovo and to assess associations with demographic variables.

Methods: Twenty-one human crania comprising 498 permanent teeth recovered from the archaeological sites of Vendenis and Municipium Dardanorum DD were examined. Occlusal wear was assessed macroscopically using the Tooth Wear Index (TWI), which classifies wear into six ordinal grades (0–5). Teeth were analyzed according to age category, sex, and archaeological context. Statistical analysis employed Chi-square testing adapted for small sample sizes to evaluate associations between wear severity and demographic factors.

Results: Occlusal wear was present in 89.35% of examined teeth, while 10.65% demonstrated no visible wear (TWI 0). Moderate wear stages (TWI grades 2–3) predominated across the sample. First permanent molars showed the highest levels of wear, suggesting increased functional demand. A statistically significant age-related increase in wear severity was observed, indicating cumulative masticatory stress over time. No significant differences were detected between sexes. Severe wear stages (TWI grades 4–5), characterized by dentin exposure and occasional pulp involvement, were less frequent but confirmed prolonged functional use under abrasive conditions.

Conclusions: The high prevalence and progressive nature of occlusal wear indicate exposure to a coarse and abrasive diet and intensive mastication among Antique Dardanian populations. These findings highlight the value of dental wear analysis as a practical tool for forensic and bioarchaeological interpretation of past populations.

Ethics committee and informed consent: This research involved analysis of archaeological human skeletal remains curated in institutional collections. Ethical



approval and individual informed consent were not required due to the historical and non-identifiable nature of the material. The study followed accepted ethical standards for bioarchaeological and forensic anthropological research.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: The authors thank the relevant archaeological and institutional authorities for providing access to the skeletal material used in this study.

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O24 Use of dental restorations to determine when a deceased person may have lived

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Keywords: Dental Amalgam; Electron Scanning Microscopy; Forensic Dentistry; Human Identification.

Background: When unidentified human remains are discovered, a key objective is to establish the person's identity.⁽¹⁾ Estimating the time period during which the individual lived can help narrow the search among missing persons. Different dental restorations have been introduced and later discontinued at known times.⁽²⁾ These temporal patterns may therefore provide useful forensic indicators.

Methods: This study evaluated whether a scanning electron microscope (SEM-EDS) equipped with energy-dispersive X-ray spectroscopy⁽³⁾ can be used to characterise the chemical composition of different dental amalgam restorations, with a particular focus on distinguishing copper amalgam from conventional silver amalgam. Six amalgam products that had previously been widely used in clinical practice were selected.⁽⁴⁾ From each product, five test samples were prepared. Each sample was analysed by SEM-EDS at five separate locations, yielding a total of 25 measurements per amalgam brand. The elemental profiles obtained were compared across the different amalgam types, with special attention to diagnostically important elements such as silver, tin, copper, and other key constituents.

Results: The SEM-EDS analyses revealed clear and consistent differences in elemental composition between conventional silver amalgams and copper amalgams. Copper amalgams were characterised by very low or non-detectable levels of silver and tin, in contrast to the conventional silver amalgams, which showed substantial quantities of these elements. The observed compositional patterns were reproducible across samples from the same product and sufficiently distinct between product categories to allow reliable classification based on SEM-EDS data alone.

Conclusions: SEM-EDS proved capable of differentiating copper amalgam from conventional silver amalgam on the basis of their elemental composition. Given that specific amalgam types were used during limited time periods⁽²⁾, such distinctions may be exploited in forensic casework to provide approximate temporal information about dental treatment. Consequently, SEM-EDS has the potential to serve as a valuable adjunct in the identification of unknown human remains by contributing to the reconstruction of the individual's likely period of life and thereby helping to refine the pool of possible matches among missing persons.



Ethics committee and informed consent: The use of amalgam was approved by the Norwegian Environment Agency (ref. 2022/4155) and dispensation from the use of mercury was given for research purposes.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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O25 Accuracy and confidence in human dental identification using panoramic radiographs: the role of observer experience

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Keywords: Adult; Experience; Forensic Odontology; Identification; Panoramic Radiographs.

Background: Swift and accurate disaster victim identification (DVI) is essential. Dental comparison is one of three primary identification methods recognized by The International Criminal Police Organization (INTERPOL)⁽¹⁾, and is conducted by forensic odontologists, often by matching antemortem and postmortem intraoral radiographs. However, obtaining postmortem intraoral images can sometimes be challenging (e.g., from burn victims) and in those cases extraoral methods, especially computed tomography (CT), could be an alternative.⁽²⁾ This study uses conventional panoramic radiographs (PRs) to simulate CT-reconstructed PRs which are increasingly used in forensic scenarios, where traditional intraoral postmortem imaging is challenging. The identification accuracy varies between professions when using convention methods.⁽³⁾ This study aims to assess the accuracy in comparative dental identification by different professionals when comparing antemortem intraoral radiographs to postmortem PRs.

Methods: In this retrospective study, intraoral radiographs and PRs from 30 patients were used to simulate a closed disaster event with 25 deceased and 30 possible missing persons. Twenty-five observers from four professional groups—eight oral radiology specialists (ORs), three forensic odontologists (FOs), six dentists trained in the basics of DVI (DVI-D), and eight dental students (DS)—matched PRs, serving as simulated postmortem radiographs, to antemortem intraoral radiographs using a comparative method. Statistical analysis was performed using chi-square and Kruskal-Wallis tests.

Results: FOs and ORs achieved 100% accuracy, while DS and DVI-D had accuracy rates of 98.5% and 94.7%, respectively. Fillings were the most commonly used radiographic feature for matching. Confidence levels, ranging from “no match” to “established”, differed, with 96% of ORs and 92% of FOs selecting established matches compared with 67% of DS and 51% of DVI-D.

Conclusion: Conventional PRs can be used for accurate matching in dental identification, particularly when interpreted by experienced observers. FOs and ORs had significantly higher matching accuracy and confidence, emphasizing the critical importance of observer experience; these findings support that ORs may be an asset in DVI operations.

Ethics committee and informed consent: Ethical approval was obtained (Dnr 2023-08010-01), and the Swedish Ethical Review Authority has raised no objections to the research project. Furthermore, a review by the Västerbotten Region was conducted and



approved on March 11, 2024. Given the retrospective and anonymized nature of the study, informed consent was waived by the Swedish Ethical Review Authority.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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O26 From concept to code: generative AI as a tool for custom software development in forensic odontology research environment

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Keywords: Forensic Sciences; Human Identification; Artificial Intelligence.

Introduction: The increasing incorporation of digital methodologies into Forensic Odontology (FO) research has highlighted a gap between this expertise and formal training in programming and software development. This limitation often restricts methodological autonomy, often requiring technical expertise that represents a significant barrier for research teams. Recent advances in generative artificial intelligence (GAI), particularly large language models (LLMs), offer an opportunity to reposition software development as an accessible and pedagogically valuable activity within forensic research environments.⁽¹⁻⁵⁾

Objective: This experience report describes the use of GAI-assisted software development in a FO research group, emphasizing the creation process and the resulting research tools.

Methods: This initiative involved the supervised development of custom software solutions addressing recurring research demands, including radiographic image analysis, facial morphometrics, three-dimensional measurements, machine-learning applications, and 3D reference modeling for forensic facial approximation. The workflow was intentionally structured with initial code generation and interface prototyping, performed using an open-access LLM DeepSeek, developed by Hangzhou, with strong coding capabilities. The iterative refinement, debugging, and optimization supported by a second LLM, provided by Gemini, from Google. This sequential use of models made it possible to compare outputs, identify errors, and critically evaluate AI-generated solutions. Python was adopted as the primary programming language due to its readability and extensive scientific ecosystem. Core libraries included tools for computer vision and landmark detection, such as Mediapipe; numerical and geometric computation provided by Numpy, graphical user interface construction by Tkinter, image handling with Pillow, file system management, time stamping, and structured data storage by Pandas.

Results: From an educational perspective, rather than replacing technical learning, GAI can act as a frame that supports problem-based learning while maintaining the central role of expert analysis of FO topics. The resulting software tools were functional, reusable, and aligned with specific research objectives, while the process itself promoted autonomy, reproducibility, and interdisciplinary competence.



Conclusions: This report indicates that the coordinated integration of GAI into FO research workflows can simultaneously support software production and serve as an effective educational strategy for developing computational skills in scientific development.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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O27 Alternative matrices for post-mortem forensic toxicology: an *in vitro* investigation of methadone, cocaine, and THC penetration patterns in dental tissues

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Keywords: Forensic Toxicology; Forensic Odontology; Substances of Abuse; Dental Tissues; Alternative Matrices.

Background: Teeth serve as valuable alternative matrices in post-mortem forensic toxicology when conventional ones (blood and hair) are degraded or unavailable. Their stratified architecture offers forensic pathologists a distinctive advantage in differentiating acute from chronic substance-of-abuse exposure patterns in drug-related deaths. However, the mechanisms governing substances of abuse accumulation in dental tissues remain inadequately characterized, particularly for orally administered compounds that may penetrate through external enamel rather than via systemic circulation.⁽¹⁻³⁾ Passive contamination reaching the innermost pulp vessels⁽⁴⁾ risks misclassifying external exposure as acute intoxication, potentially leading to erroneous cause-of-death determinations. The insufficient understanding of drug-dental tissue interactions underscores the urgent need for foundational research examining chemical properties and deposition pathways.

This study establishes two *in vitro* protocols to equip forensic pathologists and toxicologists with reliable methodologies for assessing substances of abuse exposure in drug users to disclose the cause of death in drug-related cases correctly.

Methods: The study investigates three substances with distinct physicochemical properties: methadone (as oral syrup), and cocaine and THC (as smoke). Seven human teeth, extracted for clinical reasons from non-consumer living subjects, were collected and assigned to two different *in vitro* study protocols. Three teeth underwent methadone exposure via 30-minute immersion cycles in commercial syrup at simulated durations of 1, 7, and 14 days of administration. Four teeth (two sound and two decayed⁽⁵⁾) were exposed to crack (cocaine) and THC smoke for 30-45 minutes simulating an occasional intake through



typical oral inhalation. Only dental crowns were contaminated to simulate oral cavity exposure while avoiding systemic artifacts. Teeth were then pulverized to isolate enamel, dentin, and pulp, which underwent toxicological analyses by Gas Chromatography-Mass Spectrometry (GC-MS).

Results: Preliminary results demonstrated that methadone failed to penetrate any dental tissue across all detection windows up to a 14-day intake. The THC molecule remained exclusively in rinsing fluid without tissue penetration, hinting at a superficial, non-invasive contamination. The cocaine molecule exhibited structure-dependent behavior. When enamel integrity was compromised, it penetrated directly to the pulp. Conversely, intact enamel permitted cocaine contamination of enamel and dentin while excluding pulp. These differential patterns likely reflect the distinct molecular structures of each compound.

Conclusions: This study validates the feasibility of *in vitro* investigation into oral contamination mechanisms of dental tissues in drug users. The findings enhance understanding of teeth as alternative post-mortem toxicological matrices, providing forensic pathologists with more reliable interpretive tools when investigating drug-related deaths.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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O28 Postgraduate specialist training in forensic odontology: the Indonesian model

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Keywords: Forensic Odontology; Graduate Dental Education; Specialist Training Program; Indonesian College of Forensic Odontology.

Introduction: The competency standards of postgraduate education in forensic odontology remain an important topic of discussion among practitioners. Given its status as the world's largest archipelagic country and its exposure to diverse disaster risks and a high crime rate, Indonesia faces a critical need to strengthen national resilience through the capacity of forensic science. Since the establishment of the first Master's program in Forensic Odontology in Indonesia in 2012, graduate competencies have continued to evolve. In 2022, a specialist program in forensic odontology was established to produce graduates with advanced capabilities and practical skills in managing a wide range of dentistry-related forensic cases.⁽¹⁻¹⁹⁾

Methods: The development of competency standards begins with identifying the scope of forensic cases relevant to core forensic odontology and related disciplines, including forensic medicine, criminology, and other supporting fields. Guidelines from IOFOS, Interpol DVI, ABFO, ICRC, the Indonesian National Agency for Disaster Management (BNPB), and other relevant institutions were used to integrate multidisciplinary and interprofessional collaboration into the standards. The spectrum of clinical conditions and their management was aligned with ICD-based practices. Advanced technology and innovation, case complexity, quality assurance, and evaluation methods were also incorporated to enhance professional competence.

Results: A professional education framework in forensic odontology was established, consisting of a specialist competency level and two subspecialty areas: forensic odontology identification and clinical forensic odontology. A forensic odontology specialist possesses expertise in victim identification; analysis of skeletonized, fragmented, and mutilated bodies; dentoalveolar and oro-craniofacial trauma; sex and race determination; age estimation; bite mark analysis; oro-craniofacial toxicology



analysis; negligence; physical and sexual abuse; suicide- and crime-related cases; chain-of-custody management of evidence; ethics; law; medicolegal practice; and expert reporting. Advanced competencies are provided at the forensic odontology subspecialist level.

Conclusions: The development of professional competencies in forensic odontology is aligned with the Indonesian National Qualifications Framework, Level 8 for specialists and Level 9 for subspecialists. Regulations governing specialist and subspecialist education are coordinated directly by the Indonesian Ministry of Higher Education and the Ministry of Health. In addition to formal education, strengthening professional competence in forensic odontology through fellowship programs and related skills training remains essential.

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Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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ORAL PRESENTATIONS V

O29 Age estimations: my experiences and some recommendations

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Keywords: Age Estimation; Children Adolescents and Adults; Dead or Alive; Experiences; Recommendations.

Background: I have been working with age estimation of children, adolescents and adults from 1972 till 2012. Also, I have always assessed the age of dead persons whom I help identify, either visually when it is of minor importance or also using scientific methods when of great importance. My thesis was on age changes and estimation of age by adult.⁽¹⁻⁸⁾ In addition, I have published a few articles on age estimation usually with co-workers.

Methods: Based on my experiences I give some recommendations to forensic odontologists and researchers.

Results: Based on the inquisitory system for experts, I will describe how I think age estimation should be performed and reported. An expert should give his personal assessment based on his visual assessment and results from calculation in specific methods He should take into consideration all surrounding information, especially ethnicity, serious diseases, nutrition, water supply, and how the teeth have been taken care of. A method for visual estimation will be presented. Recommendations for the legal report of an age estimation will be given. It should contain an introduction and description of the material and methods used. Results and discussion are important but especially the formulation of the conclusion is important. Finally, some recommendations for critical reading of articles. In addition, some recommendation to observe if you want to do a scientific study of age estimations.

Conclusions: After considering all information in the case the expert should assess the age as "According to my opinion the person is approximately 25 years of age". The likelihood of any given or suggested age should be assessed and whether above or below a critical age like 18 years.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

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O30 AI-based comparison of intraoral scans: what factors are significant for dental identification?

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Keywords: Intraoral Scan; Scanning Technology; Image Reconstruction; Forensic Dentistry; Artificial Intelligence.

Introduction: Intraoral scans represent digital datasets which are valuable yet underutilized resource for person identification in forensic practice. Artificial intelligence (AI) offers new possibilities for automated comparison of antemortem and postmortem intraoral scans, even in conditions of scans being fragmented.⁽¹⁻¹¹⁾ Objective of present study was to evaluate which intraoral, restorative, and scan-related parameters are most relevant for AI-based matching of intraoral scans in forensic contexts.

Methods: Dataset of anonymized intraoral scans collected in clinical practice of the first author was used to appraise performance of specifically developed AI-based algorithm for comparison of such using curve-to-curve and nurb-to-nurb principles. Overall, 112 pairs of full intraoral scans with different clinical conditions obtained by three different intraoral scanning devices with time interval of 8-23 months between initial scanning and repetitive scanning were used and randomized for comparison. Also, 50 initial intraoral scans with various clinical scenarios have been fragmented in randomized manner based on divisions of overall intraoral scan area, on fragments with 10%, 20%, 30%, 40% and 50% of initial area and various localizations. Deep learning-based 3D comparison model was trained to perform pairwise matching between reference and test scans. Variables analyzed included tooth morphology, palatal morphology, dental arch length, palatal morphology, alignment parameters, technology of image capturing and processing within used intraoral scanning devices, scan quality indicators.

Results: The AI-based model demonstrated high overall identification accuracy in conditions of comparing intraoral scans fragments with 20-50% of initial intraoral scan area (range of approved identification 78.9-96.7% while using level of superimposition as criteria of assessment). The most significant reproductive discriminative factor for the maxilla was segmented region of palate, which provided enough comparability even within the condition of significant changes of dental status, even while using different devices for intraoral scanning itself. Occlusal wear patterns and overall tooth surfaces curvatures demonstrated relatively moderate stability in means of being used as comparative identifies, due to their dynamic changes and effect of image processing errors (OR=1.17, 95% CI 0.79-1.25; p >



0.05). Scan resolution below defined quality threshold significantly reduced matching reliability ($p < 0.05$).

Conclusions: AI-based comparison of intraoral scans represents a promising tool forensic dental identification, yet still proper threshold of matching should be further developed to optimized obtained results identification. Also, intraoral scan quality criteria for the use in forensic dental practice should be developed to establish strict algorithm form AI-based comparison as elements of ante-mortem and post-mortem records.

Ethics committee and informed consent: The current research was approved by an independent ethics committee of Educational and Scientific Institute of Dentistry and Laboratory Medicine at Uzhhorod National University and subjects gave their informed consent before they were enrolled in the study.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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O31 Has the advent of fully automated age estimation made conventional dental methods redundant?

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Keywords: Dental Development; Artificial Intelligence; Demirjian 8-tooth Method; Kohler Stages; Open Apex Method.

Introduction: In recent years, machine learning models have shown to increase prediction consistency and workflow efficiency in dental age estimation.^(1,,2) Furthermore, deep learning techniques have been applied to reveal more accurate age estimates than conventional methods.⁽³⁻⁵⁾ Some concluded that deep learning models using fully automated feature analyses without human involvement achieve superior performance in dental age estimation.^(6,7) The present author applied a recently published artificial intelligence (AI) user interface on an untested population, and compared its age estimates with conventional measurement- and stage-based methods. The objectives were to ascertain if the age estimates from the fully automated method (FAM) produced better performance metrics, and if there was statistical consistency between the resulting age estimates across the methods.

Methods: Age was estimated on 100 orthopantomograms of 61 females and 39 males in the age range of 15–22 years using the population-appropriate formulas of Demirjian 8-teeth method,⁽⁸⁾ third molar maturity index⁽⁹⁾ (I3M, or open apex method of lower left 3rd molar) and Kohler stages^(10,11) (all four third molars), and compared with the FAM.⁽¹²⁾ Performance metrics (MAE – mean absolute error, RMSE – root mean square error, bias and R2) were calculated. Intraclass correlation coefficient (ICC) test was undertaken to assess statistical consistency between age estimates of the four methods.

Results: The FAM produced the lowest MAE and RMSE followed by the Kohler, modified Demirjian and I3M methods (MAE = 1.17, 1.38, 1.47 and 1.68, respectively; RMSE = 1.5, 1.69, 1.77 and 2.05, respectively). R2 was highest for the FAM followed by the Kohler, modified Demirjian and I3M methods (0.60, 0.49, 0.41 and 0.34, respectively). Bias was lowest for the modified Demirjian method followed by the fully automated method, Kohler and I3M methods (0.26, –0.31, 0.42, and –0.83 years, respectively). ICC between the FAM and others ranged from 0.70–0.82.

Conclusions: The results indicate that the FAM is more accurate and has best variance explanation; furthermore, the tendency of the FAM to underestimate age may be advantageous since it may result in fewer false positives or Type I (ethically unacceptable) errors. However, its MAE is higher than the 'gold standard' of $\leq \pm 1$ year desirable in developing dentitions. Furthermore, age estimates produced by conventional methods are consistent with the FAM; also, one of the conventional methods (modified Demirjian) produced lower bias. To conclude, conventional methods of dental age estimation can continue to be used until the FAM outperforms them on all metrics.



Ethics committee and informed consent: Approval was obtained from the Institutional Ethics Committee (no. 2023/S/FO/04).

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

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O32 Structured digital forensic dentistry for identification and age estimation

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Keywords: Age Estimation; Dental Identification; Digital Analysis; Forensic Odontology; Standard System.

Introduction: Forensic dental examinations in clinical and medico-legal settings are commonly based on manual interpretation of dental records and individual expert judgment. Although this approach is well established, it is associated with inter-examiner variability, limited reproducibility, and delays in case processing, particularly in high-volume scenarios such as disaster victim identification and forensic age assessment. These challenges highlight the need for standardized, quality-assured, and traceable approaches in forensic odontology.⁽¹⁻³⁾

Methods: A structured digital forensic framework was developed through a research-driven process. The system integrates standardized protocols, guided analytical workflows, and internal quality assurance mechanisms. Core tasks, including dental record interpretation, antemortem to postmortem comparison, dental age estimation, and automated dental image analysis, were organized within a traceable and auditable digital environment. Automation was implemented as decision support rather than decision replacement, preserving the role and accountability of the forensic examiner.

Results: Institutional proof-of-concept and validation phases demonstrated measurable operational benefits. Observed outcomes included faster case processing, improved identification accuracy, and greater consistency across examiners and age groups. The structured digital workflow also enabled more reliable documentation and supported consistent performance across diverse case profiles.

Conclusions: Structured digital forensic frameworks may improve consistency, traceability, and transparency in forensic dental analysis while maintaining the central role of expert judgment. Standardized digital workflows support reproducibility and governance, and may enhance diagnostic confidence and large-scale case management in both disaster response and judicial contexts. These approaches are consistent with established principles of dental age assessment and quality-assured forensic practice.

Ethics committee and informed consent: The current research was approved by an independent ethics committee, and subjects gave their informed consent before they were enrolled in the study.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

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O33 COST Action CA24147 (AID-AgE): artificial intelligence driven dental age estimation network – scientific rationale, objectives and strategic impact

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Keywords: Artificial Intelligence; Dental Age Estimation; Forensic Odontology; Standardization; Validation Studies.

Introduction: Dental age estimation is a key tool in forensic and clinical practice, particularly in legal age assessment and identification. Despite validated morphological and radiographic methods, variability persists across populations and operators.^(1,2) COST Action CA24147 (AID-AgE) was established to address these limitations through a coordinated European network focused on AI-driven dental age estimation.

Methods: As Chair of CA24147, this communication presents the scientific framework and specific objectives of the Action. The network aims to: (1) develop standardized protocols for radiographic data acquisition and annotation; (2) create shared, ethically compliant multicentric datasets; (3) design, train and benchmark AI models for dental age estimation; (4) validate AI outputs against established forensic and clinical reference methods; and (5) elaborate consensus recommendations for reproducible and legally defensible applications. The Action is structured into dedicated Working Groups integrating experts in forensic odontology, radiology, data science, bioethics, and legal medicine under the COST framework.

Results: CA24147 establishes the first coordinated European platform exclusively dedicated to AI-based dental age estimation. Expected deliverables include harmonized methodological guidelines, validation studies across diverse populations, training schools, Short-Term Scientific Missions, and dissemination tools aimed at facilitating responsible implementation in forensic casework. By integrating technological innovation with forensic standards, the Action seeks to reduce inter-observer variability, increase accuracy, and enhance transparency in age assessment procedures.

Conclusions: This communication presents the scientific agenda of CA24147, highlighting the need for a coordinated European network on AI-driven dental age estimation. Through COST-supported collaboration, AID-AgE promotes methodological harmonization and evidence-based validation toward internationally recognized and legally reliable standards.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The author declares no conflict of interest.

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O34 Effect of incineration on ante-mortem to post-mortem tooth matching

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Keywords: Biometric Identification (MeSH D056667); Digital dental radiography (MeSH D019252); Forensic; Dentistry (MeSH D005553); Incineration (MeSH D055700).

Background: Teeth can survive temperatures of >1000°C and are therefore valuable as a primary forensic identifier for victims of incineration.^(1,2) However, incineration also may result in destruction and loss of dental restorative material, separation of enamel or complete loss of the tooth crown, as well as shrinkage and colour changes.⁽³⁻⁶⁾ The objective of this study was to expose extracted human molars to controlled incineration and then document the ability of experienced, blinded forensic odontologists to successfully match pre- and post-incineration (simulated “ante-mortem” and “post-mortem”) digital radiographic images.

Methods: 65 extracted molar teeth were exposed to temperatures ranging from 400 to 1200 °C for 10, 20 or 30 minutes (N=2 per time point, N=6 per temperature). Tooth condition, including restorations and presence of caries, was documented prior to incineration. Digital radiographs were obtained before and after incineration (“AM” and “PM” images), taken from bucco-lingual and mesio-distal orientation at standardized exposure and source-film distance. Three experienced Forensic Odontologists independently blind-matched AM and PM images. Matching was performed without physical access to the teeth.

Results: Prior to incineration, 28% of the 65 molar teeth had amalgam restorations, 20% had composites, 30% had caries, 1.5 % had other restorations (PFM crown), 1.5% had root-canal treatment, and 40% of teeth were unrestored and non-caries. Some teeth had more than one condition. 10 teeth did not survive incineration (90% of these after incineration at temperatures below 800°C, 50% at 400-500°C). 55 teeth remained for which identical post-incineration (“PM”) images were obtained. 82% of the teeth lost either the enamel or the entire crown. There was no relationship between temperature and loss of crown. Successful matching of AM-PM images by the 3 forensic odontologists ranged from 71 – 95% (average 79%). One examiner recorded 2 incorrect matches, 2 examiners had one case with bracketed (“either/or”) matches, two had placed question marks behind one match, and one examiner had 5 matches with question marks. Lack of clinical crown had no obvious effect on identification. Teeth without crowns were not identified for 7 - 27% (mean 18%) of cases however teeth without crowns were correctly identified in 73 - 93 of cases (mean 81%) of cases.



Conclusion: Despite lack of clinical context and significant heat-related damage, forensic odontologists successfully matched post-incineration radiographic images of isolated molar teeth with pre-incineration images. Success was not related to incineration parameters nor to pre-treatment restorative condition of the tooth.

Ethics committee and informed consent: The current research was approved by the University of Otago Human Ethics Committee (H23/059) and the Ngāi Tahu Research Consultation Committee, Otago University. Subjects gave their informed consent to the use of their extracted teeth.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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STUDENT ORAL PRESENTATIONS - COMPETITION

SP1 Evaluation of palatal morphology for forensic identification using 3D model comparison

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Keywords: Forensic Dentistry; Human Identification; Palate; Three-dimensional Surface Comparison; Virtual Models.

Background: Forensic odontology is one of the three recognised primary identifiers in human identification, alongside DNA and fingerprints.⁽¹⁾ Although teeth are traditionally central to dental identification, their evidentiary value can be compromised by disease, clinical intervention, post-mortem damage, or improving oral health trends. Consequently, palatal morphological features, which are relatively resistant to decomposition and incineration, may provide valuable supplementary points of comparison to enhance the forensic identification and reconciliation process. With 3D ante-mortem data for the palate becoming increasingly available via radiographic and optical surface scans⁽²⁾, this study aims to evaluate the utility of palatal morphology for human identification using 3D model comparisons.

Methods: 162 maxillary casts from 81 twin pairs, in permanent dentition were digitised twice using an extra-oral 3D scanner (3Shape, E4, Copenhagen, Denmark; accuracy 4 µm) and exported as .stl files. Full-arch scans with both palate and teeth constituted the antemortem (AM) database, while palate-only segments extracted from the second scan represented simulated postmortem (PM) queries. Many-to-many comparisons were performed in ModelMatch3D software (3D Slicer platform) to simulate a Disaster Victim Identification workflow, using Fast Point Feature Histogram (FPFH) RANSAC algorithm for initial alignment, followed by Iterative Closest Point (ICP) refinement.^(3,4) Matching percentage (fitness) and root mean square error (RMSE) were calculated to evaluate correspondence between same-individual, twin pair and unrelated individuals.

Results: Initial (RANSAC-based) fitness values demonstrated clear and statistically significant discrimination ($p < 0.01$) between comparison groups, with highest value for same-individual matches (median = 1.00), followed by related (0.90), and unrelated pairs (0.77). Following ICP refinement, fitness values remained significantly different across groups. Same-individual matches retained the highest median fitness (0.62), while related (0.20) and unrelated (0.15) mismatches showed substantially lower and more closely clustered values. Initial RMSE values also showed significant separation, with lowest error



for same-individual matches (0.29), compared to related (0.58) and unrelated comparisons (0.60); but converged after ICP (same: 0.20; related/unrelated: 0.22). Segmented palatal queries were successfully matched against full-arch databases without requiring database segmentation during initial alignment. Overall, fitness is superior to RMSE as the correspondence metric because of independence of scale and easy interpretability.

Conclusions: The palate shows potential as a supplementary tool for odontology identification. In cases where conventional dental information is insufficient, palatal morphology may augment the reconciliation process. Future studies should incorporate longitudinal data at multiple timepoints to evaluate the stability of palatal features over time and their effectiveness in improving identification accuracy.

Ethics committee and informed consent: The current research was approved by the University of Adelaide Human Research Ethics Committee to use the collections of dental casts (H-2024-134).

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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SP2 Sexual dimorphism in fingerprints by evaluation of ridge density: systematic review and meta-analysis

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Keywords: Fingerprinting; Forensic Anthropology; Sex Estimation.

Introduction: Dermal papillae have unique morphological characteristics that enable to identify individuals and are recognized by INTERPOL (International Criminal Police Organization) as a primary method of identification in criminal investigations around the world.⁽¹⁾ Several studies have analyzed different populations to identify patterns that differentiate male's and female's fingerprints.⁽²⁻⁴⁾ Ridge density (RD) corresponds to the count of ridges in a defined area of the fingerprint and has been used to investigate sexual dimorphism in various populations.⁽⁵⁾

Objective: This systematic review aimed to evaluate the applicability of dermal ridge density analysis in sex estimation applied in forensic contexts, especially when there are limitations in access to fingerprint databases, as sex estimation can assist in conducting investigations.

Methods: The systematic review was registered in PROSPERO and conducted according to the PICO strategy to evaluate the feasibility of fingerprint ridge density for sex estimation. Searches were carried out on Embase, PubMed/MEDLINE, Scopus, LILACS, SciELO, and Web of Science databases, with no restrictions on language or year of publication. Study selection was performed independently by two reviewers, and methodological quality and risk of bias were assessed using the Joanna Briggs Institute checklist.⁽⁶⁾ A meta-analysis was conducted using a random-effects model, including analyses of heterogeneity, influential studies, publication bias, and sensitivity.

Results: Of the 484 records initially identified, 23 studies met the eligibility criteria, and 18 were included in the meta-analysis. Most studies analyzed fingerprints from the hands, particularly the radial area. The findings consistently demonstrated higher fingerprint ridge density in females compared to males. The meta-analysis revealed a statistically significant difference between sexes; however, extremely high heterogeneity ($I^2 > 99\%$) and evidence of publication bias were observed, even after the removal of influential studies.

Conclusions: Fingerprint ridge density analysis proved to be a useful approach for investigating sexual dimorphism and shows potential forensic applicability. Nevertheless,



due to high heterogeneity, overlap of confidence intervals, and possible publication bias, the technique should be applied as a complementary tool, in conjunction with population-specific reference data, ethnic considerations, and other forensic indicators.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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SP3 The impact of photo manipulation on forensic identification: a review of individual and professional role

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Keywords: Identification; Social Media; Oral; Digital; Forensics.

Introduction: Social media platforms have become an essential resource for forensic investigators, providing photographic data when traditional medical or dental records are unavailable. However, the widespread use of AI-driven filters and editing software creates a significant gap between an individual's digital appearance and their biological reality. This study examines the ethical problem created when an individual's right to edit their appearance for social reasons meets the professional's need for accurate data in forensic identification.

Methods: This study employs a normative ethical analysis and a comparative legal review to evaluate the transition of images from social tools to forensic evidence. This study reviewed and compared image transparency laws from different countries, including France's "Photoshop Law" ⁽¹⁾ and "Influencer Law" ⁽²⁾, Norway's Marketing Act ⁽³⁾, and the UK's ASA standards.⁽⁵⁾ While these laws enforce transparency for commercial and public figures, a total regulatory void remains regarding the forensic accuracy of private digital content. This creates a critical gap when these 'social' images are suddenly required for legal or forensic identification.

Results: Analysis indicates that for individual users, photo editing is a standard social practice motivated by aesthetic curation rather than a desire to obstruct justice. While legal thresholds for deception exist in cases of "catfishing" or document fraud, most personal digital alterations remain unregulated. This creates a "forensic gap" where experts risk misidentification by mistaking digital artifacts or deepfakes for biological traits. Currently, forensic protocols lack standardized methods to validate the authenticity of social media assets, shifting the burden of verification entirely onto the professional.

Conclusions: It is concluded that while individuals bear no moral blame for social photo manipulation, the responsibility for accuracy lies strictly with the professional. Forensic experts must classify social media imagery as "subjective data" rather than objective truth. To preserve judicial integrity, the authors propose a mandatory disclosure of "digital uncertainty" in forensic reports to mitigate the risk of tragic misidentification coming from unverified digital sources.



Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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SP4 Cause of death analysis on Indonesian filicide cases: a review on Indonesian supreme court verdicts

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Keywords: Asphyxia; Criminology; Facial Injuries; Infanticide.

Background: Epidemiological studies indicate that a substantial proportion of child homicides are perpetrated by parents or primary caregivers, a phenomenon commonly referred to as filicide.⁽¹⁾ Filicide is frequently associated with maternal vulnerability, including financial hardship, limited social support, psychological distress, and unmarried status.⁽²⁾ Within the Indonesian medico-legal framework, neonaticide and infanticide are prosecuted under specific penal provisions and are conceptually aligned with filicide, together with *visum et repertum* that constitutes a primary medico-legal document used by courts to establish cause of death and injury patterns. This study aimed to analyze causes of death and trauma patterns documented in *visum et repertum* from filicide cases adjudicated by the Indonesian Supreme Court.

Methods: A cross-sectional document review was conducted between June and August 2025 using Indonesian Supreme Court filicide cases published from 2009 to 2024, retrieved from the official open-access Supreme Court database (<https://putusan3.mahkamahagung.go.id>) with predetermined keywords. Cases prior to 2009 were not digitally available. Extracted data included perpetrator and victim demographics, cause of death, trauma distribution, and applied legal articles. Filicide case records containing *visum et repertum* were included in this study, whereas cases with non-parental perpetrators, absence of medical examination data, inadequate record information, as well as duplicate records were excluded. Eligible records underwent abstract screening followed by full-text review.

Results: A total of 150 Supreme Court decisions were initially identified using predetermined keywords. After duplicate removal (n = 4) and summary exclusion (n = 18), 128 full-text decisions were assessed for eligibility and 47 court decisions were included in the final analysis. Most perpetrators were female (93.6%), generally young and unmarried mothers (mean age 25.4 ± 7.8 years). Victims consisted mostly of neonates (95.7%), with unwanted pregnancy identified as the primary motive (89.3%). Asphyxia was the leading cause of death (32%), followed by exsanguination (13%) and blunt force trauma (11%). Forensic findings most frequently involved the maxillofacial (33%) and cervical (25%)



regions and were obtained mainly from external examinations. Autopsy was conducted in only one-third of cases, suggesting a substantial risk of undetected internal injuries.

Conclusions: Filicide in Indonesia is predominantly associated with unwanted pregnancies, reflecting a multifactorial interaction of social vulnerability, psychological distress, and limited support systems. These findings accentuate the critical role of autopsy as a comprehensive medico-legal examination in clarifying fatal mechanisms, and highlight the need for preventive strategies focusing on early violence detection and structural social factors to reduce the risk of fatal violence against children.

Ethics committee and informed consent: Not applicable. This study analyzed publicly accessible Indonesian Supreme Court decisions and did not involve human participants or identifiable personal data.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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SP5 Sex estimation based on maxillary sinus analysis using Cone-Beam Computed Tomography in an adult Greek population

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Keywords: Cone Beam Computed Tomography; Forensic Dentistry; Identification; Maxillary Sinus; Sexual Dimorphism.

Objective: To evaluate the accuracy and reliability of sex estimation based on volumetric and linear measurements of the maxillary sinuses using Cone Beam Computed Tomography in an adult Greek population, and to develop a multinomial binary logistic regression model using these measurements to estimate sex.

Methods: Cone Beam Computed Tomography scans performed for diagnostic and therapeutic purposes were utilized. The sample consisted of 300 scans equally distributed between sexes. Patient age ranged from 20 to 70 years and the study subjects were equally distributed into 10 groups per decade and sex. CBCT datasets were anonymized prior to evaluation to maintain blinding throughout the study. The selected scans included both maxillary sinuses in their entirety, with most posterior teeth present^(1,2) and no history of surgical interventions or pathology affecting sinus dimensions.⁽¹⁾ Scans presenting these conditions, as well as severe sinus opacification, were excluded.⁽³⁾ Linear and volumetric measurements were performed on each scan using ITK-SNAP 4.4.0.⁽⁴⁾ The assessed linear values included maxillary sinus height, length, range⁽⁵⁾, and interatrial distance.⁽⁶⁾ Volume measurements were conducted using semi-automated segmentation with thresholding.^(4,7) All measurements were performed by one calibrated observer. Statistical analysis was conducted in two stages. Independent t-tests compared mean values between sexes, and correlations were assessed using Pearson's correlation coefficient. A multivariable binary logistic regression model was then developed based on statistically significant results from the first stage. A p-value < 0.05 was considered statistically significant.

Results: Comparative analysis revealed statistically significant differences across nearly all maxillary sinus measurements. Males exhibited larger maxillary sinus dimensions than females, with the most pronounced differences observed in volume and height. Based on correlations and sex-related differences between the as well as the univariate models' performance, predictor variables were selected. A binary logistic regression model for sex estimation was developed using these predictors, demonstrating moderate classification performance. The ROC curve analysis indicated a good overall fit and strong discriminatory capacity.



Conclusions: Linear and volumetric measurements of the maxillary sinuses, particularly volume and height, assessed through Cone Beam Computed Tomography, exhibit sexual dimorphism. Maxillary sinus analysis may therefore serve as an adjunct method for sex estimation, especially when combined with other forensic evidence to enhance biological profiling in forensic investigations.

Ethics committee and informed consent: The current research was approved by an independent ethics committee. The CBCTs were conducted in the context of the patients' treatment, and not for this study.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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SP6 Machine learning approach to establishing legal adulthood in a Portuguese population: a retrospective study

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Keywords: Age Estimation; Algorithms; Dental Methods; Legal Majority.

Introduction: The global socio-political context triggered migration flows, creating an ever-growing need for age assessment, strictly complying with ethics and legality.⁽¹⁻⁴⁾ According to the Study Group for Forensic Age Diagnosis, an oral examination with orthopantomograms is recommended in a multidisciplinary approach.⁽⁵⁾ Machine learning extracts and quantifies image characteristics, resulting in optimal representations of anatomical structures⁽⁶⁾, with an emphasis on nonlinear behavior.⁽⁷⁾ Models generated by convolutional neural networks are designed to use large data sets, establishing a complex and comprehensive relationship between human features and age.⁽⁸⁻¹⁰⁾ Studies on molars have shown very accurate results, which can be associated with the highly nonlinearity of development, morphology, and morphometry.^(6, 8) This study aims to contribute to forensic human identification by verifying and interpreting the accessibility, applicability, and accuracy of computer modeling for legal adulthood estimation in a Portuguese population.

Methods: The Third Molar Maturity Index (3MI), Mincer method and Caldas *et al.* classification were applied to lower third molars using orthopantomograms of patients from the Faculty of Dental Medicine of the University of Porto. Image J® software was employed for semi-automatic measurements. The images were then submitted to Panacea® software to perform automatic assessment. The inclusion criteria were the participants aged between 14 and 22 years old, Portuguese nationality, and presence of healthy lower third molars. The exclusion criteria were the presence of systemic and/or dental disorders, tooth rotation and/or overlapping affecting third molars, and magnification, noise, and/or artifacts. Statistical analysis was performed using the Statistical Package for Social Sciences® software.



Results: The assessment by Caldas *et al.* classified 74.3% of individuals as minors and 25.7% as adults. The 3MI approach classified 54.3% of individuals as minors and 45.7% as adults. The mean estimated age by the Panacea® software was 19.43 (SD = 1.26; Min. = 16.21), and the mean minimum estimated age was 16.78 (SD = 1.26; Min. = 13.56).

Conclusions: The minimum estimated age by the Panacea® software was closer to the estimated age by non-automatic techniques. This study showed that it is more likely to classify an individual as a minor by applying the Caldas *et al.* classification than the 3MI in cases where there is uncertainty, reinforcing the requirement to comply with ethically acceptable principles. However, neural networks have the advantage of fully automated assessment, providing accurate predictive models based on sensitivity to multiple features that would be unfeasible to detect and calculate manually.

Ethics committee and informed consent: The current research was approved by the Health Ethics Committee of the Faculty of Dental Medicine of the University of Porto under research project no. 36/2024.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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SP7 Houston, we have a prosthesis: achieving human identification, by a single center experience

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Keywords: Forensic Identification; Forensic Odontology; Human Remains; Implants; Prosthesis.

Introduction: When unidentified human remains are recovered, establishing identity is not only a legal duty but also a way to preserve the dignity of the deceased. In complex scenarios, especially in cases involving burned, decomposed, or skeletonized bodies, conventional identification methods may be limited or not immediately applicable. In these contexts, prosthetic devices can represent an additional and sometimes decisive source of information.⁽¹⁻³⁾ This case series aims to highlight the role of dental and orthopaedic prostheses in the identification process within a multidisciplinary forensic approach.

Methods: Three cases examined at the Institute of Legal Medicine in Palermo were retrospectively reviewed. Two burned bodies were recovered in the same crime scene in 2013, while in 2020 skeletal remains were found in a mountainous area. Post-mortem radiology, autopsy, forensic odontology and the analysis of prosthetic devices were integrated with police investigations and, when available, DNA comparison. Particular attention was paid to the identification potential of dental treatments and orthopaedic implants, including their morphological features and serial numbers.^(4,5)

Results: In Case #1, extensive dental treatments, including crown coverage and metallic onlay reconstructions, allowed comparison with ante-mortem radiographs and led to positive identification despite severe heat-related damage. In Case #2, a trochanteric stabilization system (DHS type) with identifiable markings, together with dental findings, contributed to narrowing the search and supported subsequent DNA confirmation. In Case #3, the presence of a hip prosthesis with a readable serial number made it possible to retrieve ante-mortem medical records, which proved crucial in establishing identity. In all cases, prosthetic devices provided relevant information that complemented conventional identification techniques.

Conclusions: Our experience underlines the importance of integrating "unconventional" sources of information, such as dental and orthopaedic prostheses, with established



identification methods. In situations where primary techniques may be limited or delayed, these elements can offer decisive clues, guide investigations and supporting the identification process. A multidisciplinary approach, based on the progressive integration of different types of data, appears essential to reduce uncertainty and improve effectiveness in complex forensic scenarios.^(6,7)

Ethics committee and informed consent: Not applicable due to the forensic and judicial nature of the cases.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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SP8 Multi-threshold legal age classification on OPG using transfer learning CNN: support for judicial decision-making (AldentifyAGE)

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Keywords: Age assessment; Convolutional Neural Network; Artificial Intelligence; Legal Age Threshold.

Background: The forensic age assessment plays a critical role in judicial decision-making, in contexts of criminal responsibility, asylum procedures, and child protection. ⁽¹⁾ Biological markers for dental development observed in orthopantomograms (OPG) remains one of the most reliable method. ^(2,3,4) Transfer learning strategies allow pretrained deep learning architectures to be adapted to imaging datasets, optimizing performance with limited annotated samples. ^(5,6) This demonstrated diagnostic accuracy across imaging and is highly explored in forensic age estimation. ^(6,7) However, most AI-based dental age studies focus on continuous age regression or single legal cut-offs, with limited emphasis on multi-threshold classification. Judicial systems require categorical determinations corresponding to legally defined ages—such as 10, 12, 14, 16, 18, and 21 years—rather than purely biological predictions. ^(8,9,10)

Objectives: To develop and evaluate a Convolutional Neural Network (CNN) model for age classification using orthopantomograms (OPG), age of 10, 12, 14, 16, 18, and 21 years.



Methods: A dataset of 9,815 OPGs (5,057 male; 4,758 female), aged 5–25 years from a Portuguese population, was collected at the University Hospital Santa Maria and Faculty of Medicine, Lisbon. Images were categorized into legal age thresholds (10, 12, 14, 16, 18, 21 years), and binary classification models were developed for each. A transfer learning approach using pretrained CNNs, particularly Xception, was applied. Data were split into training (70%), validation (15%), and testing (15%), with external datasets included. Preprocessing, augmentation, hyperparameter tuning, and fine-tuning improved performance. Evaluation used accuracy, recall, precision, F1-score, and Grad-CAM for interpretability.

Results: The Xception-based transfer learning CNN achieved accuracy reaching 1.000 at the 10-, 12-, and 18-year thresholds and above 0.998 for other cut-offs. Precision and recall were similarly high, indicating minimal classification error. Validation accuracy ranged from 0.9103 to 0.9558, remaining strong up to 16 years, with slight declines at 18 and 21 years due to developmental variability. Internal testing showed stable accuracy (0.9185–0.9579), with reliable precision and recall. External testing demonstrated acceptable generalizability (0.8542–0.9274), with the highest accuracy at 21 years. F1-macro scores indicated balanced classification, with reduced performance at higher age thresholds.

Conclusions: CNN models demonstrated high accuracy in the classification of legal age thresholds using OPGs. Performance remained robust across internal and external testing datasets, supporting the reliability and generalizability of the approach. Multi-threshold classification aligned with legally defined age limits enhances the practical applicability of deep learning in forensic contexts. As a decision-support tool, this methodology may contribute to increased objectivity and reproducibility in judicial age assessment, while maintaining the essential role of expert medico-legal interpretation.

Ethics committee and informed consent: The research has been approved by the Ethics Committee of the Faculty of Dental Medicine, University of Lisbon, under the reference CE-FMDUL202516, on March 26th, 2025.

Conflicts of interest: The authors declare no conflict of interest.

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SP9 Dental age assessment from OPG using transfer learning CNN regression: a tool for judicial decision-making (AldentifyAGE)

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Keywords: Dental Age Assessment; Convolutional Neural Network; Artificial Intelligence.

Introduction: The forensic assessment of age constitutes a fundamental component of judicial and administrative processes, particularly in matters concerning criminal liability, sexual consent, asylum claims, and others.⁽¹⁻⁴⁾ Among the various biological indicators, dental maturation assessed through orthopantomograms (OPGs) is considered one of the most dependable radiographic markers, due to its stability against environmental influences.⁽⁵⁻¹⁰⁾ Advances in artificial intelligence, particularly through Convolutional Neural Networks (CNNs), have transformed medical image analysis by enabling automatic detection of morphological features, demonstrating strong diagnostic performance and growing use in forensic age estimation.^(1, 8, 10, 11)

Objective: To develop and evaluate a transfer learning-based Convolutional Neural Network (CNN) model for dental age assessment based on regression, using orthopantomograms (OPG), and to assess its performance as a judicial decision-support tool in forensic age estimation by dental markers.

Methods: A radiographic dataset comprising 9,815 orthopantomograms (OPG) (5,057 males; 4,758 female) from a Portuguese population, aged between 5 and 25 years was collected from the University Hospital Santa Maria and Faculty of Medicine, Lisbon. The dataset was randomly partitioned into training, validation, and testing subsets, comprising 70%, 15%, and 15% of the total sample, respectively. In addition, independent external testing datasets were incorporated to further evaluate model generalizability across



different populations and potential imaging variability. Image resizing, intensity normalization, and contrast optimization were applied. Data augmentation techniques were also implemented to reduce overfitting and increase feature variability, enhancing model robustness. Hyperparameter optimization was conducted during the training phase.

Results: The Xception-based model demonstrates strong predictive performance across the training, validation, and test datasets. On the training set, it achieves very low error values (MAE = 0.37, RMSE = 0.48) and a high R^2 score of 0.99, indicating excellent fit to the data. Performance slightly decreases on the validation and test sets, with MAE around 1.12–1.16 and R^2 values above 0.90, suggesting good generalization. Although errors increase outside the training set, the model remains accurate and stable. Overall, the results show that the model effectively captures underlying patterns and maintains reliable predictive capability on unseen data.

Conclusions: This study shows that transfer learning-based CNNs are accurate, reliable tools for dental age assessment in forensic contexts. The Xception-based model achieved high predictive performance, with low error rates and strong generalization across datasets, confirming deep learning's effectiveness in capturing dental maturation patterns from OPGs and its potential as an objective, reproducible judicial decision-support tool.

Ethics committee and informed consent: The research has been approved by the Ethics Committee of the Faculty of Dental Medicine, University of Lisbon, under the reference CE-FMDUL202516, on March 26th, 2025.

Conflicts of interest: The authors declare no conflict of interest.

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SP10 Can the mandible predict sex? A CBCT-based forensic anthropometric study in a Greek adult population

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Keywords: Anthropometry; Cone-beam Computed Tomography; Forensic Odontology; Mandible; Sex Estimation.

Objective: This study aimed to evaluate the reliability and predictive performance of mandibular anthropometric measurements derived from cone-beam computed tomography (CBCT)-based three-dimensional reconstructions for forensic sex estimation in a Greek adult population. A secondary objective was the development of a population-specific predictive model applicable to forensic practice. Previous studies have demonstrated significant sexual dimorphism of the mandible across different populations.

(1,2)

Methods: CBCT volumetric data from 204 adult individuals of Greek origin (102 males and 102 females) were retrospectively analyzed. Three-dimensional mandibular surface reconstructions were generated, and standardized anthropometric measurements were obtained from predefined anatomical landmarks. Measurement reliability was assessed using intra- and inter-observer intraclass correlation coefficients (ICC). Sex estimation was performed using logistic regression analysis to develop a predictive model based on mandibular linear and angular parameters.

Results: Measurement reliability was excellent, with intra- and inter-observer ICC values exceeding 0.94. All linear mandibular measurements demonstrated statistically significant sexual dimorphism ($p < 0.001$), with higher values observed in males, whereas angular parameters did not show significant differences between sexes. The final logistic regression model incorporated seven linear variables and achieved a sex classification accuracy of 74.4%, with a sensitivity of 83.2%, specificity of 79.2%, and an area under the receiver operating characteristic curve (AUC) of 0.896, indicating high predictive performance.

Conclusions: Mandibular anthropometric analysis based on CBCT-derived three-dimensional reconstructions provides a reliable and reproducible approach for forensic sex estimation. The proposed population-specific model demonstrates strong diagnostic performance and may serve as a valuable supplementary tool in cases where traditional skeletal indicators are unavailable or incomplete. These findings are consistent with previous CBCT-based forensic studies.⁽³⁻⁵⁾



Ethics committee and informed consent: The current research was approved by an independent ethics committee. The CBCTs were conducted in the context of the patients' treatment, and not for this study.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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e-POSTER PRESENTATIONS I

PP1 Multifactorial age estimation of third molars and clavicle to determine majority in a German population – a retrospective CT scan-based study

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Keywords: Forensic Age Estimation; Clavicle; Maturity; Multifactorial Age Estimation; Third Molars.

Background: Legal age estimation is aiming for reliable predictions regarding the determination of maturity, especially in the context of unaccompanied minor refugees. The methods used for age estimation should be easily applicable, rapid and non-invasive for the patient. The German AGFAD (working group for forensic age estimation) recommends, among others, the radiographic evaluation of third molars and clavicle to estimate legal relevant ages of 14, 16, 18 and 21 years. Due to endogenous and exogenous factors single indicators show high standard deviations of several years.⁽¹⁻⁸⁾ The objective of this study was to examine a more precise method by combining age estimation from third molars and clavicles based on one data set.

Methods: Three raters retrospectively evaluated third molars and clavicles on three-dimensional CT scans undertaken for medical reasons at University Center Mainz. The study sample include 151 scans of men and women between 14 and 21 years. Third molar stages were evaluated according to Demirjian et al. and clavicle stages according to Kellinghaus et al. and corresponding reference population data were applied. The statistical evaluation focused on the deviation of the third molars and clavicles as well as the combination of both markers according to the subjects' known chronological age and on sensitivity and specificity.

Results: The mean chronological age was 18,34 years (SD 1,95) for 58 men and 93 women. Interclass-Correlation was calculated ICC=0,795. Mean absolute error was smallest for the combination of both indicators (1.57 years), 1.61 years for third molars and 1,99 years for clavicles. Regression analyses showed similar higher variance for clavicle ($R^2=0,591$) and combination of both indicators ($R^2=0,59$) than for third molars ($R^2=0,48$). 118 patients were



correctly classified as minors and majors (age under or over 18 years old). Thirty majors were incorrectly estimated as minors and three minors (age 17.56, 17.66 and 17.08) were incorrectly estimated as majors. For estimation minority the sensitivity was 95,59% and specificity was 63,86%.

Conclusions: The results demonstrate the applicability of the method used by the three raters. The combination of both indicators showed higher variance than third molars as a single indicator. The underestimation is legally justifiable, as well as three incorrectly estimated minors at the age of 17. The present study supports the interdisciplinary and multifactorial approach for age estimation in the forensic context.

Ethics committee and informed consent: Study was approved of the Ethics Committee of Rhineland-Palatinate (2023-16971) and patients' informed consent to computed tomography imaging, including the use of the acquired data for scientific purposes.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP2 AI-assisted radiographic identification of original vs. replica dental implants: comparing accuracy of human experts vs. probabilistic and deterministic AI

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Keywords: Artificial Intelligence; Implant Dentistry; Identification; Replica; Original.

Objectives: In dental implantology the application of artificial intelligence (AI) for the identification of different implant systems is gaining increasing importance, particularly in a forensic context, where implants may serve as reliable individual markers. The growing prevalence of replica products has made the valid identification of dental implants more challenging. Accurate identification, however, is a condition for robust forensic conclusions.⁽¹⁻⁴⁾ This study therefore investigates the feasibility of distinguishing between two nearly identical implant systems (original implant and its replica) using an automated, AI-based analysis of radiographic images. The diagnostic accuracy of the AI software is evaluated using a test dataset and compared with the performance of experienced human experts.

Material and Methods: A dataset of 906 radiographic images was initially compiled, consisting of ex situ recordings of both the original and the replica implants (with and without a cover screw in situ). The implants were positioned in a standardized way at different distances, angulations and rotations relative to the detector. Four deterministic AI models and one probabilistic model were trained using different subsets of varying sizes of the dataset, including the full dataset and then evaluated against a designated test dataset. For comparison 28 dental professionals also assessed the same test dataset.

Results: The accuracy of the deterministic model trained solely with 488 radiographs of implants with inserted cover screws was 0.579 (57.9%). In contrast the accuracy of the second model exceeded 90% when an additional 186 radiographs of implants without an inserted screw were included in the training process. For the third model, an accuracy of 1.00 was already achieved by the second and third classifiers when the model was trained on a combined dataset comprising 418 images without an inserted screw and the dataset



used for the first model. The first three models consisted of five classifiers each. The fourth deterministic model, based on 28 classifiers and the complete training dataset, classified the test dataset without error. The probabilistic model likewise achieved perfect classification using 28 classifiers and the corresponding training dataset.

The participating dental experts achieved an overall accuracy of 0.8616 (86.16%) when classifying the test dataset.

Conclusion: This study suggests that AI-supported implant recognition software has the potential to offer valuable assistance in clinical practice for distinguishing between original and replica implants. Such differentiation may be crucial for forensic identification, the selection of prosthetic suprastructures and the validity of associated manufacturer warranties.

Ethics committee and informed consent: The study was conducted according to the guidelines of the Declaration of Helsinki and was approved by the Ethics Committee (2023-16979).

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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PP3 Forensic age estimation of third molars: a comparison of OPT, CBCT, and CT using the Olze method

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Keywords: Age Determination; Cone-Beam Computed Tomography; Computed Tomography; Forensic Odontology; Third Molar.

Objectives: The aim of this study was to compare the application of Olze stages for dental age estimation across orthopantomography (OPT), cone-beam computed tomography (CBCT), and computed tomography (CT). Forensic dental age estimation plays a central role in legal and humanitarian contexts, particularly for individuals without valid identity documents.^(1,2) Detectability and accuracy of age estimation were assessed across three imaging modalities and multiple raters using matched radiographic datasets from the same individuals with known chronological age.

Materials and methods: A total of 27 human skulls with known chronological age were included. For each individual, orthopantomography (OPT), cone-beam computed tomography (CBCT), and conventional computed tomography (CT) images were available. Three independent examiners assessed third molar development according to the Olze classification.⁽³⁾ Interrater reliability was evaluated using the intraclass correlation coefficient (ICC). Differences between estimated dental age and known chronological age were calculated and analyzed.

Results: All 27 individuals were fully evaluated. The detectability of third molars was 79.9% on OPT, while CBCT and CT achieved 100%. Interrater reliability was excellent (ICC = 0.954). The mean absolute deviation between estimated and chronological age was 1.89 years for OPT, 1.90 years for CBCT, and 1.87 years for CT. A small systematic overestimation was observed for all modalities, with mean bias ranging from +0.64 to +0.74 years. Olze-based age estimates differ significantly between OPT, CBCT, and CT ($p < 0.001$). No significant differences were found between examiners, and no examiner-dependent modality effects were detected. In multiple regression analysis, the three imaging modalities jointly explained 74% of the variance in chronological age; however, only CT-based estimates were an independent predictor of true age ($p < 0.001$).

Conclusions: Although CT provided the strongest independent association with chronological age, the overall accuracy of Olze-based age estimates was comparable across OPT, CBCT, and CT. The high interrater reliability confirms the robustness and



reproducibility of the Olze method^(4,5), supporting its modality-independent application in forensic age estimation, comparable to other validated age estimation approaches.⁽⁶⁾

Ethics committee and informed consent: The study was conducted according to the guidelines of the Declaration of Helsinki and was approved by the Ethics Committee (2022-16398).

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP4 Automated 3D comparison of palatal rugae for forensic identification – a proof of concept

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Keywords: Forensic Dentistry; Identification; Palate; Pattern Recognition; Imaging; Dental Records; Software.

Objectives: Traditional forensic identification relies on DNA, fingerprints, and dental records, which may be unavailable in degraded remains.⁽¹⁻⁷⁾ This study investigates palatal rugae as an alternative intraoral marker and evaluates a fully automated digital matching process with the hypothesis that it achieves superior accuracy compared with semi-automated methods.

Materials and methods: Palatal scans from 345 living participants (11.2–73.2 years) were recorded using an Omnicam intraoral scanner. After segmentation and Poisson disk downsampling (10,000 points), a four-step matching process was applied: (1) data preparation, (2) rough alignment via Fast Point Feature Histograms (FPFH), (3) fine alignment using the Iterative Closest Point (ICP) algorithm, and (4) distance-based similarity scoring. The algorithm was validated on 224 development scans and 111 unseen scans. Matching accuracy and sampling effects were analyzed.

Results: The automated system achieved 100% accuracy in identifying identical scans and rejecting non-matching pairs. Random rotation confirmed robustness to initial alignment. Downsampling analysis showed that 3,000 points suffice for perfect accuracy, reducing computational demand without loss of precision.

Conclusions: Automated 3D alignment of palatal rugae enables highly accurate, reproducible, and objective identification under controlled conditions in living individuals. While the method outperforms semi-automated approaches, its applicability to forensic casework, particularly for identifying unknown deceased individuals, remains to be validated. Post-mortem changes, tissue degradation, and variability introduced by different scanning conditions may affect performance. Therefore, further studies using post-mortem



data and diverse acquisition settings are required before routine forensic implementation can be recommended.

Ethics committee and informed consent: The study was conducted according to the guidelines of the Declaration of Helsinki and was approved by the Ethics Committee (2021-16264).

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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PP5 Reframing adult age determination in forensic odontology: from the 18-year threshold to a certainty-based 20-year biological standard (MIDAS)

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Keywords: Adult Age Determination; Dental Maturity; Third Molar; Human Rights; Biological Age; Forensic Odontology.

Background: Age estimation in living individuals is a critical medico-legal procedure, particularly in migration and asylum contexts involving unaccompanied minors, where misclassification may result in rejection or denial of protection.⁽¹⁾ International forensic standards emphasize multidisciplinary methodology, scientific validation, observer calibration, and proportionality in protecting minors.⁽²⁻⁴⁾ Dental age assessment based on third molar development remains central in forensic age diagnostics.⁽⁵⁻⁸⁾ The Third Molar Maturity Index (I3M), proposed by Cameriere et al., has become a widely applied method for assessing the 18-year legal threshold.⁽⁷⁾ However, systematic reviews confirm substantial biological variability in mandibular third molar maturation around 18 years, limiting absolute certainty.⁽⁶⁾ Recent population-based and combined statistical approaches further demonstrate that developmental staging and maturity indices provide probabilistic rather than deterministic conclusions near the age of majority.^(5,11,12) This variability generates a 17–20-year gray zone in which the risk of wrongful adult classification persists.

Objective: To introduce and pilot MIDAS (Maturity Index for Determination of Adult Status), a certainty-based forensic framework designed to determine adult status using a conservative biological cut-off of ≥ 20 years rather than 18 years, thereby operationalizing the benefit-of-the-doubt principle in favor of minors.^(1,4)

Methods: A pilot study was conducted on 200 selected anonymized panoramic radiographs of individuals aged 14–25 years, derived from public panoramic datasets [13,14] and private dental clinics in Bari and Teramo (Italy), for which no ethical approval was required. MIDAS integrates: (1) structured assessment of third molar radicular development based on validated developmental staging systems^(5,7); (2) evaluation of apical closure; and (3) structural morphometric analysis of trabecular stabilization. Degenerative mandibular radiomorphometric indices and CEJ–crest bone loss parameters were deliberately excluded due to their late-life and confounding characteristics.^(9,10) Any computational tools employed functioned strictly as calibrated decision-support systems under expert supervision, ensuring transparency, reproducibility, and compliance with medico-legal standards.⁽³⁾ The composite maturity index was calibrated to prioritize specificity and minimize false-positive adult determinations.

Results: Preliminary findings indicate that only individuals presenting complete radicular and apical maturation combined with structural stabilization patterns compatible with ≥ 20 years were classified as adults. The elevated biological threshold effectively excludes the



17–20-year gray zone from affirmative adult classification, reducing the risk of misclassification and aligning forensic decision-making with child-protection and human rights principles.^(1,4)

Conclusions: MIDAS reframes adult age determination from probabilistic estimation toward certainty-based adult status confirmation. By shifting the biological threshold from 18 to 20 years and integrating validated third molar science within a structured, ethically proportionate framework, MIDAS enhances methodological transparency, legal defensibility, and the protection of minors' fundamental human rights in forensic practice.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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PP6 Conventional 3D registration methods are unsuitable for automatic bite mark matching in foodstuffs

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Keywords: Bites; Human; Food; Forensic Dentistry; Imaging, Three-Dimensional.

Objective: The aim of this study was to evaluate whether two widely used 3D registration superimposition methods – Iterative Closest Point (ICP)⁽¹⁾ and Random Sample Consensus-based (RANSAC-based) registration⁽²⁾ – can be applied to automatically compare bite marks in inanimate food objects (dark chocolate, toffee bar and hard cheese) with digital dentition models. The goal was to determine whether the algorithms can distinguish between true matches and mismatches.

Methods: Dentitions from three participants were scanned using a 3D intraoral scanner (Primescan AC, Sirona Dental Systems GmbH, Germany). Each participant then bit into three different foodstuffs: dark chocolate, a toffee bar and, hard cheese. Dentitions were cleaned before and between experiments to prevent contamination. All nine bitten food items were 3D scanned immediately after biting. Stereolithography (STL) files of the upper jaw dentitions and the foodstuffs were used for analysis. Matching was performed between full upper jaw dentitions scans and scans of the bitten foodstuffs using ICP and RANSAC-based registration. All foodstuff STL files were manually trimmed to feature only the actual bite mark. A second analysis was conducted using dentition scans trimmed to include only the anterior teeth. For both ICP and RANSAC-based registration, Fitness and Inlier Root Mean Square Error (RMSE) values⁽¹⁾ were calculated and visualised to compare true matches and mismatches.

Results: For ICP, both full and trimmed upper jaw dentitions produced valid Fitness distributions with clear visualisation. However, substantial overlap occurred in the Inlier RMSE distributions, resulting in no meaningful separation between true matches and mismatches. For RANSAC-based registration, acceptable fits were not found in most cases for neither full nor trimmed dentitions, leading to complete overlap and no separability in both Fitness and Inlier RMSE distributions.

Conclusions: The results indicate that neither Iterative Closest Point (ICP) nor RANSAC-based registration is suitable for automatic matching of digital 3D bite marks in foodstuffs and dentitions. The inability to distinguish between matches and mismatches suggests that conventional 3D algorithms lack the robustness required for this complex task. Future research should focus on developing new algorithmic approaches rather than further parameter adjustments of the methods applied here.



Ethics committee and informed consent: The current research was deemed exempt from approval by an independent ethics committee (case-no. 1-10-72-9-25). Subjects gave their informed consent before they were enrolled in the study.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP7 An analysis of forensic odontological identification cases

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Keywords: DVI; Forensic Odontology; Human Identification; Postmortem Computed Tomography.

Introduction: Dental features are widely used for human identification in forensic casework.⁽¹⁻⁴⁾ The aim of this study was to analyze which criteria contributed to different levels of certainty in conclusions drawn from single forensic odontological identification cases, and to assess the frequency and nature of inaccuracies in antemortem (AM) dental records.

Methods: 50 completed single-case dental identifications were retrospectively included. The received AM material was systematically registered, and discrepancies between written dental records, dental charts, and radiographic findings were recorded. Postmortem (PM) material was registered, including the condition of the jaws and teeth, radiographs taken, PMCT and clinical documentation.⁽⁵⁻⁷⁾ Dental characteristics and treatments were recorded for both AM and PM material. Radiological details were further categorized according to the contour of the restorations, layering in composite restorations and root treatments.⁽⁸⁻¹²⁾ AM-PM comparisons and the resulting level of certainty in identification were registered.^(13,14)

Results: Radiological details in dental treatments were present in all cases in which a positive identification was established. Recognition of radiological details in both AM and PM material was almost as frequent in composite restorations as in metal restorations. Composite restorations exhibited different types of radiological characteristics compared to metal restorations. Inaccuracies in AM dental records were identified in more than half of the cases, predominantly in dental charts.

Conclusions: Radiological details in dental restorations play a crucial role in achieving a high level of certainty in forensic dental identification. Accurate interpretation of dental records requires specialist expertise.^(15,16) This underscores the importance of continuous training and experience for forensic odontologists, particularly in single-case investigations and Disaster Victim Identification (DVI) scenarios.

Ethics committee and informed consent: According to the Danish Act on Ethics Review of Health Research Projects and Health Data Research, forensic methodological quality research is exempt from ethical review. The study was conducted in accordance with the ethical principles and regulation in the General Data Protection Regulation (GDPR) and the Danish Data Protection Act.

Clinical study registration number: 514-1313/26-3000



Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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PP8 Forensic odontology education in Finland

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Keywords: Dentistry; Education; Forensic Odontology; Qualification; Training.

Introduction: The structure and content of forensic odontology (FO) education vary internationally, and the need for global standardization has been widely acknowledged.^(1,2) Research indicates that specialized training programs are limited worldwide.^(1,2,3,4,5) In Finland, FO is included in the undergraduate dental curriculum, and in 1999 a postgraduate special competence in FO was established.⁽⁶⁾ Since its introduction, 24 dentists have completed the qualification, and 42 students are currently enrolled. The structure of the Finnish FO studies is presented.

Methods: Eligibility for the FO studies requires a DDS degree, a minimum of two years of clinical practice, and a membership in the Finnish Dental Association (FDA) and the Finnish Forensic Odontology Association (FFOA). The educational program is jointly organized by the FFOA, the Forensic Medicine Unit of the Finnish Institute for Health and Welfare (THL), and the Department of Forensic Medicine at the University of Helsinki. The curriculum is designed to provide comprehensive competence across core FO domains and consists of seven compulsory courses, one per semester, covering dental identification, anthropology and osteology, age estimation, basics in forensic medicine, safety investigation, traumatology and jurisprudence. The training further includes participation in forensic autopsies, hands-on practice in dental identification and forensic age estimation, completion of a thesis, and finally, the examination. The program is structured to allow concurrent professional practice. The aim is to prepare students to function as independent forensic odontologists.^(4,5,7) Forensic autopsies and forensic age estimations are conducted at THL, the national authority responsible for forensic medicine in Finland. Special competence qualification is granted by the board of the FDA upon recommendation from the Committee for Special Competence in FO.⁽⁶⁾

Results: Experience from the 1999-2026 indicates that the Finnish scientific and practical program in FO continues to attract increasing interest among dentists, and candidates may also pursue a PhD within the field. The FFOA has currently 101 members and provides regular seminars and continuing professional training. Forensic odontologists constitute an essential expert group within the Disaster Victim Identification (DVI) unit of the Finnish National Bureau of Investigation, and participation in the unit's meetings and trainings are essential for the continuing education.^(7,8) Members of the FFOA are strongly encouraged to participate international education and conferences.⁽⁹⁾

Conclusions: The special competence in FO is a mandatory qualification for professional practice at THL and ensures the use of consistent methods and quality in FO procedures.

Ethics committee and informed consent: Not applicable.



Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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PP9 Intraoral digital scanning of the dentition: a step-by-step guideline and its relevance for human identification

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Keywords: DVI; Intraoral Digital Scans; Forensic Odontology; Human Identification; Postmortem Image.

Introduction: Intraoral digital scanning, widely used in clinical dentistry, offers a practical method for capturing highly detailed three-dimensional dental records of the deceased.⁽¹⁻¹⁷⁾

The objective of this poster is to present a clear, step-by-step guideline for performing intraoral digital scans in postmortem settings, including practical tips and common challenges. The poster also outlines how such scans may serve as a valuable tool in personal identification, particularly in DVI operations, by enabling remote assessment and efficient data collection.

Methods: An illustrated, step-by-step guideline was developed based on the combined practical scanning experience of three of the authors over a 1-year period; assessments of scanner performance in postmortem conditions from 8 actual identification cases; and established forensic odontology standards. The method describes preparation of the deceased, recommended positioning, optimal scanning sequences using the 3Shape TRIOS 5 intraoral scanner. Additional considerations include equipment handling, and secure digital data management.

Results: The resulting guideline provides a structured workflow that enables practitioners to perform intraoral digital scans efficiently and consistently in postmortem contexts. The protocol demonstrates that intraoral digital scanning can be integrated into existing postmortem examination procedures with minimal adaptation. The digital output captures fine morphological detail and can be stored, reviewed, and shared easily through the 3Shape Unite software, offering the possibility of supporting forensic identification processes.

Conclusions: This poster presents a practical, user-oriented protocol for conducting intraoral digital scans of the deceased. By focusing on technique, workflow, and common challenges, it aims to support practitioners in adopting this method within forensic odontology. While further evaluation may clarify its full value, intraoral digital scanning shows promising potential as a supplementary tool for human identification, particularly in DVI scenarios where efficient, shareable, and remotely accessible dental documentation is advantageous.



Ethics committee and informed consent: According to the Danish Act on Ethics Review of Health Research Projects and health Data Research, forensic methodological quality research is exempt from ethical review. The study was conducted in accordance with the ethical principles and regulation in the General Data Protection Regulation (GDPR) and the Danish Data Protection Act.

Clinical study registration number: 514-1210/25-3000.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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PP10 Sex estimation in a Brazilian population based on lateral teleradiographic measurements

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Keywords: Forensic Anthropology; Forensic Dentistry; Radiography; Sex Characteristics.

Objective: This study investigated the potential of linear, angular, and area measurements obtained from lateral teleradiographs for sex estimation in a Brazilian population through the development of a binary logistic regression model.

Methods: A total of 320 digital lateral cephalometric radiographs from Brazilian adults aged 20-40 years were analysed, with equal representation of both sexes. Eight craniofacial landmarks were identified on each image to obtain linear, angular, and area measurements using ImageJ™ software. Radiographs presenting trauma, cranial pathologies, skeletal developmental alterations, or imaging artifacts were excluded.

Results: Statistical analyses were conducted using Microsoft Excel™ and RStudio™ software. After outlier screening, 252 teleradiographs (127 males and 125 females) remained in the final sample. Two angular variables and one area measurement showed significant associations with sex and were selected to construct the binary logistic regression model. After comparing two models with similar performance, the more parsimonious model was selected. This model achieved accuracy of 82.14% in the training set and 84.38% in the test set, with balanced sensitivity and specificity.

Conclusions: Overall, the proposed model demonstrated good predictive performance and represents a simple, objective, and practical approach for sex estimation in contemporary Brazilian populations, with potential applicability in forensic human identification.

Ethics committee and informed consent: The current research was approved by the Research Ethics Committee of the General Hospital of the Ribeirão Preto Medical School – University of São Paulo (Protocol Number: 4.745.387).



Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP11 A retrospective analysis of the pink teeth phenomenon prevalence and potential associations with forensically relevant parameters

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Keywords: Dental Pulp; Forensic Dentistry; Pink Teeth; Postmortem Changes; Tooth Discoloration.

Background: The pink teeth phenomenon has been observed in cases with various causes of death, such as suffocation or drowning. However, reported observations are inconsistent as the discoloration may be present in some cases and yet entirely absent in other cases with comparable post-mortem conditions. Thus, the clinical significance of pink teeth remains unclear and systematic investigation of its occurrence may clarify whether it could serve as an indicator of particular circumstances of death or environmental conditions like temperature or humidity.⁽¹⁻³⁾ The aim of this study was to assess the incidence of documented pink teeth during forensic autopsies and to evaluate their potential correlations with forensic parameters.

Methods: Autopsy reports and protocols were screened for written or photographic documentation of pink teeth in cases examined at the Center for Forensic Medicine in Vienna, Austria between 2011 and 2020. Pink teeth were recorded along with the number of affected teeth and their dental notation. Forensically relevant parameters were extracted, including cause of death, age at death, biological sex, location where the body was found, post-mortem interval until discovery, body position and degree of decomposition.

Results: A total of 55 cases with pink teeth was identified among 4369 screened autopsies. Pink discoloration was predominantly observed in mandibular teeth, anterior teeth, in individuals of mature age and in males as well as in cases with bodies recovered from dry environments and with an advanced degree of decomposition. Intoxication as a cause of death showed a significantly higher number of pink teeth compared with other causes of death. A significant correlation was observed between age at death and the number of pink teeth, with fewer pink teeth identified in older individuals. No statistically significant associations were found for the remaining parameters investigated.

Conclusions: Pink teeth were rarely documented in routine forensic autopsies and showed limited or no associations with most forensically relevant parameters. Given the low numbers of cases that were unequally distributed in the different categories assessed, results must be interpreted carefully. Unexpectedly, the majority of cases were identified in individuals recovered from dry locations, in contrast to existing literature that frequently links pink teeth to deaths in wet environments. This finding suggests that pink teeth could reflect secondary desiccation following an initial phase of wet decomposition. To further



explore this hypothesis and clarify underlying mechanisms, an experimental follow-up study will investigate the development of pink tooth discoloration under controlled in vitro conditions.

Ethics committee and informed consent: The current research was approved by the Ethics Committee of the Medical University of Vienna, Austria (vote no. 1069/2024). As the study was based on the retrospective analysis of post-mortem records, no written informed consent from study participants was obtained.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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PP12 Direction of head deviation from the reference lines on postmortem panoramic radiographs

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Keywords: Postmortem Panoramic Radiograph; Head Deviation; Reference Line; Supine Position, Head Correction.

Introduction: Panoramic radiographs are useful for personal identification by dental methods.⁽¹⁻⁶⁾ However, head alignment might be difficult in postmortem cases.⁽⁷⁻⁹⁾ We evaluated the direction of head deviation from the reference lines on panoramic radiographs, and investigated the feasibility of correction.

Methods: The subjects were 299 forensic autopsy cases (aged 15-78 years, mean age 62 years, excluding 10 unidentified cases), in which postmortem panoramic radiographs were taken using a portable apparatus (LPX7007D; Asahi Roentgen, Japan) with the subject in the supine position^(10,11) at Akita University between 2018-2019. The head was positioned to align with the reference lines as closely as possible. We extracted the cases in which teeth were out of the focal trough, based on difficulty confirming the number of teeth. Subsequently, the direction of head deviation from the reference lines was evaluated based on lateral head tilt, rotation, flexion/extension, and the anteroposterior position of the incisors on the panoramic radiographs.⁽¹²⁾

Results: The number of remaining teeth was difficult to confirm in 49 (21%) and 57 (25%) cases for the maxilla and mandible, respectively. Among the 49 maxillary cases, lateral head tilt was rare, with only eight cases (16%) in total on both sides. However, rotation to the right was observed in 25 cases (51%) and that to the left in six cases (12%); extension in 24 cases (49%) and flexion in five cases (10%). The incisor position was anterior to the focal trough in 21 cases (43%) and posterior in 13 cases (27%). The maxilla was commonly rotated to the right, extended (chin up), and positioned anteriorly. Among the 57 mandibular cases, lateral head tilt was observed in eight cases (16%) in total on both sides. Rotation to the right was observed in 25 cases (44%) and that to the left in eight cases (14%); extension in 16 cases (28%) and flexion in 15 cases (26%). The incisor position was anterior to the focal trough in 15 cases (26%) and posterior in 17 cases (30%). Compared to the maxilla, the differences of mandibular position between flexion and extension, and between anterior and posterior incisor positions, were smaller.

Conclusions: Lateral head tilt could be corrected by rotation of the trunk with the head, but rotation and flexion/extension were difficult to correct in many cases. Despite these limitations, postmortem panoramic radiographs remain valuable for identification when key findings can be compared with antemortem radiographs.



Ethics committee and informed consent: The current research was approved by the ethics committee of the authors' institution. Because the study involved deceased individuals, informed consent could not be obtained from the subjects. Furthermore, as the cases were forensic autopsies, obtaining informed consent from the next of kin was impracticable; therefore, an opt-out opportunity was provided to the bereaved families.

Clinical study registration number: This study was approved by the Ethics Committee of Akita University (Approval No. 2166).

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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<https://doi.org/10.1007/s41894-021-00111-4>.



e-POSTER PRESENTATIONS II

PP13 Accuracy of sex estimation using the Saini method in cone beam CT scans of Peruvian adults

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Keywords: Cone Bean Tomography; Mandible; Saini Method; Sex Estimation; Sexual Dimorphism.

Objective: To determine the accuracy of sex estimation using discriminant functions derived from the Saini method applied to cone beam computed tomography (CBCT) scans of Peruvian adults treated at a radiodiagnostic center in Lima, Peru.

Methods: A descriptive, observational, retrospective cross-sectional study was conducted based on the analysis of 142 CBCT scans with confirmed biological sex (69 male and 73 female). Five osteometric parameters of the right mandibular ramus were evaluated: maximum width (A), minimum width (B), condyle-inferior border distance (C), projective height (D), and coronoid height (E). Individual and multivariate discriminant functions were constructed from these variables according to the Saini method.⁽¹⁻²⁰⁾ Linear discriminant analysis with cross-validation was applied to evaluate the classification capacity and overall accuracy of the model.

Results: The morphometric variables showed significantly higher values in males than in females ($p < 0.001$), indicating pronounced mandibular sexual dimorphism. Mandibular height measurements revealed the most significant differences between the sexes. Discriminant analysis identified condylar-inferior border distance and coronoid height as the parameters with the highest discriminative power, followed by projective height, while maximum and minimum amplitudes showed a significantly lower contribution. The comprehensive model, composed of the five variables, achieved an overall accuracy of 94.4% in the original classification and 93.7% in cross-validation, with higher accuracy in males (95.7%). The reduced model, based on variables C, D, and E, retained significant predictive power, with an overall accuracy of 93.0% and 92.3% after cross-validation.

Conclusions: The methodology proposed by Saini demonstrated high accuracy in determining sex in Peruvian adults using CBCT, highlighting coronoid height and condyle-inferior border distance as the most discriminatory parameters. The implementation of



multivariate models made it possible to obtain significant levels of accuracy, even with limited schemes, which corroborate their relevance in the forensic field.

Ethics committee and informed consent: The research was conducted after submitting the corresponding letter and obtaining institutional authorization from the RAMADO Institute of Maxillofacial Radiology and Dental Diagnosis. Additionally, the project was approved by the Ethics Committee of the Universidad Científica del Sur.

Clinical study registration number: 194-2022-POS9.

Conflicts of interest: The authors declare no conflict of interest.

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PP14 A 13-year review of dental disciplinary proceedings in Singapore: trends, outcomes and implications for practice

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Keywords: Professional Misconduct; Dental Ethics; Malpractice; Disciplinary Action; Dental Regulation.

Introduction: Dental disciplinary proceedings represent a unique intersection of clinical practice, professional ethics and dental legislation.⁽¹⁾ Beyond individual culpability, such cases provide insight into regulatory priorities, standards of professional accountability, and systemic vulnerabilities within dental practice. While disciplinary trends among dental professionals have been explored in Western jurisdictions⁽²⁻⁵⁾, comparable studies from Asia remain scarce.⁽⁶⁾ In Singapore, outcomes of disciplinary proceedings are publicly available, yet have not been comprehensively examined in a systematic approach.⁽⁷⁾ This study aims to review the structure of Singapore's dental regulatory framework and to quantitatively analyse the characteristics, causes, procedural timelines, and outcomes of all concluded Disciplinary Committee (DC) inquiries conducted by the Singapore Dental Council (SDC) between January 2012 and June 2025. It further evaluates factors influencing disciplinary severity, including practitioner seniority, offence type, plea behaviour, and the application of the Wong Meng Hang sentencing framework.⁽⁸⁾

Methods: Retrospective analysis was conducted using publicly available Grounds of Decision documents from the SDC website.⁽⁹⁾ A total of 41 concluded DC inquiry cases meeting defined inclusion criteria were analysed. Extracted variables included practitioner demographics, offence classifications, procedural milestones, legal representation, pleas, and penalties imposed. Charges were categorised into regulatory, clinical, and criminal domains.⁽¹⁰⁾ Quantitative analysis was performed using R statistical software⁽¹¹⁾, employing descriptive statistics and inferential tests to examine associations between practitioner characteristics, offence types, and disciplinary outcomes.

Results: The rate of disciplinary action was low, averaging 1.13 cases per 1000 practitioners per year.⁽¹²⁾ Most respondents were fully registered dentists practising in the private sector, with a mean professional experience of 13.6 years. Regulatory infractions, particularly breaches of supervision and scope-of-practice requirements, were the most common charges, exceeding treatment-related offences. Clinical misconduct cases disproportionately involved senior practitioners and frequently resulted in suspension. Criminal convictions, particularly involving fraud, were the only offences leading to removal from the dental register. Guilty pleas (78%) were significantly associated with fewer hearings, shorter proceedings, and lower financial penalties. Application of the Wong Meng Hang sentencing framework was associated with longer suspension periods but comparatively lower fines.

Conclusions: Although uncommon, disciplinary actions in Singapore show distinct trends in practitioner demographics, offence types, and outcomes. Seniority, regulatory non-compliance, and criminal conduct were key determinants of disciplinary severity. These findings highlight the value of disciplinary data in identifying risk factors for professional



misconduct and informing regulatory, educational, and preventive strategies.⁽¹³⁾ Such analyses strengthen professional accountability and support the evolving role of forensic dentistry within regulatory and legal frameworks.⁽¹⁴⁾

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP15 Assessment of majority legal age using second lower molars according to Olze's method in a Brazilian population

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Keywords: Age Estimation by Teeth; Secondary Dentin; Forensic Dentistry.

Introduction: Age estimation methods are frequently used in forensic practice, particularly in situations involving legal age thresholds. Thus, root pulp visibility can be used to estimate age in adults through the four stages of the method proposed by Olze et al. in lower third molars.⁽¹⁻⁹⁾ This study aimed to validate the Olze et al. method in a Brazilian sample, using the mandibular second molar.

Methods: A cross-sectional observational study was conducted using 1,190 orthopantomographs from individuals aged 14.00 to 30.99 years, equally distributed by sex. Root pulp visibility was classified into four stages, with the primary objective of distinguishing whether a participant was younger or older than 18 years, as this age represents the legal age of majority in the country.

Results: A significant association was observed between developmental stage and chronological age ($p < 0.001$), whereas sex showed no significant influence. For the assessment of legal adulthood, stages 2 and 3 demonstrated high predictive value, with probabilities of 95.26% and 100%, respectively, for individuals being 18 years or older. An overall accuracy of 72% was achieved for predicting legal adulthood. However, stage assignment alone may not be very effective for estimating chronological age, since stages 0 and 1 were observed across the entire age range evaluated.



Conclusions: Despite its limitations, the method can contribute to forensic analysis when used in combination with other age estimation methods, particularly in situations where the third molar is absent.

Ethics committee and informed consent: the current research was approved by the Research Ethics Committee of the General Hospital of the Ribeirão Preto Medical School – University of São Paulo (Protocol Number: 6,820,594).

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP16 Learning outcome using virtual models of human teeth in dental anatomy education

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Keywords: Education; Dental; Learning Outcome; Models; Anatomic; Morphology; Dental; Printing; Three-Dimensional.

Background: Virtual anatomy models offer several advantages over traditional physical models, including unlimited availability, scalable visualization as well as cost- and time-efficient preparation. However, their impact on learning outcome in dental anatomy education remains poorly understood.⁽¹⁻⁷⁾ The aim of the study was to compare learning outcome following the use of virtual dental models or equivalent physical 3D-printed teeth for dental anatomy training and to assess potential influencing factors, including spatial ability and learning styles.

Methods: Fourth-year dentistry students (n=94) at the University Clinic of Dentistry in Vienna were assigned to two groups. One group completed practical exercises using 3D virtual surface models only, while the other group worked exclusively with 3D-printed teeth based on identical digital datasets. Learning outcome was assessed by a written exam consisting of feature determination of a randomly assigned 3D-printed tooth and multiple-choice questions evaluating theoretical dental anatomy knowledge. Spatial ability and learning preferences were assessed voluntarily using the "Schnitte" test by Fay & Quaizer-Pohl (n=27) and the VARK questionnaire (n=34).

Results: Students using 3D-printed models achieved significantly higher scores in feature determination compared to the virtual model group. No significant differences were observed between groups in theoretical knowledge assessed by multiple-choice questions. Overall learning outcomes were significantly higher in the 3D-printed model group. No correlations were found between learning outcomes and spatial ability or learning style.

Conclusions: The use of physical 3D-printed dental anatomy models resulted in superior learning outcome compared to using virtual models only. While virtual models offer important practical advantages, physical models provide haptic feedback and appear to be essential for dental anatomy education. A combined use of virtual and physical models is therefore recommended.

Ethics committee and informed consent: The Ethics Committee of the Medical University of Vienna, Austria confirmed that no formal approval was required in accordance with the Declaration of Helsinki. Approval for this study was obtained from the Data Protection



Committee of the Medical University of Vienna, Austria. All participants gave their written informed consent before they were enrolled in the study.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP17 Domestic violence against minors: forensic odontology evidence in judicial cases under article 152 of the Portuguese criminal code

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Keywords: Article 152 of the Portuguese Criminal Code; Domestic Violence; Forensic Odontology; Judicial System; Minors under 18 years.

Introduction: Domestic violence, as defined and punished under Article 152 of the Portuguese Criminal Code, constitutes an autonomous public offence aimed at protecting the dignity, physical and psychological integrity, and freedom of victims within family or equivalent relationships. The amendment introduced by Law no. 57/2021 clarified the legal framework of the offence and expressly allowed criminal liability based on a single act. Children and adolescents under the age of 18, whether as direct victims or witnesses to domestic violence, represent a particularly vulnerable population. In this context, bucomaxillofacial injuries are frequently observed, placing dentists under a legal and professional obligation to identify, document, and report suspected cases to the competent authorities.⁽¹⁻¹³⁾

Objective: To analyse the practical application of Article 152 of the Portuguese Criminal Code, as amended by Law no. 57/2021, in domestic violence proceedings involving victims under 18 years of age, adjudicated in the Judicial Courts of the Lisbon and Lisbon North Districts, with particular emphasis on forensic evidence, including the role of forensic odontology.

Materials e Methods: A retrospective observational epidemiological case series was conducted through structured documentary analysis of judicial proceedings involving victims under 18 years of age, adjudicated in the Judicial Courts of the Lisbon and Lisbon North Districts between 2021 and 2024. Variables related to the victim, the perpetrator, procedural handling, and the presence of forensic evidence were collected and analysed descriptively. Statistical analysis employed parametric and non-parametric tests according to the distribution of the variables.

Results: Twenty-seven minor victims were identified. Biological parents were the predominant perpetrators (77.8%). In cases legally classified as offences "against minors," economic dependence on the perpetrator was consistently observed, increasing victims' vulnerability. Bucomaxillofacial injuries were documented in two cases, both extensive and clinically visible. Forensic examinations were performed in only 22% of cases. The average duration of judicial proceedings was approximately four years, with higher compensation awards in more severe cases involving parental perpetrators.

Conclusions: Domestic violence against minors is predominantly intrafamilial in nature, with parents being the main perpetrators. Economic dependence reinforces the victim's



vulnerability and is associated with offences of greater severity. The low frequency of forensic examinations highlights an insufficiency in the institutional response and demonstrates the need to strengthen the role of Forensic Odontology within the justice system. Dentists, as healthcare professionals bound to legal duties of reporting and cooperation with judicial authorities, play an essential role in the detection, documentation, and reporting of such cases to the competent entities.

Ethics committee and informed consent: A study protocol regarding data collection was prepared and submitted to the Superior Council of the Judiciary of Portugal, together with a formal request for authorization. The study received a favorable opinion from the Council prior to its implementation.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP18 Estimation of the age of a sub-adult Portuguese population: analysis of the body of the fourth cervical vertebra

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Keywords: Baccetti's Method; Cameriere's Method; Cephalometric Radiographs; Cervical Vertebrae Maturation; Forensic Age Estimation.

Introduction: Age estimation is a key aspect of forensic science, particularly when the chronological age of living individuals is unknown. It is fundamental for establishing legal and criminal responsibilities.⁽¹⁻³⁾ Among the different biological markers, skeletal development has a relevant role⁽⁴⁾, and the cervical vertebrae are adopted as anatomical references for the assessment of biological maturity.⁽⁵⁻⁷⁾

Objectives: The purpose of this study was to estimate the biological age of a Portuguese subadult population (6–23 years) through the analysis of the fourth cervical vertebra (C4)⁽⁸⁾ on lateral cephalometric radiographs. Two approaches were applied: Baccetti's method, a qualitative staging system based on the morphology of cervical vertebrae C2–C4⁽⁵⁾, and Cameriere's method, a metric approach that calculates the ratio between the anterior and posterior heights of C4.⁽⁸⁾ The main goal was to provide reference data for the Portuguese population to support the forensic application of these skeletal scoring methods in age estimation.⁽⁹⁻¹¹⁾

Materials and Methods: The sample consisted of 528 lateral cephalometric radiographs, evenly distributed by sex and age.⁽⁹⁻¹¹⁾ Each radiograph was independently analysed using both methods.⁽⁵⁻⁸⁾ Intra- and inter-observer reliability were assessed using the Intraclass Correlation Coefficient and weighted Cohen's kappa.⁽¹⁻⁴⁾ Statistical analyses included correlation and multiple linear regression models, as well as Classification and Regression Tree and Receiver Operating Characteristic curve analyses to evaluate performance at the legal age thresholds of 12, 14, 16, and 18 years.⁽³⁻¹⁴⁾

Results and Discussion: Baccetti's method showed a strong correlation with chronological age ($R^2 = 0.753$; $p < 0.001$), with a mean error of approximately two years and high accuracy at the 12-, 14-, and 16-year thresholds, decreasing slightly at 18 years. Cameriere's method demonstrated lower explanatory power ($R^2 = 0.568$; $p < 0.001$) and a mean error of approximately 2.7 years, although the C4 ratio exhibited excellent discriminatory ability across all thresholds ($AUC \geq 0.89$). Combining both methods



increased explained variance to nearly 78%, highlighting their complementary value. Both methods showed excellent observer reliability. Females reached skeletal maturity earlier than males, with no significant sex-related differences in estimation error.

Conclusions: Both Baccetti's and Cameriere's methods demonstrated a strong and statistically significant correlation with chronological age in the Portuguese subadult population. While Baccetti's method showed greater precision, Cameriere's approach offered enhanced objectivity and reproducibility. These findings support the forensic applicability of cervical vertebral assessment for age estimation, particularly when integrated with additional biological indicators to improve accuracy and evidential robustness.

Ethics committee and informed consent: Ethical approval for the study was obtained from the Ethics Committee of ULS Santa Maria (approval no. 217/23). The study protocol and all supporting documents were reviewed and approved, including authorization from the Director of the Department of Stomatology and the Clinic Director of FMDUL. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP19 Crimes against sexual self-determination of minors under 16 years of age: a retrospective study in Lisbon and Lisbon North (2021–2024) and the role of forensic odontology

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Keywords: Child Sexual Abuse; Crimes Against Sexual Self-determination; Forensic Odontology; Judicial Proceedings; Criminal Justice System.

Introduction: Crimes against the sexual self-determination of minors, as defined in Articles 171 to 178 of the Portuguese Criminal Code, represent a phenomenon with major social, legal, and public health impact. These offences primarily affect children in contexts of vulnerability and often occur within environments of proximity and trust. Forensic odontology plays a relevant role in the early identification of suspected cases, particularly through the recognition and documentation of orofacial findings, contributing to child protection and effective coordination with the justice system.⁽¹⁻¹⁶⁾

Objectives: To characterize the profiles of victims and perpetrators, the family and socioeconomic context, the legal classification of crimes against sexual self-determination, the recorded physical and psychological harms, and the judicial outcomes, while assessing the presence and relevance of forensic evidence and highlighting the role of forensic odontology in the detection and reporting of child sexual abuse.

Materials and Methods: A retrospective observational study was conducted based on the analysis of judicial cases with final judgments involving minors under 16 years of age identified as victims of crimes against sexual self-determination between 2021 and 2024, in the Lisbon and Lisbon North Judicial Districts. Sociodemographic variables, family and socioeconomic context, victim–perpetrator relationship, criminal classification, location and type of assault, forensic examinations, recorded damages, and judicial outcomes were analysed descriptively. Statistical analysis was performed using Python® and Microsoft Excel® 365.

Results: A total of 94 victims were identified, of whom 49 were under 16 years of age. Overall, 90 victims were female and 4 males. The most frequent crime was aggravated child sexual abuse. Most cases involved male perpetrators, frequently family members, and occurred predominantly in private residences, often within economically vulnerable households. In 81% of cases, no forensic examination was conducted; when performed, sexual examination was the most common. Physical injuries were recorded in 23% of cases, while psychological harm was more frequently documented in older victims. Judicial sentences were more severe in cases involving younger victims.



Conclusions: Crimes against the sexual self-determination of minors predominantly affect female victims and frequently occur in contexts of family proximity and socioeconomic vulnerability. The high incidence of serious offences contrasts with the limited use of forensic examinations, revealing institutional gaps in evidence production. Forensic odontology plays a crucial role in the early detection, documentation, and reporting of suspected child sexual abuse, underscoring the need for specialized training and structured integration within multidisciplinary child protection and justice systems.

Ethics committee and informed consent: A study protocol regarding data collection was prepared and submitted to the Superior Council of the Judiciary of Portugal, together with a formal request for authorization. The study received a favorable opinion from the Council prior to its implementation.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP20 Foreign materials in the oral cavity during medicolegal autopsy with forensic odontologist participation: a 14-year case series from the Dominican Republic

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Keywords: Forensic Odontology; Medicolegal Autopsy; Oral Cavity Examination; Foreign Materials; Mechanical Asphyxia.

Introduction: Foreign materials within the oral cavity and upper airway are documented in medicolegal autopsies, particularly in violent, accidental, or suspicious deaths. These findings may be causal, contributory, or incidental, yet they hold substantial forensic and legal relevance. Proper in situ documentation—including description, measurements, and photographic recording—is critical. Despite their importance, oral cavity findings are frequently detected only after neck organ block dissection.⁽¹⁻²⁰⁾ This case series evaluates the forensic significance of foreign materials identified during systematic external oral examination with direct participation of a forensic odontologist.

Methods: A retrospective descriptive case series was conducted including 23 medicolegal autopsies performed between 2007 and 2021 at the National Institute of Forensic Pathology “Dr. Sergio Sarita Valdez” (Dominican Republic). Cases were selected when foreign materials were identified within the oral cavity during autopsy. Extracted variables included sex, age, nationality, manner of death, type of foreign material, causal relationship to death, and timing of detection. All examinations involved direct participation of a forensic odontologist during the external inspection of the oral cavity prior to neck organ block removal. Foreign materials were categorized as food-related or non-food objects.

Results: Of the 23 cases, 20 were male (87%) and 3 female (13%), with a mean age of 19.7 years (range: 1 month–55 years). Nationalities included Dominican (74%), Haitian (13%), Argentine (4%), and unidentified (9%). The manner of death was classified as accidental in 65%, homicidal in 30%, and natural in 4%. In 78% of cases, the foreign material directly caused death, most commonly by mechanical asphyxia; 22% represented incidental findings. Materials identified included food items (57%) and non-food objects (43%), such as coins, projectiles, dental prostheses, and other inserted materials. Notably, all foreign bodies were visualized in situ during the external examination, prior to neck dissection.

Conclusions: Systematic external oral cavity examination performed with forensic odontologist participation increases detection of foreign materials and may directly



influence determination of cause and manner of death. These findings support the incorporation of standardized oral inspection protocols in medicolegal autopsies and reinforce the role of forensic odontology within multidisciplinary forensic practice.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP21 AIUDF - Artificial Intelligence Unidentified Dental Form - the new approach in DVI

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Keywords: Forensic Dentistry; Artificial Intelligence; Human Identification; Form; Dental Implants.

Introduction: Human remains sometimes went through challenges in human identification procedures, like in fire cases. Forensic dentistry is a branch of legal medicine that can establish the identity, using the guidelines of the American Board of Forensic Odontology (ABFO). The ID in War Times Project allows the use of dental implants as a method of victim identification; it is considered an innovative method that presents an accurate and effective option. From the beginning until now, with different technologies, the dental implant industry shows thousands of models and brands, and millions of people across world were rehabilitated with these techniques. Artificial Intelligence is becoming a potential outgroup of human identification, which may make humanity more salient. Forensic Dentistry must keep up with the remarkable advances made in Artificial Intelligence and explore how human identification by dental implantology, webring exposed to Artificial Intelligence, we developed an Artificial Intelligence Unidentified Dental Form, abbreviated designed AIUDF.⁽¹⁻¹⁶⁾ The aim of the work is to construct Machine Learning algorithms in dental implantology, to facilitate the role of the expert dentists in forensic offices.

The AIUDF must be introduced to the forensic dentistry departments, to perceive Artificial Intelligence as tool of human identification, and therefore Artificial Intelligence experience positively predicts identification of humans.

The developed AIUDF model is useful in the medicolegal identification of unknown bodies, with advantage in mass disaster victim identification (DVI) context, by comparing antemortem (AM) and postmortem (PM) dental evidence in implantology.

Methods: At the form elaboration we used to construct the AIUDF and the Code Manual of the National Crime Information Center (NCIC) from the Federal Bureau of Investigation (FBI), the Federation Dentaire Internationale (FDI) Numbering System (FDI Two-Digits Notation, ISO 3950).

Results: The result is the construction of the AIUDF with the Dental Categories Classification includes 5 sections: Section 1 - Admin Info and Evidence Available; Section 2 - Dental characteristics (FDI System); Section 3 - Dental Codes Section 4 - Dental Remarks; Section 5 - Additional Dental Information and Additional Section 6 - Implant Characteristics.

Conclusions: All available methods must be used to add the Forensic Dentistry Experts in Human Identification. Forensic dentistry computer software compares AM and PM records,



quantifies the number of matches, mismatches, and possible matches between records and presents a ranked order to aid in reconciliation. The AIUDF aims to standardize human identification in forensic dentistry procedures, especially in cases of mass disasters.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

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PP22 Multidisciplinary age assessment in Finland

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Keywords: Age Estimation; Multidisciplinary Age Assessment; Pact on Migration and Asylum.

Introduction: According to Finnish legislation, Aliens Act⁽¹⁾, age assessment for asylum seekers is considered a forensic age assessment. The EU Pact on Migration and Asylum⁽²⁾ requires member states to implement age assessment using a multidisciplinary approach. This new multidisciplinary age assessment should include document analysis, interviews, a visual assessment based on physical appearance, and a psychosocial assessment before conducting a forensic age assessment. The objective was to investigate the methods used in multidisciplinary age assessment and based on these findings, to develop guidelines for professionals performing multidisciplinary age assessment prior to forensic age assessment in Finland.

Methods: The research was carried out as an assignment from the Ministry of the Interior, utilizing the existing knowledge base⁽³⁻⁸⁾ and consulting experts in multicultural health and well-being of the Finnish Immigration Service's Reception Unit, including a Senior Inspector, a Master of Social Sciences (MSSc) social worker, and the chief physician as well as a chief inspector from the unit for unaccompanied minors, who all work with individuals seeking international protection.

Results: The study showed that in the reception centre the applicants have discussions with a nurse, a social worker, their designated counsellor, and possibly a doctor and a psychologist. During these interviews a lot of information is gathered covering issues that help multidisciplinary experts assess age, topics related to growth, development and health, learning and independence, personal and cultural account of one's background and arrival in the country as well as the psychosocial development and the factors influencing it. We saw a possibility to use this gathered information in the multidisciplinary age assessment, and the new draft of the Aliens Act supported the use of this collected information.

Conclusions: Guidelines for a new age assessment protocol were developed, including a two-step multidisciplinary assessment prior to conducting a forensic age assessment. The first estimate is largely based on life-event history and is carried out by social worker and/or supervisor. In the second step, a psychosocial estimate is conducted, in which maturity and cognitive and physical development are evaluated by a multidisciplinary team, including, for example, a psychologist, a social worker, and a doctor/pediatrician. If age cannot be determined after these two multidisciplinary steps, a forensic age assessment, including radiological examination, may be requested. The multidisciplinary age assessment is now included in Aliens Act.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.



Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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PP23 Sex-related morphological trends of palatal rugae in adolescents and their forensic identification value

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Keywords: Forensic Dentistry; Human Identification; Palatal Rugae; Palatoscopy; Sexual Dimorphism.

Background: Palatal rugae are permanent anatomical landmarks located on the anterior hard palate. Due to their morphological stability and individual variability, these structures have gained increasing importance in forensic identification, particularly in scenarios where conventional dental comparison is limited.⁽¹⁻⁶⁾

Methods: A cross-sectional morphological evaluation was conducted on dental cast models obtained from 100 adolescents (with an equal male-to-female distribution), aged between 12 and 18 years. Rugae configurations were classified according to standardized morphological criteria into six pattern categories. Statistical evaluation was performed using Pearson correlation to assess bilateral symmetry and chi-square testing to investigate sex-related distribution differences. Statistical significance was defined at $p < 0.05$.

Results: Analysis of over one thousand recorded palatal rugae revealed that linear morphological configurations constituted the most frequently observed pattern, followed by undulating and curved forms. Female participants demonstrated a predominance of linear patterns, whereas male participants exhibited higher proportions of undulating configurations. Comparative statistical testing confirmed a significant association between rugae morphology and biological sex. Evaluation of palatal sides showed no relevant asymmetry, while correlation analysis indicated strong bilateral consistency across both sexes.

Conclusions: The morphological characteristics of palatal rugae display measurable sexual variation while maintaining bilateral structural stability. These findings support the reliability of palatal rugae assessment as a complementary forensic identification technique in adolescent populations and highlight its potential integration into forensic odontology protocols.

Ethics committee and informed consent: Ethical approval was obtained from the institutional review board. Written informed consent was secured from all participants before data collection.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP24 Impact of restorative and prosthetic interventions on the accuracy of YOLOv5x6-based tooth detection in OPGs

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Keywords: Convolutional Neural Networks; Tooth; Radiography; Panoramic; Forensic Dentistry.

Objective: While automated tooth detection on orthopantomograms (OPGs) has achieved significant advancement through deep learning⁽¹⁻³⁾, the impact of diverse dental interventions on model reliability remains an underexplored area of research. In forensic odontology, the consistent performance of deep learning models in the presence of diverse dental interventions is of particular importance, as these features constitute critical identifiers in the comparison of antemortem and postmortem dental records.⁽⁴⁾ This study evaluates the performance and robustness of a YOLOv5x6 Convolutional Neural Network (CNN) for automated tooth detection on digital OPGs, with a specific focus on the impact of restorative and prosthetic dental interventions on detection accuracy.

Methods: The YOLOv5x6 model was employed with an input resolution of 1820px. The dataset comprised 1,400 manually annotated digital OPGs, partitioned into training (75%), testing (12.5%), and validation (12.5%) sets. Interventions including fillings, crowns, bridges, and endodontic treatments were analyzed. Standard object detection metrics, such as mean Average Precision (mAP), were found to be unsuitable for evaluating intervention-specific impact as false positive detections cannot be reliably associated with specific dental procedures. Therefore, an alternative metric was introduced, measuring the detection success rate of teeth with a given intervention as the ratio of correctly detected teeth to the total number of teeth with that intervention in the dataset.

Results: The model achieved high mAP values for teeth in the upper jaw (0.9641) and lower jaw (0.9982). Individual tooth mAP values were generally high, with notable decrease observed for tooth 16 (0.7970). Success rates were exceptionally high for teeth with crowns (1.0000), fillings (0.9984), and endodontic treatments (0.9900). Conversely, a lower success rate of 0.8415 was recorded for bridge pontics. This performance gap is attributed to the absence of natural morphological markers, such as root structures and periodontal ligament spaces, which the CNN could utilize as key features for recognition.

Conclusions: The findings suggest that most dental interventions do not significantly impair tooth detection performance. This research, in line with similar studies⁽⁵⁾, demonstrates the robustness of CNN-based approaches in panoramic dental image analysis, while also indicating that structures lacking root, such as bridge pontics,



represent specific detection limitations. The introduced success rate metric provides a more realistic and clinically relevant evaluation of model reliability in the presence of complex restorations compared to standard mAP. The observed robustness of the CNN model in detecting teeth across diverse restorative and prosthetic conditions supports its applicability in forensic odontology, where precise and reproducible identification of dental structures is fundamental for dental identification.

Ethics committee and informed consent: The current research was approved by an independent ethics committee, Institutional Ethics Committee (05-PA-30-XXX-10/2021) of the School of Dentistry, University of Zagreb. Patients signed consent for the images (OPGs) to be used for scientific purposes. All personal data was removed from the radiological images used before further use in the research.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP25 Age estimation using pulp/tooth volume ratio of canines on CBCT: a digital workflow approach

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Keywords: Age Estimation; Canines; Cone-Beam Computed Tomography; Forensic Odontology; Pulp/Tooth Volume Ratio.

Introduction: Age estimation is a crucial aspect of forensic odontology, playing an important role in identifying unknown individuals. One of features of teeth used in age estimation is the apposition of a secondary dentine. Throughout life, the apposition of secondary dentin leads to a gradual reduction in coronal pulp volume, making it one of the most reliable and easily measurable morphometric parameters for age estimation in adults. The pulp/tooth volume ratio (PV/TV) reflects this change, making it a reliable age marker. Cone Beam Computed Tomography (CBCT) provides accurate three-dimensional imaging. The use of CBCT scans for age estimation based on teeth is non-invasive and non-destructive method.⁽¹⁻¹⁶⁾ The aims of this retrospective study were to estimate chronological age of the Bosnian-Herzegovinian population and to assess its correlation with age, based on the tooth and pulp volume of maxillary and mandibular canines.

Methods: This retrospective study analysed CBCT scans of 300 adults aged 18 years and older. Canines were segmented in Mimics software to calculate pulp and total tooth volumes, and PV/TV ratios were derived. Pearson correlation coefficient was used to evaluate the correlation between the chronological age and the PV/TV. Linear regression models were used to predict age from PV/TV ratios, and model performance was evaluated using the coefficient of determination (R^2). The accuracy of the predictions was tested using the Wilcoxon signed-rank test. The precision of the models was expressed as fluctuation intervals, representing the range of predicted ages.

Results: PV/TV ratios showed a strong negative correlation with age ($r=0.934$, $p<0.01$), confirming that pulp volume decreases with age. Regression models explained approximately half of the variation in age ($R^2=0.919$, $p<0.05$, for all four canines; $R^2=0.906$ for maxillary canines; $R^2=0.902$ for mandibular canines). The precision of developed models, presented by fluctuation intervals, i.e. the age range, moved from ± 3.4 to ± 3.85 years of age.

Conclusions: The PV/TV ratio of maxillary and mandibular canines measured by CBCT provides a reliable and non-invasive method for age estimation. The findings confirm that pulp volume decreases with age and that pulp/tooth volume ratio analysis of canines using CBCT can be used as a practical tool in forensic age estimation. The accuracy of this age estimation method is higher compared to most other commonly used approaches. Future studies should validate these results in larger and more diverse populations and explore automated or semi-automated segmentation to improve efficiency and reduce observer variability.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.



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PP26 Dental professional liability in Brazil: a preliminary analysis of 2024 court rulings using artificial intelligence

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Keywords: Malpractice; Forensic Dentistry; Legal Liability; Case Law.

Introduction: The litigation landscape in Brazilian dentistry requires longitudinal analysis to comprehend its trends.⁽¹⁻³⁾ Building upon a 2022–2023 mapping⁽⁴⁾ in which Implantology and Prosthodontics predominated, this study presents preliminary results regarding 2024 court rulings. The research employs Artificial Intelligence (AI) to optimize legal screening, a strategy to manage and synthesize the complexity and volume of these decisions.

Methods: A retrospective cross-sectional study was conducted on civil liability court rulings involving dental professionals published by Brazilian state Courts of Justice between January 1 and December 31, 2024. Data collection was performed on the Jusbrasil platform using the search term "dental professional liability." The methodology was innovated through the application of Python scripts for initial screening and the use of AI, which acted as an automated filter to locate specific terms and extract variables of interest from the text of each ruling. The algorithm segregated irrelevant cases, such as Social Security and Administrative Law, isolating cases with dental merit. The variables included specialty, type of defendant, decision, presence of expert reports, and compensation amounts.

Results: Tests performed on a sample of court rulings demonstrated the effectiveness of using programming scripts associated with AI to exclude false positives, optimizing the qualitative analysis of the data. In this preliminary phase, Implantology remains among the primary areas of litigation, while the distribution of other specialties is still under analysis. A strong correlation was observed between the expert report and the legal outcome: evidence of the absence of technical failure resulted predominantly in the dismissal of claims. In cases where liability was found, the cumulation of material damages (restitution) and moral damages was frequent, with moral compensation ranging between US\$ 960.00 and US\$ 2,880.00.

Conclusions: The use of AI presents itself as a promising tool for processing large volumes of case law in Forensic Dentistry. Partial results from this research suggest that failures in the duty to inform and the frustration of expectations remain relevant vectors of civil liability⁽⁵⁻⁷⁾, reinforcing the need for rigorous clinical documentation.⁽⁸⁻¹⁰⁾

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Clinical study registration number: Not applicable.

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PP27 Sex estimation from mandibular measurements: a retrospective Cone Beam Computed Tomography (CBCT) study using discriminant function analysis

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Keywords: Cone Beam Computed Tomography; Forensic Anthropology; Mandible; Measurements; Sex Estimation.

Background: Accurate sex estimation is a cornerstone in forensic anthropology and medico-legal identification. One of the most reliable bones used for this purpose is the mandible, owing to its dense composition and resistance to postmortem changes. Within the mandible, certain landmarks such as the gonion and menton are known to exhibit measurable sexual dimorphism.⁽¹⁻⁵⁾ This study evaluates the effectiveness of cone-beam computed tomography (CBCT) derived mandibular measurements in distinguishing between male and female individuals, using discriminant function analysis.

Methods: In this retrospective study, CBCT scans of 190 individuals (95 males, 95 females) aged 18–60 years were analysed for mandibular parameters, including Right and Left Gonion to Menton distances, Intergonial distance, and Gonial angle. Two observers independently recorded the values, and intra- and inter-observer reliability was confirmed (ICC > 0.90).

Results: All analyses were conducted using SPSS v25.0. Statistical significance was set at $p < 0.05$. Independent t-tests assessed sexual dimorphism. Discriminant function analysis (DFA) was performed for each variable individually to assess classification accuracy. A stepwise DFA model was developed to identify the most predictive combination of variables. Significant sexual dimorphism was observed in linear measurements ($p < 0.001$), with males showing consistently higher values. The angular measurement (gonial angle) showed no significant difference. Right Gonion to Menton distance had the highest individual classification accuracy (72.6%). A stepwise model incorporating Right and Left Gonion to Menton distances yielded an overall classification accuracy of 74.7%.

Conclusions: CBCT derived mandibular metrics, especially gonion-to-menton distances, are reliable indicators of sex and offer significant applicability in forensic and anthropological contexts. In forensic investigations where only partial skeletal remains are available, CBCT-based morphometric assessment provides a dependable, non-invasive, and reproducible method for sex estimation.

Ethics committee and informed consent: The current research was approved by the institutional ethics committee. Since it was a retrospective study using the radiographic archives, informed consent was not applicable. Patient confidentiality was strictly maintained.

Clinical study registration number: Not applicable.



Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: Nil.

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PP28 Evaluating ChatGPT-5.2 as an AI-assisted tool for dental age estimation using orthopantomograms: a comparative study with conventional forensic methods

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Keywords: Age Assessment; Artificial Intelligence; Dental Age Estimation; Forensic Odontology; Orthopantomogram.

Introduction: Forensic dental age estimation is a key component in legal age assessment and clinical decision-making, relying primarily on radiographic developmental methods such as Demirjian, Moorrees, and Willems. These methods remain widely accepted due to their reproducibility and scientific validation. With the rapid development of artificial intelligence (AI), there is growing interest in assessing whether AI-based systems may support or enhance traditional forensic workflows. Although AI applications in dentistry are expanding, the use of large language model-based systems such as ChatGPT-5.2, for dental age estimation has not yet been explored. The objective of this study is to evaluate the potential of ChatGPT-5.2, as an AI-assisted tool for dental age estimation and compare its estimations with established forensic methods in a Kosovar sample of children and adolescents.

Methods: This study is based on a dataset of 1000 orthopantomograms (OPGs) originating from the author's doctoral research. Dental age estimations previously performed using Demirjian, Moorrees, and Willems methods serve as reference standards. The same dataset is currently being re-evaluated using a standardized protocol designed to generate AI-assisted estimations through ChatGPT-5.2, based on documented dental developmental stages. Planned analyses include comparative assessment of agreement between methods, evaluation of variation across age and sex groups, and consistency analysis between AI-generated and conventional estimations.

Results: Research is ongoing. Results are expected for presentation at the Triennial I.O.F.O.S. Congress. The planned analysis will compare ChatGPT-5.2-assisted estimations with Demirjian, Moorrees, and Willems methods, with particular attention to agreement between methods and potential variation across age and sex groups.

Conclusions: This ongoing research explores the feasibility of integrating artificial intelligence into forensic dental age estimation workflows. Final results are expected to provide insights into the applicability, strengths, and limitations of ChatGPT-5.2, as a decision-support tool while emphasizing the continued importance of validated conventional methodologies.

Ethics committee and informed consent: The study utilizes a previously approved doctoral research dataset. Ethical approval and informed consent were obtained according to institutional guidelines.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.



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PP29 Digital CBCT analysis of canine pulp/tooth volume ratio in sex estimation

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Keywords: CBCT; Canines; Forensic Odontology; Pulp/Tooth Ratio; Sex Estimation.

Introduction: Sex estimation is one of the most important stages in forensic science and it is an essential part of building the biological profile of unidentified human remains. While skeletal morphology often provides the highest accuracy, dental structures can serve as reliable alternatives when skeletal elements are incomplete or damaged. One of features of teeth used in sex determination is the apposition of a secondary dentine, that reduce the volume of the coronal pulp. Volumetric analysis of teeth, especially canines, using cone beam computed tomography (CBCT) offers a non-invasive and non-destructive method of sex determination.⁽¹⁻¹²⁾

Methods: This retrospective study analysed CBCT images of 300 adults from the Bosnian-Herzegovinian population, all aged 18 years or older, with equal numbers of males and females. The research included all four canines, therefore, the total of 1,200 teeth were analysed. From the sample, using the random sampling method, 3D CT scans of 60 individuals of both sexes, were chosen, and a repeated procedure was made at least 6 months following the first segmentation and tooth volume determination. The control group included scans of 60 individuals of both sexes that were not included in the primary sample. Segmentation and three-dimensional (3D) modelling and a calculation of the pulp volume (PV) and the total volume (TV) of each canine was performed with Mimics 10.01 software. The PV/TV ratio was calculated for each tooth. Binary logistic regression and Receiver Operating Characteristic (ROC) curve analyses were applied to determine optimal cut-off values for the PV/TV ratio and to evaluate model performance using sensitivity, specificity, and overall accuracy.

Results: Logistic regression analysis identified statistically significant associations between the PV/TV ratio and sex. The overall model (four canines combined) produced an optimal cut-off value of ≥ 3.755 (0.595 sensitivity, 0.557 specificity, and ~58% accuracy). Maxillary canines yielded a cut-off ≥ 2.925 (sensitivity 0.269, specificity 0.953, accuracy ~61%), and mandibular canines ≥ 3.660 (sensitivity 0.604, specificity 0.537, accuracy ~57%). Across all models, males showed significantly higher PV/TV ratios compared to females, reflecting dental sexual dimorphism.

Conclusions: CBCT-based volumetric assessment of permanent canines provides moderate capacity for sex estimation. While the PV/TV ratio may serve as a supportive tool in forensic contexts where skeletal indicators are unavailable, its predictive performance suggests that it should be used in combination with other morphological or odontometric parameters. Future research should investigate additional dental measurements and explore automated segmentation techniques to improve predictive accuracy and reduce observer variability.

Ethics committee and informed consent: Not applicable.



Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP30 Craniofacial morphometric and morphological analysis of human skulls for forensic profiling and human identification: foundations for future digital workflows

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Keywords: Craniofacial Morphometrics; Forensic Anthropology; Forensic Facial Approximation; Human Identification; Skull Profiling.

Introduction: The skeletal assessment of craniofacial skeleton is essential for human identification in “forensic sciences”, “forensic odontology”, and “forensic and legal medicine”. Besides, it forms basis for reconstructive identification by means of determination of age, sex, and ethnicity, sometimes playing a crucial role in disaster victim identification (DVI) and forensic facial approximation (FFA).⁽¹⁾ Although the non-metric assessment of skull parameters is more widely used, it is still subjective and lacks accuracy. Hence, measurement of craniofacial traits (morphometrics) along with their interpretation enhances the objectivity of results and reproducibility.⁽²⁻⁴⁾ This is the first study to analyse a well-preserved resource of human skulls from a national forensic laboratory, which is rarely available for research due to ethical and custodial constraints. This study paved the foundation towards a digital-ready format for combined craniofacial morphometric and morphological data for future AI-assisted applications, human identification and facial reconstruction. Thus, this study was planned with the aim to analyse the human skulls for morphometric and morphological parameters and use the acquired data for forensic profiling and FFA.

Methods: Fifty-three human skulls were obtained from a central forensic laboratory in India following due institutional clearance. After anonymisation, skulls were analysed for 21 established metric and morphological craniofacial traits, which are routinely used for sex, age, and ancestry estimation. Standard anthropological thresholds were used to categorize the metric values. Sex estimation was performed using composite parametric traits and craniofacial indices, while ancestry assessment was based on morphological evaluation of the nasal, orbital, zygomatic, and palatal regions.

Results: Sex estimation classified 33 skulls (62.3%) as male, 11 (20.8%) as female, and 9 (17.0%) as indeterminate. Ancestry estimation demonstrated consistent midfacial trait clustering, with wide nasal apertures (60.4%), square orbits (65.4%), flared zygomatic arches (56.6%), and U-shaped palates (73.6%) predominating, alongside a subset of skulls exhibiting intermediate features reflecting biological variability. Age estimation was determined with dental parameters, wear, and mandibular morphology in more than 50% of the assessed skulls. Minor discordance was observed in approximately 10–15% of subjects. The age estimates differed by 1–2 years across age estimation indicators, highlighting the multifactorial nature of craniofacial ageing.



Conclusions: The analysis provided an objective and consistent framework for the purpose of reconstructive and comparative forensic profiling, human identification, specifically in facial approximation. Future aspects of this measured skull data can be transformed into digital datasets for a robust AI-assisted foundation for forensic odontology and facial approximation workflows.

Ethics committee and informed consent: Due permission and clearance were obtained from Central Forensic Science Laboratory (CFSL), Chandigarh before using the collection of skulls for the study. All skulls were anonymized before the collection of data.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

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PP31 Exploring machine learning approaches for precise dental age estimation in forensic odontology: focus on children and adolescents in Bosnia and Herzegovina

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Keywords: Dental Age Estimation; Children and Adolescents; Forensic Odontology; Machine Learning.

Objective: In forensic odontology, dental age estimation is crucial when identification documents are missing or disputed⁽¹⁾, as legally defined age thresholds (such as minority status) carry significant legal consequences. Traditional methods rely on manual staging and predefined linear models, making them time-consuming and prone to inter-observer variability. These limitations are pronounced in children and early adolescents, where biological age is highly uncertain.⁽²⁾ Building on our population-specific Bosnian linear formula⁽³⁾, we automate dental age estimation from pediatric OPGs using machine and deep learning.

Methods: We used 434 pediatric OPGs from Bosnia and Herzegovina (2013–2019).⁽³⁾ For cases with known birth and acquisition dates (N = 421), the mean age was 10.53 ± 1.95 years. Preprocessing included manual anonymization and photometric augmentations (brightness/contrast, gamma, CLAHE, blur, and noise), without geometric transformations that can introduce unrealistic variability. In the first step, we built a simple baseline using a linear model with Lasso regularization trained on tooth measurements taken from expert labels. In the second step, we used a two-step deep learning method: YOLO⁽⁴⁾ finds the teeth in the OPG and a ResNet-18 CNN⁽²⁾ predicts age from the cropped tooth images. Finally, a Vision Transformer (ViT)⁽⁵⁾ was trained on full OPGs and will be compared under identical evaluation.

Results: Four ResNet-18 models using tooth crops were evaluated. The baseline (BL) achieved MAE = 0.68 ± 0.09 and ± 6 -month accuracy of 0.46 ± 0.10 . With online colour jitter, JL achieved MAE = 0.66 ± 0.11 and ± 6 -month accuracy = 0.49 ± 0.09 , while JM showed similar performance (MAE = 0.67 ± 0.09 , accuracy = 0.49 ± 0.09). The best configuration was JMB (medium colour jitter + Gaussian blur), achieving MAE = 0.66 ± 0.12 , MSE = 0.77 ± 0.26 , $R^2 = 0.80 \pm 0.07$, and accuracies of 0.28 ± 0.07 (± 3 months) and 0.49 ± 0.10 (± 6 months).



Performance was similar across JL, JM, and JMB, while BL showed lower ± 3 - and ± 6 -month accuracy.

Conclusions: These findings indicate that the YOLO+CNN approach achieves promising accuracy in this challenging age range while providing more balanced error characteristics important for forensic interpretation. Final results will cover ViT performance and a unified comparison across all approaches. Additionally, explainable AI analyses⁽²⁾ will be applied to enhance interpretability and to compare the features and anatomical regions driving age predictions.

Ethics committee and informed consent: This study was approved by the Ethics Committee of Faculty of Dentistry in Sarajevo, Bosnia and Herzegovina under approval No. 09-552-9/2013.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interest.

Acknowledgements: None.

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PP32 Enhancing disaster victim identification training in Indonesia through collaboration between higher education institutions and the Indonesian National Police

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Keywords: Disaster Victim Identification; Forensic Odontology; Dental Education; Interprofessional Collaboration; Student Perception.

Background: Indonesia is a disaster-prone country frequently affected by natural and human-induced disasters, requiring well-prepared Disaster Victim Identification (DVI) systems. Forensic odontology plays a crucial role in DVI, and dentists are expected to possess fundamental competencies aligned with international standards, including the INTERPOL DVI Guidelines 2023. However, forensic dental education in higher education institutions often faces limitations in terms of specialized human resources, infrastructure, and exposure to real forensic practice. In contrast, national police institutions possess extensive operational experience, professional expertise, and adequate facilities for forensic identification.⁽¹⁻¹⁰⁾ This study aimed to describe and evaluate a collaborative educational model between a faculty of dentistry and the Indonesian National Police to strengthen forensic dental education and DVI competencies among clinical dental students in a disaster-prone setting.

Methods: This study employed a descriptive cross-sectional design as part of an educational program evaluation. The program was conducted from 28 to 30 August 2025 at the Hospital Centre of the Indonesian National Police, Jakarta, Indonesia. A total of 43 clinical dental students from the Faculty of Dentistry, Universitas Muhammadiyah Semarang participated in the program. The educational activities included theoretical lectures, skills laboratory training, case-based discussions, and direct exposure to Disaster Victim Identification procedures based on the INTERPOL DVI Guidelines 2023. This publication presents data derived from a post-program questionnaire survey capturing students' responses and testimonials regarding their learning experiences. The structured questionnaire, using Likert-scale and open-response items, assessed students' perceptions of knowledge improvement, learning interest, educational effectiveness, relevance of real-world forensic exposure, and overall satisfaction with the collaborative program. Survey data were analyzed descriptively.

Results: Most participants reported a marked improvement in their understanding of Disaster Victim Identification concepts and forensic dental procedures following the program. The majority of students perceived the collaborative learning experience as more effective and engaging than conventional classroom-based instruction. Direct exposure to a real forensic environment and interaction with experienced forensic practitioners enhanced students' motivation, focus, and perceived readiness to participate in disaster



response scenarios. Student testimonials highlighted the value of hands-on training and expert-led discussions in improving confidence and practical insight into forensic dental practice.

Conclusions: Collaboration between higher education institutions and national police agencies represents an effective strategy for strengthening forensic dental education in disaster-prone countries. This collaborative educational model bridges the gap between academic learning and operational forensic practice, enhancing students' competencies and preparedness in Disaster Victim Identification. Incorporating student feedback through structured surveys provides valuable insights into the educational impact of such programs and supports the sustainability and replication of collaborative forensic dental education initiatives.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interests.

Acknowledgements: None.

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EXHIBITION ROOM

Room 1

ER1 Migrant Disaster Victim Identification

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Keywords: Migrant Disaster Victim Identification.

Background: The COST Migrant Disaster Victim Identification (MDVI) Action is supported with European Union funding and has more than 200 members from 32 countries or international organisations. The Action was set up in 2023 to enhance MDVI through research collaboration, professional training and innovation.⁽¹⁻⁴⁾

Discussion: The workshop exhibits outcomes relating to the Action, such as technological innovation, training programme, publications and professional guidance. These include a MDVI Automated News Intelligence Tool for tracking missing migrants, fatalities, the Action training schedule for practitioners and identification efforts across global migration routes, a report on the status of MDVI across Europe and a Forensics Application Repository.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interests.

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ER2 Connecting expertise for trustworthy AI in dental age estimation: early collaborative activities of COST Action CA24147

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Keywords: Artificial Intelligence; Dental Age Estimation; Forensic Odontology; International Collaboration.

Background: Dental age estimation plays a fundamental role in forensic science, legal medicine, anthropology, and clinical dentistry. Recent advances in artificial intelligence (AI) have created new opportunities to improve the accuracy, reproducibility, and efficiency of dental age estimation.⁽¹⁾ However, the implementation of trustworthy AI remains limited by fragmented datasets, heterogeneous imaging protocols, inconsistent annotation strategies, and the lack of internationally harmonized validation frameworks.⁽²⁾ Addressing these challenges requires coordinated multidisciplinary collaboration and the development of shared scientific standards rather than isolated technological advances.⁽³⁾

Discussion: COST Action CA24147 (AID-AgE) has established an interdisciplinary network bringing together experts in forensic odontology, dentomaxillofacial radiology, artificial intelligence, computer science, statistics, ethics, and related disciplines.⁽⁴⁾ Rather than focusing solely on algorithm development, the Action promotes collaborative activities aimed at harmonising research protocols, encouraging data sharing, improving annotation strategies, supporting researcher mobility, and strengthening scientific exchange through Working Groups, Training Schools, Short-Term Scientific Missions, and dissemination initiatives. These early collaborative activities have already fostered new research partnerships and laid the groundwork for future collaborative research, translational projects, and AI-supported solutions for forensic odontology.

Conclusions: Continued collaboration will be essential to translate these collective efforts into scientifically robust, ethically responsible, and clinically applicable innovations.

Ethics committee and informed consent: Not applicable.

Clinical study registration number: Not applicable.

Conflicts of interest: The authors declare no conflict of interests.

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SOCIAL AND CULTURAL EVENTS

WEDNESDAY SEPTEMBER 9, 2026

18:30 Cultural Tour, Visit to the Portuguese Maritime Museum (Museu da Marinha).

20:00 Welcome Drink, Pavilhão das Galeotas Portuguese Maritime Museum (Museu da Marinha) - **Praça do Império, Santa Maria de Belém, 1400-206 Lisbon**

THURSDAY SEPTEMBER 10, 2026

17:15 All together photo, on the stairs in front of the main building on the street.

FRIDAY SEPTEMBER 11, 2026

20:45 Welcome Drink at the Darwin's Café, Champalimaud Foundation Restaurant (optional).

21:15 Gala Dinner at the Darwin's Café, Champalimaud Foundation Restaurant (optional) - **Largo da Fundação Champalimaud, 1400-038 Lisbon**

SATURDAY SEPTEMBER 12, 2026

8:30 Meeting Point Holliday Inn Lisbon (optional) - **Av. De António José de Almeida 28 A, 1000-044 Lisboa**

9:00 Sightseeing trip to Óbidos Village - departure from Holliday Inn Lisbon (optional) - **Av. De António José de Almeida 28 A, 1000-044 Lisboa**

10:30 Cultural tour with guide in Óbidos Village

13:30 Lunch Praia Del Rey Marriot Golf and Beach Resort - **Vale De Janelas, Av. Dona Inês de Castro N° 1, 2510-451 Amoreira**

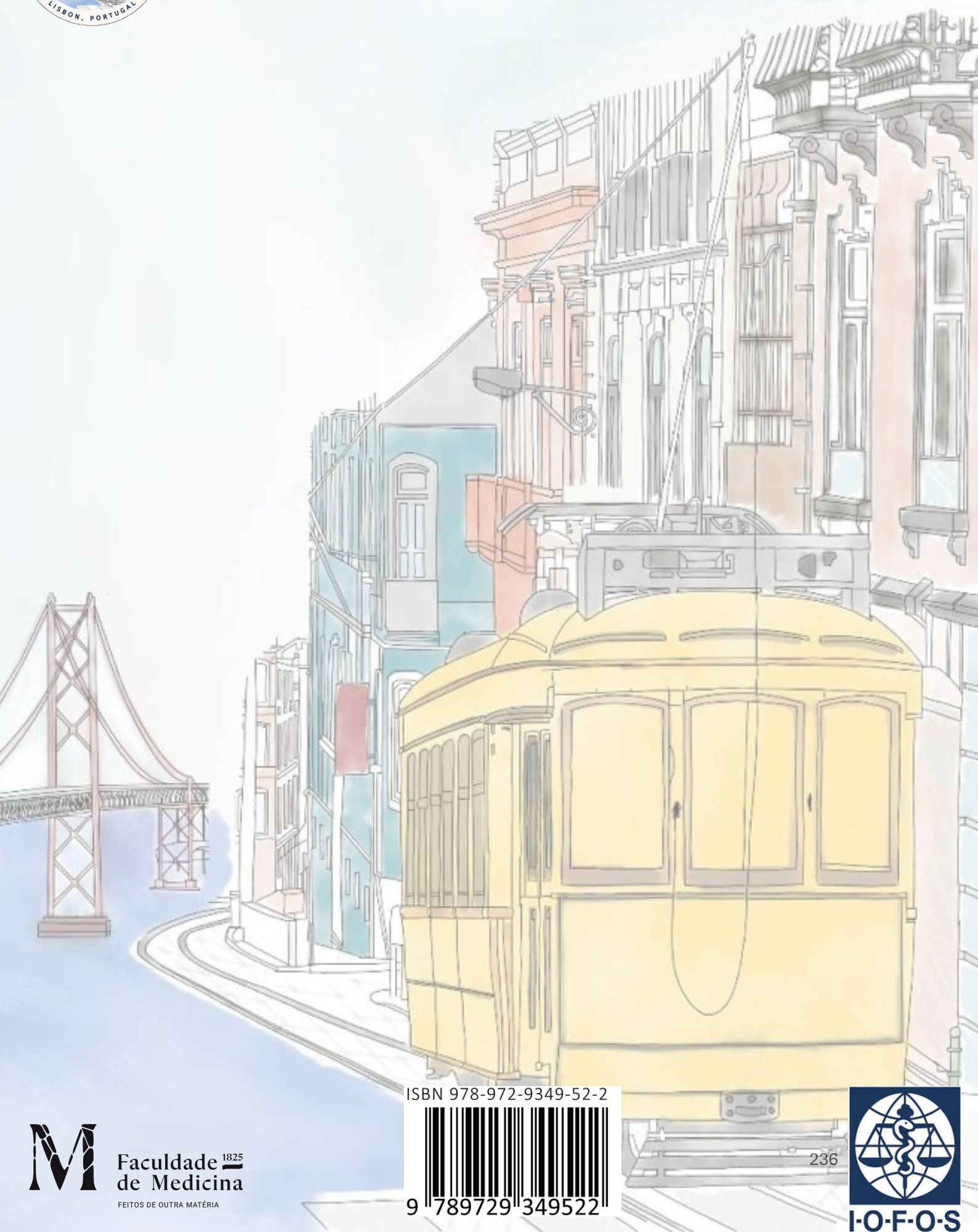
16:00 Departure to Lisbon



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