ISFRI 2023

12ᵗʰ Annual Meeting of the International Society for Forensic Radiology and Imaging (ISFRI)

18ᵗʰ Annual Meeting of the International Association of Forensic Radiographers (IAFR)

25-27 Mai 2023

Hôtel Palladia
Toulouse, France

THE INTERNATIONAL ASSOCIATION OF FORENSIC RADIOGRAPHERS

ISFRI International Society of Forensic Radiology and Imaging
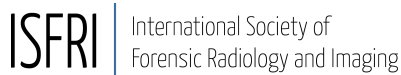
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Dear Friends and Colleagues, Dear ISFRI Members

After the troubled previous meetings …

It is really our pleasure on behalf of the ISFRI and IAFR boards and the scientific committee to welcome you PHYSICALLY to the joined 12th Annual Meeting of the **International Society for Forensic Radiology and Imaging (ISFRI)** and the 18th Anniversary Meeting of the **International Association of Forensic Radiographers (IAFR)**, that will take place at the Palladia hotel in Toulouse, France **May 25th - 27th 2023**.

Nowadays forensic imaging plays a growing major role in forensic science and constitutes a rapidly developing research area. The joint ISFRI and IAFR annual meeting is an amazing opportunity to learn the latest developments in this the field of forensic radiology and forensic anthropology. It is also of course an opportunity to meet colleges, old and new friends from all over the world.

The meeting is hosted by the Department of Forensic Medicine at the University Paul Sabatier from Toulouse.

Toulouse is an active and beautiful city situated in South West of France, between the Atlantic Ocean and the Mediterranean See. The campaign is near, mountains also, and Spain is not so far. Toulouse is only 1-hour plane ride from Paris Airport. Toulouse and the OCCITANIE Region have a lot of amazing sites, from which some are UNESCO awarded. The city and the region are perfect if you like culture, history, with a city and a region full of churches, monuments, castles, museum … (and of course food and wine 😊).

I hope that the spirit of the meeting will keep collegiality, respect, curiosity and sharing. Of course, the final aim of this meeting are multiple: to learn and initiate or strength wonderful collaborations.

Do not forget that through the ISFRI and the IAFR we have the unique opportunity to collaborate on an international and interdisciplinary level, which allows us to benefit from the experience and individual knowledge of each and every member of our society.

The joined ISFRI and IAFR meeting is an exclusive forum for international experts to share and compare their experience in forensic radiology and forensic anthropologist.

I am looking forward to seeing you all in Toulouse, to work, to share, and to enjoy a congress in what is considered to be one of the most beautiful city and region of France.

Warmest regards,

Docteur Fabrice DEDOUIT, MD. Ph.D. Chair ISFRI

On behalf of the scientific committee

ISFRI 2023

Thursday 25th May

08:00 - 08:30	**Welcome coffee**	Opéra Room
08:30 - 09:00	**Opening**	Amphitheatre

Fabrice Dédouit, ISFRI Chair

Sara Laurencin, vice dean of the Health University, Toulouse

Vincent Bounes, vice president of Occitanie Region

09:00 - 11:00 Opening sessions   Amphitheatre
Chair: Fabrice Dédouit

09:00 - 9.45: Artificial intelligence, blockchain: a link with medicine and death? **Anthony Gonnet Vandepoorte**

09:45 - 10:30: Radiological innovations and forensic imaging. **Alain Blum/Nicolas Doui**

10:30 - 11:00 Coffee / Exhibit   Opéra Room

① **11:00 - 12:15 Session: Trauma and PMCT**   Amphitheatre
Chair: Luiz Ferraz Da Silva / Michael Thali

11:00 - 11:30: A young and agile teaches an elderly: benefits of post mortem imaging in forensic pathology. **Krzysztof Wozniak**

11:30 - 11:40: Life in the Fast Lane: Fatal Motor Vehicle Accidents in Albuquerque, NM. **Jarrell Heather**

11:40 - 11:50: The impact of PMCT in demonstrating findings difficult to observe at autopsy. **Roberto Maselli**

11:50 - 12:00: Applications of post-mortem CT at the Paris Forensic Institute between 2021 and 2022. **Juliette Oliero**

12:00 - 12:15: Case report: Not All That Glitters Is Gold... Standard. **Pires-Davidson John**

② **11:00 - 12:15 Session: Fossils, anthropology and imaging**   Capitouls Room
Chair: Mislav Cavka / Rozenn Colleter

11:00 - 11:35: Virtual explorations of our ancestors. **Jose Braga**

11:40 - 11:50: Photomummetry - Rapid photogrammetric surface documentation of mummies using a mobile multi-camera system. **Dominic Gascho**

11:50 - 12:00: Paleoradiology: The utility of Lodox scanning in the assessment of injury in the Later Stone Age of southern Africa. **Calvin G Mole**

12:00 - 12:10: The quiet rest of the warrior: a story of life, death, taphonomy and bone diagenesis. **Edda E Guareschi.**

12:15 - 13:15   Lunch / Exhibit   Opéra Room

12:15 - 13:15   Posters   Opéra Room
Chair: Frédéric Savall / Krzysztof Wozniak

- Coronary artery detection using novel water-soluble contrast agents in post-mortem magnetic resonance imaging. **Mitsuha Fukami**
- Delineation ability of one-scan fused CT with deep learning imaging reconstruction (DLIR) to visualize aortic dissection. **Masahiro Yoshida**
- Estimation of sex by radiological measurement of the femoral head of an Algerian sample. **Ammar Lahouel**

- Gunshot residue detection on wounds after carbonization. **Céline Guilbeau Frugier**
- Legal retention period for imaging data in France in 2023. **Manuelo Turkiewicz**
- Two medico-legal autopsy cases of multinodular and vacuolating neuronal tumor revealed by postmortem MRI. **Yohsuke Makino**
- Validation and recalibration of the Klales et al. (2012) sexing method for Algerian population using virtual coxal bones. **Mohamed Yassine Guellati**
- Validation of an automated landmark method based on atlas. **Géromine Fournier**
- What is the yield of adding post-mortem computed tomography and fast-track toxicology to the medico-legal external examination in a Danish setting? A project outline. **Peter Roerdam**
- Which methods do forensic specialists worldwide use for gestational age estimation in fetal death? **Valerie Niehe**
- Comparative study on the development of the knee by post-mortem CT, DR, and MRI. **Apameh Khatam-Lashgari**
- 10:25 - 10:35: An Unusual Victim. **Albane Guigné**

13:15 - 14:45:   Session: Natural death and forensic imaging   Amphitheatre
                    Chair: Cristina Jacobsen / Chris O'Donnell

13:15 - 13:45: CT imaging of cardiovascular disease. **Lee Heon**

13:45 -14:00: A Pastiche of Natural Disease: Radiological/Pathological Correlation. **Jamie Elifritz**

14:00 - 14:20: Characteristics of Acute Coronary Atherothrombosis in Post-mortem CT Angiography. **Katarzyna Michaud**

14:20 - 14:35: The Last Supper: Minimally Invasive CT-Assisted Postmortem Collection of Gastric Contents. **Chris O'donnell**

14:35 - 14:45: An unusual case of venous variant leading to fatal vessel perforation during central venous catheter placement. **Jochen Grimm**

13:15 - 14:45 Session: Ballistic and forensic imaging   Capitouls Room
                    Chair: Céline Guilbeau Frugier / Thomas Ruder

13:15 - 13:30: Gunshot wounds on archeological remains: a new application of CT scan? **Mathilde Ducloyer, Elodie Cabot**

13:30 - 13:45: Detection of gunshot residue on wounds after burial. **Céline Guilbeau Frugier**

13:45 - 14:00: Establishing bullet reference ranges for in situ measurement of common handgun calibers using Lodox imaging. **Calvin G Mole**

14:00 - 14:10: Identification of entry gunshot wounds using hyperdense ring sign on PMCT. **Emilien Jupin-Delevaux**

14:10 - 14:20: Usefulness of virtual reassembly of skull or spine in cases of fragmentation due to high-energy trauma or bone separation through postmortem changes. **Haruki Fukuda**

14:20 - 14:40: The Gamut of Gun Related Deaths in the Wild West. **Jamie Elifritz**

14:45 - 15:15 Coffee   / Exhibit   Opéra Room

15:15 - 16:50 Session: Pediatric and forensic imaging   Amphitheatre
                    Chair: Mathilde Ducloyer / Rick Van Rijn *(to be confirmed)*

15:15 - 15:45: What is the interest of post mortem imaging in pediatrics? **Mathilde Ducloyer**

15:45 - 16:10: The complementary roles of whole-body postmortem computed tomography and conventional skeletal survey. **Rick Van Rijn**

16:10 - 16:25: Postmortem lung CT findings in infants. **Hyodoh Hideki**

16:25 - 16:40: Spectrum of Common and Unique Pediatric Forensic Imaging. **Brittany Depasquale**

16:40 - 16:55: How micro-CT imaging can aid a medico-legal investigation in a fatal case of suspected child abuse. **Charlotte Primeau**

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15:15 - 16:50 Session: Odontology and forensic imaging   Capitouls Room

Chair: Guy Rutty / Aleksandra Borowska-Solonynko

15:15 - 15:40: Odontology, forensic medicine and forensic imaging. **Delphine Maret Comtesse**

15:40 - 15:50: DVI-related tooth assessment. Intra-autopsy inspection versus PMCT-based evaluation. **Aleksandra Borowska-Solonynko**

15:50 - 16:00: Methods of creating a panoramic dental image from CT data. **Marttinen Fox**

16:00 - 16:10: An attempt to estimate age using alveolar bone image. **Fujimoto Hideko**

16:10 - 16:25: History of a smile. Anne d'Alégre (1565-1619, Laval, France). **Antoine Galibourg**

16:25 - 16:40: When dental comparative identification is the only way to recognize unknow human remains with a presumed identity? A case report. **Géromine Fournier**

16:40 - 16:55: Dental age estimation using PMCT: A case of a plaster-embedded infant body found 50 years after death. **Yamaguchi Rutsuko**

17:00 - 17:30: **Closing session of the day**

Chair: Dédouit Fabrice

Paleoradiology. **Frank Ruhli**   Amphitheatre

18:15 - 20:00 Cocktail at the City Hall   **Salle des Illustres**

After 20:00: Evening free

Friday 26ᵗʰ May

07:30 - 08:30
Editorial meeting for the Journal "Forensic Imaging"   Croix Baragnon Room
(for editorial board only)

08:00 - 8:30 Welcome coffee   Opéra Room

① 08:00 - 10:30 Parallel Session   Capitouls Room
TWGPAM symposium (Technical Working Group Postmortem Angiography Methods)
(limited to 80 persons max)
                    Chair: Silke Grabherr
              Learn how making postmortem angio CTs scan is possible!
08:00 - 08:35: TWGPAM and Post-mortem angiography. **Silke GRABHERR**
08:35 - 09:00: Postmortem imaging of sudden cardiac death, the pathologist's perspective. **Katarzyna Michaud**
09:00 - 09:20: Intravascular pressures during MPMCTA. **Florian FISCHER**
09:20 - 10:20: Interpretation of post-mortem angiography. Practical cases. **Virginie MAGNIN**
10:20 - 10:30: Conclusion and final discussion.

② 08:30 - 10:30 Session: Identification / Anthropology and forensic imaging   Amphitheatre
                    Chair: Fabio Cavalli / Chiara Villa
08:30 - 08:55: Paleo imaging. **Mislav Cavca**
08:55 - 09:15: Rutty's Rules. **Guy Rutty**
09:15 - 09:30: Ötzi the Iceman: forensic 3D reconstructions of a 5300-year-ago murder case. **Chiara Villa**
09:30 - 09:45: Once Upon a Time .... The Secrets of Glaciers. **Bettina Schrag**
09:45 - 10:00: Use of postmortem computed tomography in disaster victim identification: Current Japanese methods and challenges. **Maiko Yoshida**
10:00 - 10:15: Mummy Bone Density - A dual-energy CT-based method for measuring bone volume fraction in a mummified body that yields accurate results even in the presence of air in the bones. **Dominic Gascho**
10:15 - 10:30: Lodox Linear Slot Scanning Radiology (LSSR) - Unique Radiology Technology in Forensics. **Efthimia Tzetis**

10:30 - 11:00   Coffee / Exhibit   Opéra Room

11:00 - 12:00 Gil Brogdon Honorary Lecture   Amphitheatre
                    Chair: Dédouit Fabrice
Complementary investigations: weapon marks examination techniques on wounds. **Céline Guilbeau Frugier**

12:00 - 13:00   Lunch / Exhibit   Opéra Room

12:00 - 13:00   Posters   Opéra Room
Chair: Frédéric Savall / Krzysztof Wozniak

- Coronary artery detection using novel water-soluble contrast agents in post-mortem magnetic resonance imaging. **Mitsuha Fukami**
- Delineation ability of one-scan fused CT with deep learning imaging reconstruction (DLIR) to visualize aortic dissection. **Masahiro Yoshida**
- Estimation of sex by radiological measurement of the femoral head of an Algerian sample. **Ammar Lahouel**
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- Legal retention period for imaging data in France in 2023. **Manuelo Turkiewicz**
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- An Unusual Victim. **Albane Guigné**

13:00 - 14:00: Working Groups
Kindly choose your working group for one hour of brainstorming with your leader.
The aim would be to write white papers that can be published, to write recommendations papers concerning the use of specific radiological tools depending the medico legal context or case …, Update past published articles written by WG …, Develop your network, Develop your collaborations with other scientific societies.

WE NEED YOU !

DVI - Krzysztof Wozniak   *Splitted Amphitheater*
Education - Makino Yohsuke   *Splitted Amphitheater*

Guidelines - Jamie Elifritz   Filatiers Room

Image acquisition - Natalie Adolphi   Perche Pinte

Paediatric imaging - Rick Van Rijn   Croix Baragnon

Forensic anthropology - Chiara Villa   Capitouls

14:00 - 15:30: Session: Education and forensic imaging   Amphitheatre
Chair: Hideki Hyodoh / Silke Grabherr *(to be confirmed)*
14:00 - 14:30: Fetal postmortem imaging using contrast enhanced micro-CT and 3D ultrasound. **Bernadette De Bakker**
14:30 - 14:50: Post-mortem imaging techniques as complementary tools for the teaching of anatomy at the Faculty Unit of Anatomy and Morphology in Lausanne. **Sara Sabatasso**
14:50 - 15:10: Updates on the New Mexico Decedent Image Database. **Heather Edgar**

15:10 - 15:25: Personal Identification from AM and PMCT Derived 3D Lumbar Models. **Jonathan Ford**

14:00 - 15:30 Sessions - Scientific communications   Capitouls Room
12th Annual Meeting of the International Association of Forensic Radiographers
                    Chair: Lindsay Batty-Smith / Philippe Gerson
14:05 - 14:20: Current forensic imaging practices in Australia and New Zealand: Results from ANZ IAFR survey. **Courtney Steels**
14:20 - 14:35: Stature estimation of the South African male population using the postmortem Lodox imaging. **Marise Heyns**
14:35 - 14:50: From Yugoslavia to Ukraine? - The role of radiography in the forensic investigation and victim identification of war crimes. **Mark Viner**
14:50 - 15:05: Proposed radiation doses from a phantom study for an NAI skeletal survey X-ray series. **Edel Doyle**
15:05 - 15:20: Confirmation of Cardiomegaly from the Cardiothoracic Ratio in Post Mortem Lodox® Imaging. **Marise Heyns**

15:30 - 16:00 Coffee / Exhibit   Opéra Room

16:00 - 17:15 Session: Identification /anthropology   Amphitheatre
                    Chair: Krzysztof Wozniak / Bernadette De Baker
16:00 - 16:20: Standards of practice in forensic age estimation with CT of the medial clavicular epiphysis – a systematic review. **Thomas Ruder**
16:20 - 16:35: Unaccompanied Minors Automatic Forensic Age Estimation (UMAFAE): applying artificial intelligence-based methods to estimate legal age in undocumented minors. **Stefano De Luca**
16:35 - 16:45: Virtopsy approaches forensic use of 3D radiological data to confirm suspected personal identity. **Wolf Schweitzer**
16:45 - 17:00: Postmortem CT: the experience of the Research Unit of Paleoradiology and Allied Sciences of Trieste. **Martina Montanaro**
17:00 - 17:15: The practice of forensic anthropology and odontology. **Fathéma zehra Bounif**

16:00 - 17:15 Parallel Session II   Capitouls Room
12th Annual Meeting of the International Association of Forensic Radiographers
                    Chair: Edel Doyle / Eric Dumousset
16:05 - 16:25: Micro-CT imaging for forensic case work: A collaboration between West Midlands Police and WMG, Warwick University, UK. **Charlotte Primeau**
16:25 - 16:35: Development of water-soluble contrast agents for postmortem computed tomography angiography. **Nishida Hinata**
16:35 - 16:45: Novel water-soluble contrast agent for whole body postmortem magnetic resonance imaging. **Yamamoto Tomoaki**
16:45 - 17:05: Importance of additional sequences and postprocessing techniques in postmortem MRI. **Kojima Masatoshi**

17:30 - 18:30 General Assembly of the ISFRI   Amphitheatre

19:30 - Gala diner   **Salle des colonnes, Hôtel Dieu**

ISFRI 2023

Saturday 27th May

08:00 - 08:30 Welcome coffee   Opéra Room

1

08:30 - 11:00 Session: Forensic imaging and technology I   Amphitheatre
Chair: Wolf Schweitzer / Yanko Kolev

08:30 - 09:00: The use of Image Guided Minimally Invasive Autopsy in Brazil. **Luiz Ferraz Da Silva**

09:00 - 09:15: Postmortem Infrared Coronarography of the Human Heart. Results and Improved Technical Protocols. **Yanko Kolev**

09:15 - 09:30: Evaluation of subject-specific finite element analysis of skull fracture as a forensic tool. **Mikkel Henningsen**

09:30 - 09:45: Micro Computed Tomography for Post Mortem Imaging. **Daniel Docter**

09:45 - 10:00: Virtopsy of isolated bones: better fracture morphology by reducing bone surface CT artifacts through using a water bed. **Wolf Schweitzer**

10:00 - 10:15: DECT and QCT-based Measurement of Bone-Volume Fraction - An Ex Vivo Pairwise Comparison. **Patrik Wili**

10:15 - 10:30: In situ determination of pH in brain tissue using postmortem 1H-MRS. **Dominic Gascho**

10:30 - 10:45: Automated classification of ballistic-related Post-Mortem CT reports using Natural Language Processing. **Joseph Benzakoun**

10:45 - 11:00: Quantitative morphological analysis by Fourier elliptical descriptors in 3D. **Pierre-Emmanuel Zorn**

2

08:30 - 11:00 Forensic imaging and miscellaneous   Capitouls Room
Chair: Mathilde Ducloyer / Nathalie Adolphi

08:30 - 08:55: Postmortem CT and forensic identification: the role of facial approximation and craniofacial superimposition techniques. **Fabio Cavalli**

08:55 - 09:10: Knowing the case inside out: The value of having CT available in the courtroom setting. **Janette Verster**

09:10 - 09:25: Correlation between PMCTA and autopsy findings in violent deaths. **Fehmi Snène**

09:25 - 09:40: When Animals Attack: Forensic Imaging Unit. **Jamie Elifritz**

09:40 - 09:55: Detection of iodine using spectral imaging on PMCT. **Chris O'donnell**

09:55 - 10:05: Image Quality Assessment of Low-Dose Whole-Body Phantom CT Skeletal Surveys for NAI. **Edel Doyle**

10:05 - 10:15: Utility of PMCT in a case of systemic silicone embolism. **Denise Squecco**

10:15 - 10:25: Artifacts in CT-imaging of the brain: A cooling effect? **Frédérique Thicot**

10:25 - 10:40: The use of Postmortem CT-scan and quick toxicology analysis as a supplementary screening method to the medicolegal inquest. **Kisbye Lea Wold**

10:40 - 11:00: The Perils of Fentanyl: An Update on Contraband Drug Smuggling and Abuse in 2023. **Barry Daly**

11:00 - 11:30 Coffee   / Exhibit   Opéra Room

11.30 - 13:00 Forensic imaging and technology II   Amphitheatre

1

Chair: Summer Decker / Ebert Lars

11:30 - 11:45: An algorithm to display multiple CT windows simultaneously using machine learning. **Ebert Lars**

11:45 - 12:00: Mobile 3D crime and accident scene documentation with Apple's LiDAR technology. **Sören Kottner**

12:00 - 12:15: ImagingRing forensics. A cost-effective high-end mobile imaging robot for postmortem computed tomography and simultaneous 3D optical surface documentation. **Dominic Gascho**

12:15 - 12:25: Image analytics for biological profiling of human skeletal remains: the application of transfer learning-based image analysis using a user-friendly visual programming approach. **Ivan Jerković**

12:25 - 12:40: Closed or open? When X-rays help solve a forensic problem in a domestic fire case. **Mathilde Ducloyer, Ronan Vinay**

12:40 - 12:50: Can micro-computed tomography (µ-CT) be informative for microscopic study on lung fragments? About a preliminary study on 13 hanging cases. **Eulalie Pefferkorn**

12:50 - 13:00: Spatial analysis of intimate partner violence against women in the city of Toulouse. **Ryan Toutin**

11:30 - 13:00 Session: Clinical forensic medicine /Asphyxia   Capitouls Room

2

Chair: Jamie Elifritz / Thomas Ruder *(to be confirmed)*

11:30 - 11:45: Imaging after non-fatal strangulation – retrospective analysis over 13 years. **Thomas Ruder**

11:45 - 11:55: Value of medical imaging re-reading in clinical forensics: About two intriguing cases. **Agathe Bascou**

11:55 - 12:05: Diffuse idiopathic skeletal hyperostosis: a clinical case report. **Anthony Ramirez**

12:05 - 12:20: Accuracy of post-mortem computed tomography (PMCT) in diagnosing fractures of the hyoid-larynx complex (HLC). **Sara Larsen**

12:20 - 12:35: Cervical spine disc injuries evaluation using postmortem kinetic CT. **Shogo Shimbashi**

12:35 - 12:50: The value of Micro-CT imaging in the forensic evaluation of neck trauma. **Melanie Timmerman**

12:50 - 13:00: Suspension-Associated Dislocation of the Jaw in Hanging. **Joanna Glengarry**

13:00 - 13:30 ISFRI Board   Amphitheatre

Prize for Patricia Flach
Closing Ceremony

Thursday 25ᵗʰ May

09:00 - 11:00   Opening sessions

Amphitheatre

Artificial intelligence, blockchain: a link with medicine and death?

Anthony Gonnet Vandepoorte*[1]

[1]Founder of No Limits

Anthony Gonnet Vandepoorte, founder of No Limits, will lead a conference presentation on the possibilities of blockchain for the public and private sectors beyond cryptocurrency. He will explore the use of NFTs for property authentication, such as item images, patient records, and diplomas, as well as applications of blockchain in medicine, such as individual prevention through full body scanning.

During the conference, he will also discuss the use of Artificial Intelligence (AI) in medicine, as well as projects enabling 3D reconstruction on powerful computers. Finally, he will discuss topics such as AI applied to life after death and the digital storage of data left behind by the deceased.

Anthony Gonnet Vandepoorte, an entrepreneur with a passion for innovation, technology and education, has developed a powerful method called "The ABS Matrix" to solve complex problems and stimulate creativity. With No Limits, he offers content and coaching to help professionals and individuals develop their revenue streams through new technologies and multiply their results.

Radiological innovations and forensic imaging

A Blum[1], N Douis[1,2], L Martrille[3], E Marchand[2]

[1]*Service d'Imagerie Guilloz, CHRU Nancy, Fr*
[2]*Department of Legal Medicine, CHRU Nancy, Fr*
[3]*Department of Legal Medicine, CHRU Montpellier, Fr*

CT has become a vital tool in forensic practice. Not surprisingly, indications for forensic CT are increasing, and its use in practice is expanding. Postmortem CT (PMCT) has become an essential aid to the pathologist during autopsies. At the same time, advances in technology and software are leading to advances in performance.

The most significant improvement is provided by the reduction of metallic artifacts, photorealistic images (Global Illumination), simplified analysis of the rib cage, ultra-high resolution (UHR) CT with matrix up to 2048x2048 and Deep learning reconstruction. The reduction of metal artifacts not only improves the visualization of tissue near metal objects, but also the characterization of metal objects. Global Illumination provides photorealistic images of high contrast structures such as bones, bullets or skin. Simplified rib cage analysis provides the complete view of the rib cage in a single plane, simplifying its assessment and accelerating the diagnostic process. Ultra-high resolution (UHR) computed tomography allows unparalleled analysis of small structures and subtle bone lesions. Finally, deep learning reconstruction improves image quality and reduces radiation dose in living patients. Finally, all these new tools can be combined synergistically.

Thursday 25th May

11:00 - 12:15   Session: Trauma and PMCT

Amphitheatre

A young and agile teaches an elderly: benefits of post mortem imaging in forensic pathology

Krzysztof Woźniak *[1]

[1]*Jagiellonian University Medical College, Faculty of Medicine, Chair and Department of Forensic Medicine, Kraków, Poland*

Experienced forensic pathologists would admit that at the initial stage of the investigation, the outcome of the case cannot be predicted with certainty. Additional pieces of evidence may cause one to consider or undertake supplementary analyses. However, a conventional autopsy cannot be repeated with the same range of possibilities.

In contrast, the acquisition of post-mortem imaging data gives the possibility of repeatable assessment of the same material without limitations regarding the level of knowledge and experience and the pathologist's reporting skills in relation to the application of the autopsy protocol. In addition, due to the results of a preliminary evaluation, it may allow better conditions for the successful conduct of conventional examinations, including verification rather than blind searches, as well as better access to areas of the body that are quite problematic to access during a traditional post-mortem examination.

Moreover, in addition to the possibility of developing a forensic medical specialty, post-mortem imaging may provide opportunities for scientific cooperation with other specialists. It should be noted that numerous forensic cases are not encountered in clinical medicine, hence they can be valuable in teaching e.g. in expanding the imagination of clinical radiologists.

*Speaker

Life in the Fast Lane: Fatal Motor Vehicle Accidents in Albuquerque, NM

Heather Jarrell* [1], Jamie Elifritz [1]

[1] *Office of the Medical Investigator – United States*

In the United States, accidents, are among the top five leading causes of death. (https://www.cdc.gov/nchs/f causes-of-death.htm).

The Office of the Medical Investigator (OMI) in Albuquerque, NM is a statewide medical examiner's office which has instituted postmortem computed tomography (PMCT) for triage of our caseload routinely since 2014. PMCT has allowed our office to decrease our percentage of full autopsies from 80% to 50% over the last decade. The most recent data from the New Mexico Bureau of Vital Statistics confirms that accidents are the number three cause of death in our state and that motor vehicle injuries are the most common subgroup of selected causes. (https://www.nmhealth.org/data/view/vital/2504/). In New Mexico, 2021 was a particularly dangerous year to be a motorist, cyclist, or pedestrian, with over 470 traffic fatalities.

Our experience has allowed us to create a vast catalog of injuries from all anatomical locations. This presentation will be an image-rich review of motor vehicle-related deaths from head to toe. Radiologic/Pathologic correlation and scene details will be included, as well as case triaging determinations. Emphasis will be placed on injuries that, in our experience, can routinely be evaluated with PMCT in combination with an external examination and injuries that require full autopsy.

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*Speaker

The impact of PMCT in demonstrating findings difficult to observe at autopsy

Roberto Maselli * [1], Matthew D. Cain [2], Lauren Decker [2], Lauren Dvorscak [2], Jamie Elifritz [1], Heather Jarrell [2], Kurt B. Nolte [3], Natalie Adolphi [4]

[1] M.D. Office of the Medical Investigator, Department of Pathology, University of New Mexico, Albuquerque, New Mexico, USA. Center for Forensic Imaging, School of Medicine, University of New Mexico, Albuquerque, NM, USA – United States
[2] M.D. Office of the Medical Investigator, Department of Pathology, University of New Mexico, Albuquerque, New Mexico – United States
[3] M.D., Department of Pathology, University of New Mexico, Albuquerque, New Mexico – United States
[4] PhD, Office of the Medical Investigator, Department of Pathology, University of New Mexico, Albuquerque, New Mexico, USA. Center for Forensic Imaging, School of Medicine, University of New Mexico, Albuquerque, NM, USA – United States

To characterize the impact of post-mortem computed tomography (PMCT) at the New Mexico Office of the Medical Investigator, pathologists completed a PMCT usage survey for 2027 consecutive cases; whole body PMCT was performed in 1913 of these cases. In 50 cases (2.6%), the pathologist answered "yes" to the question: "Did PMCT demonstrate a significant finding that would not have been seen at autopsy?" PMCT enabled detection of 56 significant findings in these 50 cases, including injuries to the cervical spine (n=12), extremities (n=10), pelvis (n=6), face/brain (n=7), and pneumothorax (n=6). PMCT was important for detecting and extracting projectiles (n=6) and helped reconstruct projectile pathways in one case of multiple firearm injuries. PMCT displayed important features of natural disease (n=3) and medical hardware (n=4) undetectable during routine physical examination. In one notable case, PMCT demonstrated the pre-autopsy location of a bolus in the airway that was displaced during autopsy. The PMCT data allowed triage to 24 autopsies, 5 partial autopsies, and 21 external examinations. These cases highlight the critical role of PMCT in providing forensically-relevant information in support of a specific cause or manner of death that may not be easily demonstrated by physical examination.

*Speaker

Applications of post-mortem CT at the Paris Forensic Institute between 2021 and 2022

Juliette Oliero * [1], Lilia Hamza [1], Tania Delabarde [1], Ghazi Hmeydia [2],
Corentin Provost [2], Marie-Edith Richard [2], Catherine Oppenheim [2],
Bertrand Ludes [1], Joseph Benzakoun [2]

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[2] *Centre Hospitalier Sainte Anne [Paris] – Assistance publique - Hôpitaux de Paris (AP-HP) – France*

Objective: Evaluate recent developments of large-scale post-mortem CT (PMCT) in the forensic practice at the Paris Forensic Institute.

Methods: All decedents who underwent a PMCT between 2021 and 2022 were included. Variables, extracted from the PMCT information form and report metadata, included: demographic characteristics, context, degree of urgency, identity knowledge, use of CT for comparative identification, time from PMCT to radiology report.

Results: 1775 PMCT were performed on request of 5 different courts. Decedents were mostly male (n=1256, 71%) and median age was 58 years (IQR 43-72). The 3 most frequent contexts were: traumatic death (n=618, 35%), unknown cause of death in preserved (n=593, 33%) or putrefied decedents (n=434, 25%). Identity was unknown in 164 (9%) decedents and supposed in 504 (29%) cases, among which a comparative identification was successfully performed using CT in 41/504 (8%) patients. The median delay from PMCT to radiologic report was 6h (IQR 1.8-18.6hrs) and was significantly shorter for urgent as compared to non-urgent reports (2.3 hours (IQR 1.2-6.1) vs. 8.4 hours (IQR 2.4-21.4), p< 0.001).

Conclusion: Large-scale PMCT usage is possible in forensic setting, in varied indications and contexts. Fast edition of radiologic reports allows its integration into time constraints of the judiciary system

*Speaker

Case report: **Not All That Glitters** Is Gold… Standard (or: Discrepancy between minimally invasive autopsy and conventional autopsy)

John Pires-Davidson [*][1]

[1] Universidade de São Paulo Medical School – Brazil

Large research study conducted at our institution, Minimally Invasive Autopsies (MIA) were performed, followed by Conventional Autopsy (CA) for comparative purposes. MIA is performed with contrast-enhanced tomography (aqueous type, 3 liters) and guided biopsies. Thus, subsequent CA received an already manipulated body.

The body was referred to our Institution with no technical medical information. Family in- formed: bariatric gastrectomy 8 years before, tuberculosis in treatment. In native tomography showed pulmonary interstitial opacities, almost devoid of air spaces. However, after tomography and contrast injections, flooding of air spaces was remarkable. Subsequent lung biopsies were taken in otherwise clean areas.

Many alterations observed in the MIA: whole-body gas embolism in vascular spaces, absence of blood, barotrauma signs, alveolar hemorrhages, extensive hepatosplenic pneumatization, moderate non-hematic volume ascites, submuscular collections.

The body was then referred to CA (Gold Standard) and, unsurprisingly, lung examination showed edema.

Other discrepancies between MIA and CA are in the breakdown table. MIA cause of death: Extensive Gas Embolism ∕ Hypovolemia, due to Barotrauma. CA cause of death: Acute Lung Edema, due to Acute Myocardial Infarction, due to Disseminated Atherosclerosis.

The case presented demonstrates discrepancies and influence of one method over the other, hampering the Gold Standard.

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*Speaker

Thursday 25th May

11:00 - 12:15   Session: Fossils, anthropology and imaging

Capitouls Room

Photomummetry – Rapid photogrammetric surface documentation of mummies using a mobile multi-camera system

Dominic Gascho* [1], Patrick Eppenberger [2], Frank J. Rühli[2], Michael J. Thali [1], Claudia Rütsche [3], Emanuela Jochum Zimmermann [3], Sören Kottner [1]

[1] *Institute of Forensic Medicine, University of Zurich, Zurich, Switzerland – Switzerland*
[2] *Institute of Evolutionary Medicine, University of Zurich, Zurich, Switzerland – Switzerland*
[3] *KULTURAMA, Museum of Human Evolution, Zurich, Switzerland – Switzerland*

Radiographic imaging is now routine in the study of ancient, mummified human remains because it provides information about internal structures in a noninvasive manner. X-ray computed tomography (CT), which provides rapid three-dimensional (3D) documentation of the interior of the body, is the preferred modality for full-body examinations of whole mummies. However, CT-based visualization of the body surface is limited and does not reproduce color information. Therefore, additional optical imaging techniques, such as photogrammetry, may be applied for 3D surface documentation. We introduce a recently developed multi-camera system (*VirtoScan*) used to examine the 2800-year-old (22nd Dynasty) Egyptian mummy of *Ta-sherit-en-Imen* (*KULTURAMA*, Museum of Human Evolution, Inv. KMDMZ 5203). Equipped with eight industrial 3-CMOS prism-based R-G-B cameras, this mobile system enables photogram- metric documentation of the mummy's surface simultaneously with CT data acquisition. The mobile system is positioned directly in front of the CT gantry for the examination. Four hundred images are acquired at continuous table feed during a high-resolution full-body helical CT scan. The spatial 3D data (textured 3D model) is then generated using photogrammetry software. The reconstructed 3D data can be included in expert reports or scientific studies and shared and viewed interactively in 3D PDF documents.

Paleoradiology: The utility of Lodox scanning in the assessment of injury in the Later Stone Age of southern Africa

Calvin G Mole * [1,2], Deano D Stynder [3], Victoria E Gibbon [4]

[1] *University of Cape Town, Division of Forensic Medicine and Toxicology – South Africa*
[2] *University of Cape Town, Department of Human Biology – South Africa*
[3] *University of Cape Town, Department of Archaeology – South Africa*
[4] *University of Cape Town, Department of Human Biology – South Africa*

Cubitus valgus is a deformity of the elbow, wherein the injured arm presents with an excessive carrying angle. Such injuries have rarely been described in past populations. The objective of this study was to report on two cases of distal humeral fracture with associated cubitus valgus dated to 160 and 2300 years ago respectively. This study highlights the utility of radiographic assessment of historic/prehistoric remains in elucidating circumstances surrounding injury. The skeletal remains of two individuals (a middle-aged male and female) accessioned within the University of Cape Town Human Skeletal Repository had injuries to the elbow region. To determine the extent of injury and possible complications, the upper limb bones were macroscopically assessed using forensic techniques and scanned using a Lodox Xmplar-dr. In both cases, radiographic assessment indicated well healed distal humeral fracture which resulted in non-union of the lateral epicondyle and extensive morphological changes to the elbow joint. Cortical thinning of the humeri and radii on the injured side suggest disuse and possible ulnar neuropathy. Radiographic assessment provided valuable additional evidence to support physical and functional consequences of these injuries.

*Speaker

Morphological sex assessment and analysis of variation in cranial sexual dimorphism between racial groups using CT scan segmentations

Dominika Cáriková *[1]

[1] *University College of London [London] – United Kingdom*

Sex determination is one of the four major components of biological profile that is produced in order to identify an unknown individual from the skeleton. Previous research found that the expression of sexual dimorphism varies between human groups, which also has implications for the methodology. The primary objective of this thesis was to investigate the variation in sexual dimorphism between three racial groups using the New Mexico Decent Image Database of CT scans. Cranial trait scores were collected from skull segmentations of 142 individuals from three racial groups (Black or African-American, Hispanic, and White). Results revealed differences in the expression of sexual dimorphism between the groups. The overall accuracy rate was 60% and varied among the groups, therefore, the Walker method is not recommended to be used globally. A high error rate in the correct classification of males was documented as a result of significant overlap between male and female trait scores. Variation was observed between the Black or African-American and White males in glabella and mental eminence and between the Hispanic and Black or African-American females in mental eminence. Finally, the incorrectly determined sex in this study was the result of non-White males significantly overlapping female trait scores.

*Speaker

The quiet rest of the warrior: a story of life, death, taphonomy and bone diagenesis

Edda E. Guareschi * [1,2], Paola A. Magni [1,3,4], Hannah Garden [1], Brendan Chapman [1], Marco Palmesino [5], Elisabetta Cilli [6], Davide Persico [7]

[1] *Murdoch University – Australia*
[2] *University of Notre Dame Australia – Australia*
[3] *Murdoch University, Singapore – Singapore*
[4] *The University of Western Australia – Australia*
[5] *Istituto Imaging della Svizzera Italiana, Ente Ospedaliero Cantonale (EOC) – Switzerland*
[6] *Università degli Studi di Bologna – Italy*
[7] *University of Parma = Università degli studi di Parma [Parme, Italie] – Italy*

The history of human skeletal remains recovered in a distant past can be mysterious, and especially interesting if some evidence of violent/fatal trauma is displayed. The differentiation between trauma and taphonomy/diagenesis on bone can assist in the reconstruction of part of the history of these elusive archaeological relics. An example is presented in this study.

A human skull recovered many decades ago in a riverbed has been stored in a local ethnographic museum (https://www.museoguatelli.it/en/). It shows perimortem trauma and peculiar staining of taphonomic/diagenetic origin. The ongoing analysis is multidisciplinary, and involves experts and students from two distant continents. The analyses will include forensic anthropology, genetics, stable-isotope and radiometric methods, forensic pathology, Scanning Electron Microscopy- Energy Dispersive X-ray Spectroscopy and CT-Scan. The post-mortem imaging will also assist the taphonomic/diagenetic examination.

The cause of death of the individual was, most likely, a blunt-and-sharp force trauma produced by a heavy weapon with a sharp edge. The taphonomical/diagenetic analysis might confirm, doubt or contradict the post-mortem preservation of the skull in the riverbed. The post-mortem imaging will prove essential for the differentiation of bone trauma from taphonomy/diagenesis, and for completing the history of a person who will finally rejoin their cultural heritage.

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*Speaker

POSTERS

Thursday 25th May
&
Friday 26th May

12:00 - 13:00

Opéra room

Coronary artery detection using novel water-soluble contrast agents in post-mortem magnetic resonance imaging

Mitsuha Fukami * [1], Tomoaki Yamamoto [1], Hinata Nishida [1], Norikazu Matsutomo [1], Miki Nagase [2]

[1] Kyorin University [Tokyo, Japan] – Japan
[2] Kyorin University School of Medicine [Tokyo, Japan] – Japan

Purpose: A contrast-enhanced postmortem computed tomography angiography (PMCTA) and a contrast-enhanced postmortem magnetic resonance angiography (PMMRA) can be performed to obtain intravascular information. However, medical gadolinium-based contrast agents for PMMRA are expensive. Thus, in this study, we developed novel, low-cost water-soluble contrast agents for PMMRA and evaluated them in comparison to PMCTA for coronary artery detection.

Methods: PMCTA and PMMRA were performed on eighteen cadavers. Gadolinium acetate tetrahydrate was used as a novel water-soluble contrast agent for PMMRA, while amidotrizoic acid was used as a contrast agent for PMCTA. Contrast to noise ratio (CNR) was measured in the right coronary artery (RCA), the left anterior descending coronary artery (LAD), and the left circumflex coronary artery (LCX).

Results: The CNR CTA and CNR MRA for RCA were -0.75 ± 1.40 and 1.53 ± 1.45, respectively, while these same values for LAD were 0.62 ± 0.74 and 1.66 ± 1.34. Lastly, the values for LCX were 0.23 ± 0.72 and 2.01 ± 0.96, respectively.

Conclusion: Coronary artery detection was compared between PMCTA by amidotrizoic acid and PMMRA by a novel contrast agent. The CNR MRA was found to be higher than CNR CTA. Overall, our results demonstrate the possible utility for novel contrast agents for PMMRA.

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*Speaker

Delineation ability of one-scan fused CT with deep learning imaging reconstruction (DLIR) to visualize aortic dissection

Masahiro Yoshida * [1], Tomoya Kobayashi [2], Seiji Shiotani [3], Kazunori Kaga [1], Hajime Saitou [1], Someya Satoka [4], Kazuya Tashiro [1], Moyu Yamamori [1], Riho Kuramochi [1], Katsumi Miyamoto [1], Hideyuki Hayakawa [5], Shigeru Atake [6]

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[3] Department of Radiology, Seirei Fuji Hospital – Japan
[4] Department of Radiological, Shinwa Medical Resort Kashiwanoha – Japan
[5] Department of Forensic Medicine, Tsukuba Medical Examiner's Office – Japan
[6] Department of Critical Care and Emergency Medicine, Tsukuba Medical Center Hospital – Japan

Introduction/Purpose

Fused PMCT which we previously reported is to add multiple scans of the same site in order to reduce image noise, especially for vascular disease delineation. In this study, we evaluated usefulness of fused deep learning imaging reconstruction (DLIR)-processed one CT image, named "one-scan fused CT", in an attempt to delineate aortic dissection lesions.

Materials and Methods

We compared arterial wall visualization ability of routine postmotem CT (PMCT) with one-scan fused PMCT for 3 cases deceased for aortic dissection. Image quality was compared between images obtained by 1) 3-times-fused filtered-back-projection (FBP)-processed one-scan PMCT and 2) 3-time-fused DLIR-processed one-scan PMCT.

Results

Although 3-times fused FBP-processed one-scan PMCT enhanced the vascular wall, image noise became more conspicous, thus granurity of the image was degraded. With 3-times fused DLIR-processed one-scan PMCT, the vascular wall was more clearly delineated, and reduced noise. In addition, flap of aotic dissection lesions became more visible. Streak artifacts reduced after DLIR processing for bodies when the arms were lowered down.

Conclusion

3-time-fused DLIR-processed one-scan PMCT can clearly delineate lesions of aortic dissection. One-scan fused CT technique can be applied for living bodies as the radiation exposure dose is basically the same as conventional CT scan.

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*Speaker

Estimation of sex by radiological measurement of the femoral head of an Algerian sample.

Ammar Lahouel[*][1]

[1] *M. Y. Guellati, A. Boudaba, A. Grait, A. Atrouz, T. Rafai, S. Alleg, M. Boutemdjet WSE. Mordjana, M. Mechakou/ service de médecine légale/ Hôpital Central de l'Armée, Alger, Algérie – Algeria*

This study aims to evaluate the efficiency and reliability of the femoral head in the estimation of sex in the Algerian population in the field of forensic anthropology. 200 proximal femoral extremities, right and left, belonging to 100 Algerian individuals (52 men and 48 women, aged between 18 and 86 years) were included. The bones were reconstructed from clinical abdominopelvic scans, carried out during the year 2018 at the University Hospital of Ouargla (south east of Algeria). The vertical diameter of the femoral head was measured to assess bilateral symmetry, as well as its effectiveness in sex classification. An intra-observer test was performed on 20% of the sample to assess the reliability of the method.

Sex correct classification rates ranging from 89 to 90.1% were obtained by two methods using section point and binary logistic regression. The intra-observer test showed that the metric method is accurate and sufficiently reliable.
In the end, the femoral head seems effective in estimating sex in the Algerian population. Specific sex estimation references have been created from a current modern sample, which can meet forensic demand. Further studies are needed to validate the results obtained on larger samples.

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*Speaker

Gunshot residue detection on wounds after carbonization

Charbel El Khoury Moussa [1], Bruno Payré[2], Céline Frugier [*][1]

[1] Centre de Microscopie Electronique Appliquée à la Biologie – Université Paul Sabatier (UPS) - Toulouse III – France
[2] Centre de Microscopie Electronique Appliqué à la Biologie – Université Paul Sabatier-Toulouse III - UPS (FRANCE) – France

The detection of gunshot residue (GSR) on wounds can be useful to attest gunshot and it could allow the differentiation between the entry and the exit wounds. Carbonization is a good way to alter crime scenes and to destroy evidences. However, there are very few studies in this specific context. The first task for our experimental study is to check the persistence of GSR in wounds after carbonization. The second aim is to try to differentiate entry wounds from exit ones despite fire action. Sheep limbs were fired with 22LR in contact range. Specimens were divided into four groups: two reference groups without shooting (fresh and carbonized limbs) and two groups of shooting limbs (one without carbonization and one with carbonization). Carbonization was done using alcohol as an accelerant in the open air on a cast iron plate. We analyzed GSR using Scanning electron microscopy with energy dispersive X-ray spectrometry (SEM–EDX) and inductively coupled plasma mass spectrometry (ICP-MS). Despite the huge decrease of these elements after carbonization, these techniques enable their identification and the differentiation between entry and exit wounds. However, ICP-MS was more sensitive and provides quantitative data it doesn't really add value compared to SEM-EDX.

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*Speaker

Legal retention period for imaging data in France in 2023

Manuelo Turkiewicz * [1], Fabrice Dedouit *[1]

1 Service de médecine légale – CHU Toulouse – France

Medical imaging is an important working tool for the French forensic sciences in 2023. We can wonder how long is the retention period of this digital data from a legal point of view. The purpose of this communication is to enligth the practitioner on the legal duration of conservation of medical imaging, according to the clinical context in France.

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*Speaker

Two medico-legal autopsy cases of multinodular and vacuolating neuronal tumor revealed by postmortem MRI

Yohsuke Makino * [1], Yajima Daisuke [2], Inokuchi Go [3], Motomura Ayumi[2], Kojima Masatoshi [3], Arai Nobutaka [4], Kabasawa Hiroyuki [5], Iwase Hirotaro [3]

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[4] Tokyo Metropolitan Institute of Medical Science – Japan
[5] Department of Radiological Sciences, International University of Health and Welfare – Japan

The multinodular and vacuolating neuronal tumor (MVNT) is a recently recognized brain neoplasm. MVNT is known to be potentially epileptogenic with its characteristic appearance in MRI images. To the best of knowledge, no report describing this pathological entity in forensic medicine literature. We present two medico-legal autopsy cases where postmortem MRI (PMMR) was useful to detect this entity. Case 1: a man in his 30s about 7-year history of intractable epilepsy and known MVNT died suddenly in the bathroom. Although MVNT was not detected in initial morphological evaluation during autopsy, PMMR for the brain after formalin fixation revealed the tumor. Case 2: a man in his 20s hanged himself to death. PMMR prior to autopsy revealed MVNT in his brain and the diagnosis was confirmed by detailed histopathological evaluation. In both cases, postmortem CT was not useful for evaluation of the tumors. Through these cases, PMMR showed its forensic utility to detect small but epileptogenic, i.e., potentially fatal, lesions such as MVNT.

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*Speaker

Validation and recalibration of the Klales et al. (2012) sexing method for Algerian population using virtual coxal bones

Mohamed Yassine Guellati, A. Lahouel, A. Grait, A. Atrouz, T. Rafai, A. Boudaba, S. Alleg, D. Achiou, M. Berchiche [*] [1]

[1] *Facult´e de M´edecine d'alger – Algeria*

This study was carried to assess the accuracy and reliability of the Klales et al. (2012) sexing method in an Algerian population sample. A total of 171 virtual left innominates, derived from clinical CT scans of living Algerian adults were included during 2018 - 2019 in an Algerian Hospital, after individual consent and ethical approval. Accuracy of the original and the calibrated equations were assessed and an intra observer test was conducted to assess the reliability of the method. Results show significant sexual dimorphism of the innominate in the Algerian sample. Significant correct sex classification rates were noted for both original and calibrated equations, however the calibrated equation have significantly reduced the sexual bias. Intra observer test showed that the Klales et al. (2012) method was reliable suggesting the validity of the method for the Algerian population. In another way, this study consolidates the potential of computed tomography in terms of sex estimation assessment and creating specific standards in forensic anthropology.

[*]Speaker

Validation of an automated landmark method based on atlas

Géromine Fournier * [1], Delphine Comtesse [1], Norbert Telmon , Frédéric Savall

[1] Facult´e de chirurgie dentaire – Universit´e Toulouse III - Paul Sabatier – France

Morphogeometry studies often require the placement of landmarks. Manual placement can be error-prone and time consuming. Methods for automating landmark placement, such as those based on an atlas, are being developed. The aim of this study was to assess an automatic land-marking approach to human mandibles based on the atlas method. Our sample consisted of 160 mandibles from computed tomography scans of 80 men and 80 women aged between 40 and 79 years. Eleven anatomical landmarks were placed manually on mandibles. The automated land-marking through point cloud alignment and correspondence (ALPACA) method implemented in 3D Slicer was used to automatically place landmarks to all meshes. Euclidean distances and Procrustes ANOVA were calculated for both methods. The ALPACA method showed significant differences in Euclidean distances for all landmarks compared to the manual method. A mean Euclidean distance of 1.7 mm was found for the ALPACA method and 0.99 mm for the manual method. Both methods found that sex, age, and size had a significant effect on mandibular shape. The results obtained using the ALPACA method are acceptable and promising. This approach can automatically place landmarks with an average accuracy of less than 2 mm, which may be sufficient in most anthropometric analyses.

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*Speaker

What is the yield of adding post-mortem computed tomography and fast-track toxicology to the medico-legal external examination in a Danish setting? A project outline.

Peter Roerdam [*][1], Ellen Vistrup [1], Sara Larsen [1], Christina Jacobsen [1]

[1] *Department of Forensic Medicine, University of Copenhagen – Denmark*

Introduction

The decision to perform a medico-legal autopsy (MLA) is made at the medico-legal external examination (MLEE). A masters project studied the factors influencing the decision and found that undetermined manner of death was associated with the decedent being found dead and with alcohol abuse.

Aim

We aim to investigate if adding post-mortem computed tomography (PMCT) and fast-track toxicology (FTA) can qualify the medical advice at the MLEE.

Methods and materials

Deaths in the Copenhagen Police Department precinct with information regarding alcohol abuse and/or undetermined manner and/or cause of death at MLEE. All included deaths will undergo PMCT and blood sampling for FTA. Included deaths will be divided into a MLA or a non-MLA group.

Results

Cause and manner of death based on MLEE and MLEE+PMCT+FTA respectively will be compared to assess the value of adding PMCT and toxicology to MLEE.

Cause and manner of death based on MLEE+PMCT+FTA will be compared to the gold standard of MLA to evaluate the diagnostic accuracy of PCMT and FTA.

Conclusion and discussion

The aim is to develop a model for advising the police which cases could favorably be supplemented by PMCT and FTA at MLEE.

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*Speaker

Which methods do forensic specialists worldwide use for gestational age estimation in fetal death?

Valerie Niehe * [1], Bart Latten [2], Rick Van Rijn [3,4], Bernadette De Bakker[5,6,7]

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[6] Amsterdam Reproduction and Development research institute, Amsterdam, The Netherlands – Netherlands
[7] Erasmus MC – Sophia Children's Hospital, University Medical Center Rotterdam, Department of Pediatric Surgery, The Netherlands – Netherlands

Introduction:
Optimal determination of gestational age (GA) at fetal death is important in a forensic setting, especially around the GA of 24 weeks. When a fetus is considered viable at a GA of 24 weeks or more, inflicted or negligent death is a criminal offence in the Netherlands. Currently, methods used by forensic specialists to estimate GA differ and a gold standard does not exist. In a preliminary Dutch survey, the following methods for estimating GA were mentioned: foot length and crown-heel length (external measurements), femur length and the appearance of ossification centers (measurements on imaging studies).

Aim:
The aim of this study is to provide an overview of methods used by forensic specialists worldwide to estimate GA of fetal remains, including the literature they use for his estimation. To collect this data we created an online survey. The online survey will be distributed among forensic specialists (pathologists, radiologists, anthropologists and others) by email. The online survey can be completed at the 2023 ISFRI conference by scanning the QR code on this poster. We aim to use the results to stimulate uniformity in the methods used to estimate GA in the forensic field.

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*Speaker

Comparative study on the development of the knee by post-mortem CT, DR, and MRI

Apameh Khatam-Lashgari * [1], Mette Lønstrup Harving [2], Chiara Villa [1], Niels Lynnerup [1], Sara Tangmose Larsen [1]

[1] *Department of Forensic Medicine [Copenhagen] – Denmark*
[2] *Department of Diagnostic Radiology, Rigshospitalet – Denmark*

Magnetic Resonance Imaging (MRI) may be used in forensic age estimation by evaluating the ossification stages of the knee, but larger reference samples are missing. Since many forensic institutes routinely perform whole-body post-mortem computed tomography (PMCT), large image libraries are created, which could be used as reference samples, if staging methods between post-mortem MRI and PMCT are transferable. Here, we investigate the level of agreement between three modalities (Computed Tomography, MRI, Digital Radiography) in evaluating the ossification stages of the knee.

The sample included 34 autopsied individuals aged 10-25 years. The ossification stages of the tibial, fibular, and femoral epiphyses were scored in blind trials using the combined classification by Schmeling et al. (I, II, III, IV, V) and Kelllinghause et al. (IIa, IIb, IIc, IIIa, IIIb, IIIc). Intra- and inter-observer agreement was tested.

Weighted kappa statistics showed good agreement between MRI and DR (K = 0.68-0.79) and CT and DR (K = 0.61 – 0.70), but a moderate agreement between MRI and CT (K = 0.55-0.57). Thus, we cannot recommend using CT data for MRI reference studies, contrary to some previous studies. Research involving a larger population is needed to confirm our findings and make a general conclusion

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*Speaker

AN UNUSUAL VICTIM

Albane Guigné * [1], Bérengère Dautrême [1], Florence Vincent [2], Gilles Tournel [1]

1 Institut de Médecine Légale de Rouen – CHU Rouen, CHU Rouen – France
2 Service de Radiologie [CHU Rouen] – CHU Rouen – France

In April 2020, during the COVID-19 containment period, the forensic pathologist of Rouen, France, was called by the police following the discovery of a body on the banks of the Seine. On site, the body was in a rubbish bin. It was wrapped in a blanket, held by several ties. The head was missing. Breast shapes could be seen, which raised suspicions of a female body. The leg was partially unocovered, showing pale skin and tattoos. The body was not examined at the place of discovery, on the instructions of the Public Prosecutor. No sampling was carried out. For this highly suspicious case, a CT-scan and an autopsy were organised the next day. On the images, the frame was metal, the body was not human. An external review was nevertheless carried out. It was a silicone sex doll. A menstrual tampon was found in the sex hole. Several inscriptions was on the body, representing submachine guns and banknotes, or "COCAINA" on the breast. In this period of global pandemic, several people were put at risk by leaving their homes, so an investigation was conducted anyway. Under normal circumstances, investigations would not have continued after the CT-scan.

*Speaker

Thursday 25th May

13:15 - 14:45   Session: Natural death and forensic imaging

Amphitheatre

A Pastiche of Natural Disease: Radiological/Pathological Correlation

Jamie Elifritz * [1], Megan Gage [2], Heather Jarrell [1], Lauren Decker [1],
Natalie Adolphi [1], Jennifer Weaver [3], Lori Proe [1], Emily Helmrich [1]

[1] *Office of the Medical Investigator – United States*
[2] *University of New Mexico – United States*
[3] *Vanderbilt University – United States*

The Office of the Medical Investigator (OMI) in Albuquerque, New Mexico is a statewide medical examiner's office in the United States. Our jurisdiction is to investigate the sudden, unnatural and unexpected deaths for the state of New Mexico, which has a population of over 2 million people. Postmortem Computed Tomography (PMCT) is a keystone of daily operations at the OMI. As such, our office has amassed a large volume of both common and unusual findings in the cases of natural deaths; including deaths occurring in the setting of resuscitation effort and subsequent to medical procedures.

This presentation will showcase valuable radiologic/pathologic correlation. PMCT images will be presented with correlative gross autopsy photos and scene narratives. We will demonstrate how we use PMCT to triage natural deaths, how we interpret findings of resuscitation effort, and how we synthesize narrative history, imaging findings, and autopsy findings of prior medical procedures. Cases will be organized by anatomic location.
Our goal is to share our forensic imaging experience with the global community. In this manner, we hope to open a dialogue about how other institutions incorporate imaging into their practices

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*Speaker

Characteristics of Acute Coronary Atherothrombosis in Post-mortem CT Angiography

Katarzyna Michaud* [1], Virginie Magnin [1], Silke Grabherr [1], Salah Dine Qanadli [2], Mohamed Faouzi [3], Allard C. Van Der Wal [4], David C. Rotzinger [2]

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Coronary CT-angiography imaging enables the detection of radiological characteristics of atherosclerotic coronary artery disease in living patients by evaluation of coronary stenosis and detection of vulnerability criteria (lipid core (LC), spotty calcifications (SC), napkin ring sign (NRS), remodelling index (RI)). In post-mortem practice, multi-phase post-mortem CT angiography (MPMCTA) could also be helpful for the examination of these parameters in cases of sudden cardiac death (SCD). The goal of this study was to compare histologic and radiologic characteristics of coronary plaques in SCD-cases related to coronary thrombosis.
Forty consecutive SCD cases with autopsy-proven fatal coronary atherothrombosis were selected. Histological sections and MPMCTA images were assessed and findings were statistically evaluated.

The mean age (12 women and 28 men) was 53.3 ±10.9. There was no concordance between stenosis at histological and radiological examinations. RI was 1.39±0.71, NRS was detected in 40 % of cases, SC in 48.7% and LC in 46.15%. Significant correlations were observed for the presence of NRS and LC of the plaque, severe inflammation but not for the degree of calcification and the age of thrombosis.
Conclusions: MPMCTA allows identification of several parameters of atherosclerotic plaque vulnerability, but radiological evaluation of stenosis and calcifications alone can be misleading.

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*Speaker

The Last Supper: Minimally Invasive CT-Assisted Postmortem Collection of Gastric Contents

Chris O'donnell [*][1,2], Evan Leckenby [1], Catherine Vincent [1], Dimitri Gerostamoulos [1,2], Matthew Lynch [1,2]

[1] *Victorian Institute of Forensic Medicine – Australia*
[2] *Monash University, Department of Forensic Medicine – Australia*

Introduction: PMCT is increasingly being utilized in death investigation and can guide percutaneous sampling techniques.

Materials and Methods: This study explored the feasibility of gastric sampling using orogastric intubation under PMCT guidance. Parameters examined included practicality of orogastric tube placement in a deceased person, removal of liquid vs. solid contents, and volume of aspirate compared with estimated volume using PMCT postprocessing volumetric analysis.

Results: 40 cases have been analysed. In 80% of cases, a 36 French (12 mm) veterinary orogastric tube was manipulated into the stomach, with a high yield of content extraction. Technical difficulties encountered included manipulation of the tube pass the lower jaw due to rigor and difficulty in extracting solid or semi-solid material including undissolved tablets.

Discussion: Traditionally gastric content sampling requires an autopsy. Percutaneous needles are of insufficient diameter to aspirate semi-solids. Large bore orogastric tube with manual pump suction overcomes this problem. PMCT has proved to be a useful adjunct for calculating gastric content volume, determining solid v liquid, and guiding the final tube placement in the liquid pool.

Conclusion: Gastric liquid and semi-solid content can be sampled using an orogastric tube with CT assistance. This procedure is now incorporated into our medicolegal death investigations.

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*Speaker

An unusual case of venous variant leading to fatal vessel perforation during central venous catheter placement

Jochen Grimm * [1], Walter Wallner [2], Fabio Monticelli [3]

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[3] Institute of Legal Medicine and Forensic Psychiatry, Paris Lodron University Salzburg – Austria

A 73-year-old male patient rapidly deteriorated immediately after unsuccessful placement of a central venous catheter. Resuscitation attempts were unsuccessful and the patient died shortly afterwards. Unenhaced post mortem CT showed an extensive left sided hemothorax with mediastinal shift to the right side. Close inspection revealed mediastinal hemorrhage and small quantities of mediastinal gas. A previously acquired thoracic CT showed an unusual venous variant with a large superior hemiazygos vein draining into the left brachiocephalic vein. Correlation with post mortem CT showed mediastinal hemorrhage originating from the confluens of both veins. We concluded that bleeding was caused by venous perforation due to near orthogonal wall contact of the central venous catheter in the venous confluens area. This case demonstrates the potential risks of venous variant anatomy when placing central venous catheters. In this case, the events that led to the fatal hemorrhage could be reconstructed due to availability of an ante mortem CT scan for comparison. Without the preceding exam, the exact diagnosis would probably only have been possible using post mortem CT angiography.

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*Speaker

Thursday 25th May

13:15 - 14:45   Session: Ballistic and forensic imaging

Capitouls Room

Gunshot wounds on archeological remains: a new application of CT scan?

Mathilde Ducloyer [*1], Elodie Cabot [*2]

[1] *Department of forensic medicine – CHU Nantes, Nantes Université – France*
[2] *National Institute for preventive archeology, West center – INRAP – France*

Background
The major value of X-rays to explore gunshot wounds in living and deceased victims has been widely studied. But what about archaeology? Computed tomography incidentally detected a metal deposit on a skull with a bullet wound dating from 1670.

Objective:
Following this first experience, we sought to determine whether CT scans could detect metallic residues on skeletons with proven or suspected ballistic trauma, from archaeological ex- cavations of collective graves from the battles of Le Mans (December 1793).

Method:
We carried out CT on 59 skeletons selected from the 154 remains. The reading of the images was done blind to the anthropological analysis.

Results:
Of the 59 skeletons, 109 traumatic lesions were described on dry bones, of which 78 were proven gunshot wounds, 12 were undetermined and 16 were blunt trauma. The presence of metal residues was determined by hyperdense stains (2000 to 6000 HU). We showed the presence of ballistic deposits on 45 bone fragments. Of the 78 proven gunshot wounds, 37 were visible by CT scan. Imaging proved the ballistic nature of the trauma in 4/12 undetermined injuries.

Conclusion:
CT imaging can be one of the tools for assessing gunshot wounds in archaeological remains.

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*Speaker

Detection of gunshot residue on wounds after burial.

Morgan Nguyen-Hong [1], Bruno Payré [2], Céline Frugier * [2]

[1] Centre d'Anthropobiologie et de Génomique de Toulouse – Université Paul Sabatier (UPS) - Toulouse III – France
[2] Centre de Microscopie Electronique Appliquée à la Biologie – Université Paul Sabatier (UPS) - Toulouse III – France

Gunshot residue (GSR) on wounds analysis can play a crucial role in the discrimination of entry and exit wounds especially when the body is damaged. However, very few studies have looked at the retention of GSR in the face of the environment and no existing studies address burial.

The primary objective of our experimental study is to investigate the retention of gunshot residue after burial and decomposition by comparing the contribution of two techniques: SEM- EDX and ICP-MS. Our secondary objective is to determine if it is still possible to distinguish the entry wound from the exit wounds. For this purpose, we used a bovine model (cow feet), on which we fired 9 mm semi-jacketed bullets. We formed several groups: three reference groups without shooting (buried 2 days and 60 days and one unburied group), one reference group with firing but unburied and two groups with firing that were exhumed after 2 days and 60 days of burial.

The results of our study show that both SEM-EDX and ICP-MS analyses allow the detection of particles characteristic of GSR, after 60 days of burial. However, only SEM-EDX can differentiate between the entry and exit wounds.

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*Speaker

Establishing bullet reference ranges for in situ measurement of common handgun calibers using Lodox imaging

Calvin G Mole [*][1], Nastasja Van Wyk [1], Marise Heyns [2]

[1] University of Cape Town, Division of Forensic Medicine and Toxicology – South Africa
[2] Ulster University, School of Medicine – United Kingdom

The assessment of bullet caliber is fundamental in forensic ballistic investigations of firearm injury or death. Typically, bullets are retrieved from the body in a clinical setting or during post-mortem examination and retained for ballistic analysis. However, in cases where the bullet is lodged in hard tissue, or removal of the bullet would cause further harm or death of an individual it may not be possible to retrieve the bullet for examination. Radiographic techniques may be useful for *in situ* measurement of bullet caliber, however further research is necessary to establish various modalities' ability to discriminate between different bullet calibers and to establish reference ranges. The current studied aimed to assess the utility of Lodox scanning for discriminating bullet caliber of common handgun projectiles. The bullet length and base diameter of 200 bullets were recorded macroscopically (using Vernier callipers) and radiographically (following scanning with a Lodox Xmplar-dr). Ten different caliber/casing/manufacturer combi- nations were assessed, in unfired bullets and bullets fired into a water tank. High correlation was seen between physical measurements and Lodox measurements. Lodox measurements typically under quantified bullet length and over quantified bullet diameter, however these differences were systematic and thus may be used to discriminate bullet calibers.

*Speaker

Identification of entry gunshot wounds using hyperdense ring sign on PMCT

Emilien Jupin-Delevaux [*] [1,2], Corentin Provost [2], Ghazi Hmeydia [2], Marie-Edith Richard [2], Lilia Hamza [3], Tania Delabarde [3], Bertrand Ludes [3], Catherine Oppenheim [2], Joseph Benzakoun [2]

[1] Hospices Civils de Lyon – GHU-Paris Psychiatrie – France
[2] GHU Paris Psychiatrie et Neurosciences – GHU Paris Psychiatrie et Neurosciences – France
[3] Institut de Médecine Légale - IML (Paris, France) – Institut de Médecine Légale - IML (Paris, France) – France

Objective: Evaluate the reliability of a cutaneous hyperdense ring as a marker for identifying entry gunshot wounds in Post-mortem computed tomography (PMCT).

Methods: 42 head PMCT presenting with entry and exit gunshot wounds (2018-2022) were retrospectively included. Mucosal and complex wounds were excluded. Hyperdense ring sign was defined as at least 2/3 of a continuous cutaneous hyperdense circle, without bone fragments. Two radiologists independently evaluated sign presence and solved discrepancies in consensus. Gold standard for entry/exit determination was the interdisciplinary consensus between forensic physician and radiologist. Inter-rater agreement was evaluated using Kappa coefficient, and diagnostic performances for entry wound identification were computed.

Results: After exclusion of 16 complex and 4 mucosal wounds, we evaluated 30 entry and 34 exit wounds. Inter-rater agreement for hyperdense ring sign was substantial (Kappa=0.78 (95%CI: 0.61-0.95)). Sensitivity and specificity of the sign for entry wound identification were 19/30 (63% (95%CI: 44-80%)) and 33/34 (97% (95%CI: 85-100%), respectively. Positive and negative predictive values were 19/20 (95% (95%CI: 75-100%) and 33/44 (75% (95%CI: 60%-87%)), respectively.

Conclusion: Our study demonstrates that identification of hyperdense ring sign is reproducible and, when present, points to the entry wound on PMCT. This sign could help in establishing entry wounds in difficult cases.

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*Speaker

Usefulness of virtual reassembly of skull or spine in cases of fragmentation due to high-energy trauma or bone separation through postmortem changes

Haruki Fukuda * [1], Akira Hayakawa [1], Hiroyuki Tokue [2], Yoichiro Takahashi [3], Yoshihiko Kominato [1], Rie Sano [1]

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[2] *Department of Diagnostic Radiology Nuclear Medicine, Gunma University, Graduate School of Medicine – Japan*
[3] *Department of Legal Medicine, Institute of Medicine, University of Tsukuba – Japan*

With the widespread use of postmortem computed tomography (PMCT) at forensic autopsies for investigation of cause of death, three-dimensional (3D) reconstruction, 3D printing, and fusion imaging using PMCT data are now becoming common. Here, the skull and spine were virtually reassembled from PMCT data using multiple software in three cases of bone frag- mentation caused by high-energy trauma and one case of bone separation due to postmortem changes, since it was difficult to obtain detailed information of fractures in such cases by macroscopic observation alone. The first case showed that the virtual reassembly of skull provided more information about the fractures than the real reconstruction with adhesive. In the second, although the skull was severely fractured and could not be examined macroscopically, virtual reassembly allowed detailed visualization of the fractures. In the third, the virtual reassembly of skull in combination with 3D printing of the mandible was considered likely to be valid for personal identification. In the last, the virtual reassembly of spine helped to indicate that the 6th–8th thoracic vertebrae was run over by a vehicle at the scene. Thus, virtual reassembly was shown to be useful for estimation of injury patterns, individual identification, and event recreation.

*Speaker

The Gamut of Gun Related Deaths in the Wild West

Jamie Elifritz * [1], Lauren Decker [1], Natalie Adolphi [1], Jennifer Weaver [2],
Emily Helmrich [1], Heather Jarrell [1]

[1] *Office of the Medical Investigator – United States*
[2] *Vanderbilt University – United States*

The Office of the Medical Investigator (OMI) in Albuquerque, New Mexico is a statewide medical examiner's office in the United States. Postmortem Computed Tomography (PMCT) is a crucial component of our daily operations. Every case is triaged with PMCT. We have a high-volume office, with over 4,000 in-house examinations in 2021.

According to the New Mexico Department of Health, 481 residents die from firearm-related injuries in 2020. This statistic has increased by 55% over the past decade. As such, firearm- related deaths are very common in our office.

Given the unfortunate prevalence of gun related deaths in our state, we have compiled an extensive collection of firearm cases. In our presentation, we will discuss the statistics of gun violence in our country and state and provide image-rich cases demonstrating the powerful correlation of scene investigation, internal exam, and (when relevant) autopsy findings with PMCT images. We will demonstrate the differing imaging and gross appearances of gun related deaths from various types of firearms and different anatomic locations. We will share our experience using PMCT to investigate these deaths and review our protocols.

This will be an image-rich presentation, drawing from our unique experience in the "Wild West"

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*Speaker

Thursday 25ᵗʰ May

15:15 - 16:50   Session: Pediatric and forensic imaging

Amphitheatre

The complementary roles of whole-body postmortem computed tomography and conventional skeletal survey

Selena De Vries [1], Michelle Nagtegaal [1], Veronique Konijn [2], Esther Van De Mortel [2], Simon G.f. Robben [3], Rick Van Rijn * [1,4]

[1] Department of Forensic Medicine, Netherlands Forensic Institute, The Hague, The Netherlands – Netherlands
[2] Master Forensic Science, Faculty of Science, University of Amsterdam, Amsterdam, the Netherlands – Netherlands
[3] Department of Radiology, Maastricht University Medical Center, Maastricht, the Netherlands. – Netherlands
[4] Department of Radiology and Nuclear Imaging, Amsterdam UMC, University of Amsterdam, Amsterdam, the Netherlands. – Netherlands

Skeletal survey in the detection of fractures in children prior to a forensic autopsy.

Methods: We retrospectively included children aged 0 – 4 years of age who underwent both postmortem conventional radiography (PMCR) and a whole-body postmortem CT (PMCT) as part of a medicolegal autopsy at the Netherlands Forensic Institute between 2008 and 2021. The cases were, single reading, reviewed by 2 experienced pediatric radiologists.

Results: 116 cases are included, results based on 81 cases show a median age of 4.0 months (range 0-58). Fractures were observed in 36 of the cases (44%). A total of 206 unique fractures were identified. PMCT detected more fractures (n=182) compared to PMCR (n=75, p=0.011), especially rib fractures. There was no significant difference for skull fractures (p=0.063). All unique CML's (n=10) were seen on PMCR and only 2 on PMCT.

Conclusion: PMCT detects more fractures compared to PMCR, especially rib fractures. PMCR does have a role for the detection of CML's and other extremity fractures.

Limitations: The main limitation is lack of a reference standard. The forensic pathology reports could not serve as gold standard, even though forensic autopsies were performed in all included cases.

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*Speaker

Postmortem lung CT findings in infants

Hideki Hyodoh[*][1], Shogo Shimbashi [1], Kotaro Matoba [2], Rina Hayata [2],
Akiko Takeuchi [2], Shigeki Jin [2]

[1] *University of Fukui – Japan*
[2] *Hokkaido University – Japan*

Purpose

To review the findings of computed tomography (CT) performed early postmortem on infants and to clarify the
postmortem CT lung findings. Materials and Methods
Seventy-two infants were autopsied with postmortem CT (41 boys 31 girls, aged 0 -36 (mean 8.2) months). Autopsy and postmortem CT lung findings were compared with the causes of death identified by the autopsies, namely sudden infant death syndrome (n=37), acute circulatory system disease (18), drowning (7), asphyxia (5), and dehydration/undernutrition (5).

Results

The %aerated lung volume (- 700 HU or less) ranged from 0% -33% (mean 1.5%, median 0%), being less than 1% in 61 cases (84.7%) and more than 3% in 3/5 (60%) of the dehydration/undernutrition group. The dehydration/undernutrition group showed significant preservation of lung field air content compared with the other causes of death groups ($p < 0.05$). Receiver characteristic curve analysis showed a cut off value of 0.8% and area under the curve of 0.88806.

Conclusion

Evaluation of CT values on postmortem lung fields of infants usually reveals a marked de- crease in air content. When air content exceeds 0.8% on infant postmortem CT, dehydration/undernutrition should be considered in the differential diagnosis.

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[*]Speaker

Spectrum of Common and Unique Pediatric Forensic Imaging

Brittany Depasquale* [1], Harley Schainost [1], Kimberly Johnson [1], Natalie Taylor [1], Audra Kerwin [1], Jamie Elifritz [1]

[1] *Office of the Medical Investigator – United States*

The Office of the Medical Investigator (OMI) in Albuquerque, New Mexico is a statewide medical examiner's office that investigates sudden, unnatural, and unexpected deaths for the state of New Mexico. Postmortem computer tomography (PMCT) is used regularly as a way to triage cases prior to examination.

Pediatrics deaths are an unfortunate occurrence, with over 200 examinations performed on decedents under the age of 18 years in 2021. Fatal trauma, whether accidental or homicidal, is often the result of blunt force injury or gunshot wounds. In these cases, PMCT is useful in defining the extent of trauma and localizing projectiles, allowing for a more thorough examination. The use of PMCT in sudden unexpected infant death is invaluable in ruling out subtle trauma that may be easily overlooked at the time of autopsy.

Natural pediatric deaths are less common, but often highlight the most unique pathologies. Findings seen on PMCT and confirmed at the time of autopsy include congenital heart disease and abnormal brain development, amongst others.

This presentation will focus on the PMCT, with select MRI images, and autopsy correlates for the wide range of pediatric pathology seen at the OMI, from the everyday to the unusual.

*Speaker

How micro-CT imaging can aid a medico-legal investigation in a fatal case of suspected child abuse

Charlotte Primeau * [1], Waltraud Baier [1], Danielle Norman [1], Sofia Goia[1], Stuart Blaik [2], Mark Williams [1]

[1] WMG - University of Warwick – United Kingdom
[2] Thames Valley Police – United Kingdom

Micro-CT has shown to be a valuable imaging tool for especially subtle injuries due to the much higher resolution compared to clinical post-mortem CT. This presentation will highlight the usability of micro-CT in a medico-legal investigation, illustrated with a case of a suspected non-accidental injury (NAI) of a deceased infant.

The occipital, left parietal, neck structures, cervical vertebrae, ribcage, sternum, and left and right tibia and fibula of an infant were micro-CT scanned at the Forensic Centre for Digital Scanning and 3D Printing at WMG, the University of Warwick, on the request of a UK Police Force, prior to histological analysis.

Extensive trauma was apparent from the micro-CT images. These were highlighted through 3D and 2D images and videos, produced for presentation in court, illustrating the findings from micro-CT merged with the histological evidence.

With the unprecedented level of resolution from micro-CT imaging in post-mortem examinations of cases of suspected NAIs, micro-CT is a useful complementary tool to standard imaging techniques. It can illustrate features in detail through 2D and 3D rendered images and visualise trauma in a format that is better understood by non-medical professionals, such as the investigative team and jury members, with high impact for court presentation.

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*Speaker

Thursday 25th May

15:15 - 16:50   Session: Odontology and forensic imaging

Capitouls Room

Odontology - forensic medicine - forensic imaging

Delphine Maret [*] [1]

[1] *Centre d'anthropologie et de génomique de Toulouse*
Université Toulouse III - Paul Sabatier, Centre National de la Recherche Scientifique

Forensic odontology is an important offshoot of the forensic sciences. Imaging is an integral part of forensic odontology. The objective is to present three different situations that combine imaging and forensic odontology.

The first situation concerns the interest of forensic odontology in thanatology. Forensic odontology plays a crucial role in circumstances where the usual methods of identification, such as fingerprints and visual recognition, cannot be applied, in cases of decomposed, charred or skeletal bodies. The comparison of antemortem and postmortem information will be effective if there are usable data, including radiographs. In archaeo-anthropology, digital technologies such as imaging are also very interesting tools for oral analysis.

The second situation concerns the interest of forensic odontology in the living person. Imaging is an integral part of dental age estimation methods but associated with limitations that will be presented.

The third part deals with the notion of incidental findings in forensic imaging and the practitioner responsibility.

These three situations, which are very different from each, aim to highlight the importance of forensic odontology, both in practice and research.

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*Speaker

DVI-related tooth assessment – intra-autopsy inspection versus PMCT-based evaluation

Aleksandra Borowska-Solonynko *[1], S-lawomir Pyszczak [2]

[1] Chair and Department of Forensic Medicine Medical University of Warsaw – Poland
[2] Private Dental Practice – Poland

Background: Dental assessment plays an important role in disaster victim identification (DVI). If an immediate direct inspection by an experienced forensic odontologist is impossible, obtaining pertinent DVI data later-based on a post-mortem computed tomography (PMCT) evaluation by a forensic odontologist-may be considered.

Purpose: The purpose of this study was to compare the usefulness of DVI-relevant findings obtained via direct inspection by an inexperienced dentist and those obtained exclusively via PMCT image evaluation by an experienced forensic odontologist.

Material and methods: Twelve cadavers were included in this study. First, direct dental inspections were conducted by penultimate-year dentistry students, who recorded their findings in DVI forms. Subsequently, pre-autopsy PMCT images were assessed by an experienced forensic odontologist.

Results: Although in most cases (n=8) a direct inspection failed to detect dental fillings (often multiple) and evidence of endodontic treatment, in nearly half of the cadavers (n=5) it revealed carious lesions that were missed in PMCT evaluation.

Conclusions: Although a postmortem dental assessment by an inexperienced dentist fails to detect some dental features, it should not be omitted, since it provides some information that cannot be obtained later. Such cases require postmortem images, including PMCT, to be additionally obtained.

*Speaker

Methods of creating a panoramic dental image from CT data

Fox Marttinen * [1], Paul Hunter [2]

[1] HUS Medical Imaging Center [Helsinki] – Finland
[2] Teesside University – United Kingdom

Dental identification is one of the primary identification methods. Post-mortem intraoral imaging is a labourious process and post-mortem computed tomography (PMCT) has been pro- posed to replace it. Comprehensive review of the methods of creating panoramic dental images from CT data has not been made.

The aim was to synthesise the processes of automated reconstruction of a virtual dental panoramic image from CT images in the means of a systematic review. The search was conducted on February 6th 2021 using CINAHL, Google Scholar, Embase and PubMed databases. Both CT and cone beam computed tomography (CBCT) were included. Reviews and methods of reconstructing only the mandible or maxilla were excluded. Joanna Briggs Institute's Checklist for Case Series was used to assess the quality of the reports.

From the 192 reports found, seven were included in the review (three using CT, four using CBCT). These protocols were similar in three key steps of image reconstruction: segmentation of the jaws, determining the dental curve and extracting the panoramic image. Thresholding and morphological operations such as closing, hole filling and thinning were common techniques. Risk of bias was acknowledged due mostly low methodological quality. Nevertheless, the similarity of the methods suggest validity for the synthesis.

*Speaker

An attempt to estimate age using alveolar bone image

Hideko Fujimoto *[1], Kaori Kimura-Kataoka [2], Hidekazu Kanayama [3], Morio Iino [4], Haruo Takeshita [5]

[1] Hideko Fujimoto – Japan
[2] Kaori Kimura-Kataoka – Japan
[3] Hidekazu Kanayama – Japan
[4] Morio Iino – Japan
[5] Haruo Takeshita – Japan

Purpose:
It is known in clinical dentistry that horizontal alveolar bone resorption occurs with aging. However, there is no alveolar bone imaging index, and no age estimation of remains using it has been found.

In this study, we aimed to estimate the age of unidentified body using alveolar bone images. (Material/method)
G power3.1 was used with a sample size of 34,αerr prob of 0.05, power (1-β err prob) of 0.8, and effect size d of 0.7. Using the personal identification method we developed, we calculated the similarity of 34 data for each age group from 30 to over 80 years, based on data up to 29 years old.

Then we used this database to estimate age using postmortem CT images of age-known bodies; conversion between CT and panoramic X-ray images was performed using the average Procrustes distance between the same person groups.

Results:
Horizontal alveolar bone resorption was shown to change with age. It was also suggested that age estimation is possible from postmortem CT images.

Conclusion:
It was quantitatively shown that horizontal alveolar bone resorption occurs with aging. The possibility of age estimation by postmortem imaging was expanded.

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*Speaker

History of a smile. Anne d'Alègre (1565-1619, Laval, France)

Antoine Galibourg * [1], Delphine Maret Comtesse *[1], Rozenn Colleter [1]

[1] Centre d'anthropologie et de génomique de Toulouse – Université Toulouse III - Paul Sabatier, Centre National de la Recherche Scientifique – France

Analysis of the oral cavity by modern tools of human archaeological remains provides essential information about the general health of the person. The objectives of this communication are (i) to highlight an analysis of the oral condition of the embalmed body of a 17th century aristocratic woman (Anne d'Alègre) with modern periodontal diagnostic techniques and (ii) to provide a description of the therapeutic and aesthetic management aimed at limiting the functional and aesthetic consequences of tooth loss related to this disease. We propose that the objective of the treatment was threefold: therapeutic, aesthetic and societal. Beyond the only therapeutic management and far from the only coquetry, this study also shows the importance of the appearance for aristocratic women subjected to strong social constraints (like stress or widowhood), mental and physical health being able to be associated in the dental treatments.

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*Speaker

When dental comparative identification is the only way to recognize unknow human remains with a presumed identity? A case report.

Géromine Fournier * [1], Fabrice Dedouit, Norbert Telmon, Delphine Comtesse [1]

[1] Faculté de chirurgie dentaire – Université Toulouse III - Paul Sabatier – France

Forensic odontology plays a crucial role in circumstances where the usual methods of identification, such as fingerprints and visual recognition, cannot be performed, in cases of decomposed, charred or skeletal bodies. When decomposition of a recovered body is advanced, identification based on common morphological characteristics is often impossible.

Two forensic odontologists have been performing dental identifications at the time of autopsies of non-visually recognizable bodies within the Toulouse University Hospital. Comparative dental identification may be the only way to identify a visually unrecognizable body with a presumed identity.

We report the case of an unknown male, found dead near Toulouse, in September 2022. The body was in an advanced stage of putrefaction. During the autopsy, a DNA sample and a dental survey were performed. Due to the advanced stage of putrefaction, the DNA determination was unsuccessful. The availability of an ante-mortem panoramic radiograph allowed positive identification of the body using the dental comparison method.

Comparative dental identification after maxillary deposition may be the only way to identify an individual. It is a reliable and rapid practice when dental anatomical comparisons and/or dental therapeutic can be objectified by superimposing these elements on the ante- and postmortem radiographs.

*Speaker

Dental age estimation using PMCT: A case of a plaster-embedded infant body found 50 years after death

Rutsuko Yamaguchi * [1,2], Susumu Kobayashi [1], Hisako Saitoh [2], Yohsuke Makino [1,2], Suguru Torimitsu [1,2], Fumiko Chiba [1,2], Sayaka Nagasawa [2], Maiko Yoshida [2], Hirotaro Iwase [1,2]

[1] *Department of Forensic Medicine, Graduate School of Medicine, The University of Tokyo – Japan*
[2] *Department of Legal Medicine, Graduate School of Medicine, Chiba University – Japan*

Postmortem computed tomography (PMCT) is useful tool for obtaining information from bodies that are in a condition unfit for detailed observation. In this case, PMCT was used to examine the dental condition of a plaster-embedded infant body for age estimation. A man reported to the police that he had hidden the body of his 3-month-old son, who had died 50 years earlier. The body had been wrapped in cloth, embedded in plaster, and placed in a wardrobe box. His age at the time of death was not confirmed because his birth had not been reported. At autopsy, the body was almost skeletonized, with partial soft tissue conversion to adipocere. It was embedded in plaster fragments and old rags, making it difficult to observe details. The bones were very brittle and fragile over time. The PMCT clearly showed the degree of calcification and location in the tooth germs of maxillary and mandibular teeth. It also provided information on the condition of the bones before they were damaged or dissipated during the autopsy process. From these dental findings, the age of the infant at death was estimated to be 2.5 to 6 months, which was consistent with the father's statement.

*Speaker

Thursday 25th May

17:00 - 17:30   Closing session of the day

Amphitheatre

Paleoradiology

Frank Rühli*[1]

[1]*Institute of Evolutionary Medicine, University of Zurich, Zurich, Switzerland*

Paleoradiological investigations of ancient human remains allows to study changes of human health through time. Particularly mummies – bodies with preserved soft tissue – are a most valuable source in such interdisciplinary projects. The Swiss Mummy Project (SMP) at the Medical Faculty of the University of Zurich was founded more than twenty years ago. The aim of this presentation is to highlight some of the SMP forensic research aims and state-of-the-art methods being used (in-situ X-ray, CT, MRI). Examples of our work include famous cases such as King Tutankhamun or the Neolithic Iceman as well as studies of larger series (e.g., in the Valley of the Kings, Egypt). Life conditions, pathologies, cause of death or post-mortem alterations such as mummification procedures can be assessed. Finally, the public impact of such research and related ethical considerations shall be addressed in this presentation too.

Friday 26th May

08:00 - 10:30 - Symposium TWGPAM

Capitouls Room

Friday 26th May

08:30 - 10:30   Session: Identification / Anthropology and forensic imaging

Amphitheatre

Rutty's Rules

Guy Rutty * [1]

[1] *University of Leicester – United Kingdom*

The use of so-called postmortem computed tomography (PMCT) continues to increase across the world as both an adjunct and a replacement for the traditional autopsy. This is associated, certainly in the United Kingdom, with an alteration in the workforce traditional associated with the examination of the body, the reporting and interpretation of the PMCT findings and the formulation of the cause of death. If PMCT reporting is undertaken remotely and without access to the correct documentation and knowledge of the external examination then this can lead to errors in interpretation of findings and formulation of the cause of death. This could have profound adverse medico-legal consequences. This talk will be based around a single case presentation which will illustrate interpretational PMCT problems that supports the above observation. It will present a series of simple "rules" which should be followed when using PMCT as an adjunct or replacement to the invasive autopsy. It will conclude by suggesting to ISFRI that this organisation should consider producing an international positional statement of a minimal dataset required for the safe reporting of PMCT.

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*Speaker

Ötzi the Iceman: forensic 3D reconstructions of a 5300-year-ago murder case

Chiara Villa * [1], Albert Zink [2], Niels Lynnerup [1]

[1] *Department of Forensic Medicine, University of Copenhagen – Denmark*
[2] *Institute for Mummy Studies, EURAC – Italy*

In 1991, a mummified body was discovered at 3210 m in the Alps on the border between Austria and Italy. The naturally preserved mummy belongs to a middle-age man who lived around 5300 years ago. Extensive imaging investigations led to conclude that the man was exsanguination due to a puncture wound to the left subclavian artery caused by an arrowhead. We reanalyzed the CT scanning of 2013 using Mimics (Materialise) to isolate internal structures of the body and calculate the volume of isolated structures. We also performed virtual 3D animation to understand Iceman's posture at the time of the shooting.

Thanks to the detailed 3D visualizations of the different structures in the shoulder, we found that the hematoma is more extensive than previously described: the new part extends frontally, below the subclavian artery, down to the 3rd left rib. The volume of the hematoma is 75 cm3, corresponding to 12.5 cl (after correction for dehydration and shrinkage). With the help of the 3D bones of a recent deceased, we fully animated the Iceman's skeleton and simulated an ante-mortem posture, showing that a straight trajectory of the arrow could explain the lesions of the scapula and the laceration in the artery.

*Speaker

Once Upon a Time .... The Secrets of Glaciers

Bettina Schrag * [1], Virginie Magnin [2], François Mariéthoz [3]

[1] Central Institute, Valais Hospital – Switzerland
[2] University Centre of Legal Medicine, Lausanne - Geneva – Switzerland
[3] Cantonal Archaeology Office of Valais – Switzerland

Over the centuries, glaciers have preserved traces of the past in their "eternal ice". Today, due to global warming, glaciers are revealing their "secrets" and some of them are coming to the surface.

On the 15th of August 1942, a couple set out from a Valais Mountain village to go to the Alps on the other side of a glacier and were never seen again...snow that had fallen during their glacier crossing had erased all traces of the couple. According to the investigations carried out at that time, the missing couple had died in a fatal fall into a crevasse.

In 2017, the glacier released two bodies, which were subsequently identified as the remains of the missing couple. Nevertheless, the mystery of what happened on the 15th of August 1942 remained. At the same time, the forensic investigations began. Once the identity of the bodies had been established by DNA analysis, a multi-disciplinary work combining well-known and common methods including imaging, archaeological anthropology and glaciology made it possible to shed light on the events that had taken place 75 years earlier on that fatal day, although, in the end, the cause of death could not be established with certainty.

*Speaker

Use of postmortem computed tomography in disaster victim identification: Current Japanese methods and challenges

Maiko Yoshida * [1], Yohsuke Makino [2], Masatoshi Kojima [3], Rutsuko Yamaguchi [4], Go Inokuchi [3], Hirotaro Iwase [3]

[1] Chiba University – Japan
[2] University of Tokyo – Japan
[3] Chiba University – Japan
[4] University of Tokyo – Japan

Introduction

In the case of the 2011 Great East Japan Earthquake, ˷˜90% of the bodies were identified based on nonobjective means such as facial features, which resulted in misidentification. At present, the situation remains the same. In contrast, 'Disaster Victim Identification (DVI)' method is global standard which is based on objective means such as dental chart and DNA. There has been a movement to employ postmortem computed tomography (PMCT) in DVI process.

Method

In the Department of Legal Medicine of Chiba University in Japan, individual identification using PMCT taken prior to autopsy was conducted in forensic autopsy cases of unknown iden- tities when there was an assumed person for the body and the antemortem CT of the person could be acquired.

Results

A total of 20 cases were judged. In all cases, two images were compatible, indicating the same person. Image-based identification was particularly useful when dental findings or fingerprints were unavailable for comparison and there were no family members available for DNA testing.

Conclusion

In the future, this method will be applied to large-scale disasters.

*Speaker

Mummy bone density − A dual-energy CT-based method for measuring bone volume fraction in a mummified body that yields accurate results even in the presence of air in the bones

Dominic Gascho * [1], Patrick Eppenberger [2], Frank J. Rü hli [2], Michael J. Thali [1], Patrik Wili [1,3]

[1] Institute of Forensic Medicine, University of Zurich, Zurich, Switzerland
[2] Institute of Evolutionary Medicine, University of Zurich, Zurich, Switzerland
[3] ARTORG Center for Biomedical Engineering Research, University of Bern, Bern, Switzerland

X-ray computed tomography (CT), which can visualize the internal structures of objects in three dimensions and in a non-destructive manner, has become the preferred method for whole- body examinations of ancient mummified human remains. However, CT can be used not only to perform a qualitative examination of such remains, but also to conduct quantitative measurements, such as bone density, which are of great interest in anthropological, archaeological, and forensic research. CT data consists of individual voxels (volume pixels) containing radiological density values (CT numbers) in Hounsfield units (HU) that are calibrated to the physical attenuation values of water. For bone, where the water content is much lower compared to soft tissue, a separate calibration with an appropriate calibration phantom is therefore required to determine volumetric bone mineral density. By multiplication with a constant, these values can be converted into bone volume fraction. However, this quantitative CT (qCT) method is not appropriate when air is present in the bone, as is the case after prolonged postmortem interval. To address this issue, we present a dual-energy CT-based method for measuring bone volume fraction in a mummified body that yields accurate results even in the presence of air in the bones.

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*Speaker

Lodox Linear Slot Scanning Radiology (LSSR)
Unique Radiology Technology in Forensics

Efthimia Tzetis

Lodox, full body, high speed digital radiology solution for forensic pathology.
Lodox Systems – South Africa: Lodox Systems (Pty) Ltd based in Johannesburg, South Africa wishes to confirm that we are the sole manufacturers and sole suppliers of the Lodox eXero-dr (Forensics) and Xmpar-dr (Trauma) Critical Imaging Systems and all related components, software, parts, and technical support.

As a South African Medical device company, the Lodox eXero-dr and Xmplar-dr are certified to FDA 21CFR part 1020.30 for "Diagnostic x-ray systems and their major components" and holds CE 1639 registration plus UL mark certification. These registrations and certifications mean Lodox Systems (Pty) Ltd. is the only Medical Device manufacturer of an internationally certified and accredited radiographic system which has unique technology the "Lodox Linear Slot Scanning System (LSSR)", that takes a continuous seamless digital radiograph of large areas, such as the whole body, safely, rapidly with diagnostic image quality.

Background:

Advancements in medical imaging technologies such as the Lodox slit scanning radiology systems presents the pathologists with a comprehensive solution, guiding quicker and better clinical forensic findings, reducing guess work, offering peace of mind, and expediting cause of death determination.

The full body image of the Lodox System provides a comprehensive exam and replaces several smaller views, making it easier to locate, identify foreign bodies and features, and relate them to injuries.

The pathologist's clinical judgement and forensic acumen is supplemented and enhanced.

In addition, the speed and high-quality imaging of all bodies allows for quick processing which may be especially useful in:

- the case of religious groups that require an expedited burial,
- mass fatality situations,
- skeletal and poly-trauma,
- ballistic injuries and projectiles,
- victim identification,
- presence and positioning of medical devices,
- sudden unexpected death of an infant,
- diseases such as tuberculosis and medico-legal investigations
- burnt and decomposed bodies

Objective:

The objective is to present the Lodox slit scanning radiology systems as a non-invasive examination for modern forensic practices. Lodox's high quality images can objectively complete a non-destructive gathering of findings from head to toe, providing intuitive and powerful forensic evidence to assist the pathologists in the cause of death determination.

Rapid and complete data acquisition and digital records assist in research and medico – legal cases.

Conclusion:

The Lodox Solution has proven to be an invaluable resource in the Forensic Laboratory and can enhance policy formulation and entrench the constitutional right to life and dignity at death.

Friday 26th May

11:00 - 12:00 Gil Brogdon Honorary Lecture

Amphitheatre

Complementary investigations: weapon marks examination techniques on wounds.

Céline Guilbeau-Frugier, Caroline Capuani & Fabrice Dedouit

[1]Service de médecine légale, Hôpital de Rangueil, CHU Toulouse [Toulouse]

Examination of weapon marks is a crucial step to identify the type of weapon that was used, in both forensic and anthropological contexts. Various complementary techniques can be used to precisely describe a wound and collect quantitative and qualitative data. The choice of a technique depends on the information required.

Micro-computed tomography can document wounds in three dimensions at a micrometer scale, non-destructively. The bone can be imaged with the soft tissue. The acquisition and processing of successive images is time-consuming and require a powerful computer.

Epifluorescence microscopy is a 3D technique that uses the natural fluorescence of tissue and can image specimens of any size. However, for bones, soft tissue needs to be removed. The scale of images is around the micrometer. A good experience of the experimenter is crucial.

Scanning electron microscopy is a high-resolution 3D imaging technique that requires a sample preparation. It can be combined with energy-dispersive X-ray spectroscopy (SEM-EDX) to provide information about the chemical composition of the weapon. SEM-EDX analysis can be disturbed by the environment factors. So the interpretation of the results may be impossible without additional information regarding the context in which the body was discovered.

POSTERS

Friday 26th May
Find them in the Thursday 25th May session

12:00 - 13:00

Opéra room

Friday 26th May

14:00 - 15:30 Session: Education and forensic imaging

Amphitheatre

Fetal postmortem imaging using contrast enhanced micro-CT and 3D ultrasound

Bernadette De Bakker * [1,2,3]

[1] Amsterdam UMC location University of Amsterdam, Department of Obstetrics and Gynecology, Meibergdreef 9, Amsterdam, The Netherlands – Netherlands
[2] Amsterdam Reproduction and Development research institute, Amsterdam, The Netherlands – Netherlands
[3] Erasmus MC – Sophia Children's Hospital, University Medical Center Rotterdam, Department of Pediatric Surgery, The Netherlands – Netherlands

Forensic imaging of a human fetus can provide knowledge about gestational age estimation, signs of viability, possible congenital abnormalities and potentially the cause of death. Because of the small size of these specimen, clinical scanners (i.e. CT, MRI) often lack the resolution to study an ex-vivo fetus in sufficient detail. We searched for other high-resolution imaging techniques to study ex-vivo human fetuses.

In 2017 I founded the *Dutch Fetal Biobank* donation program, which allows parents to donate the fetus to science in case of pregnancy termination or preterm labor. Our biobank currently holds 350 fetuses up to 24 weeks gestation. Our team is 24/7 on call to pick up and fix or dissect the fetuses within 2-6 hours(!) after birth. At present, 25 research groups use tissues and images from our biobank.

Having state-of-the-art ex-vivo imaging methods such as Micro-CT, 7-Tesla MRI and 3D-ultrasound and the skills to generate high-resolution 3D-images of fetuses at our disposal, enables us to study fetal anatomy in an unprecedented way. I would like to share our expertise in creating a *3D Atlas of Fetal Anatomy* to further the field of postmortem forensic imaging of human fetuses. Visit our website at 3Dhumandevelopment.com.

*Speaker

Post-mortem imaging techniques as complementary tools for the teaching of anatomy at the Faculty Unit of Anatomy and Morphology in Lausanne

Sara Sabatasso * [1], Stella Fahrni *, André Mendonca-Guerra *, Sami Schranz *, Silke Grabherr

[1] Unité Facultaire d'Anatomie et de Morphologie (UFAM), Centre Universitaire Romand de Médecine légale Lausanne-Genève – Switzerland

Implementing new pedagogical tools is a major priority of UFAM. We undertook 3D surface scans of human skeletons. All bones were scanned with a high-resolution 3D scanner.3D prints of some bones were also performed. We made the skeletal 3D scans and 3D prints available during practicals for medical students. Moreover, we digitized some anatomical pieces by a 3D surface scanner, and by photogrammetry. During the Covid pandemic, we implemented these pieces into the embryology practicals to help students preparing these sessions, optimizing the learning process. Besides, we perform a native total body CT-scan of every anatomy body. This allows a more precise selection of the bodies according to the teaching needs, research projects, or external collaborations. Another ongoing project of digitalization involves a multi-modal documentation of anatomical pieces. This will allow students to be able to link the information they observe on an anatomical piece with 3D surface images and radiological views (X-rays, CT, MRI). The potential of post-mortem imaging for the improvement of the teaching of anatomy and namely for a more clinically-oriented anatomy, is huge. These tools are not intended to replace cadaveric dissection, but they can represent for the students a valuable learning support (integration of clinical aspects, revision of structures, self-assessment, preparation for the exams).

*Speaker

Updates on the New Mexico Decedent Image Database

Heather Edgar * [1], Shamsi Daneshvari Berry [2]

[1] *University of New Mexico (UNM) – MSC 01 1050 1 University of New Mexico Albuquerque NM 87131, United States*
[2] *Homer Stryker Western Michigan School of Medicine – United States*

The New Mexico Decedent Image Database (NMDID) is a unique, web accessible database of > 15,000 full body CT scans and associated data from the New Mexico Office of the Medical Investigator (OMI) in Albuquerque, NM, USA. The associated data includes lifestyle, health, demographic, and circumstances of death from the investigation and interviews with next of kin. Demographics reflect that of the state except that mortality is skewed downward. Currently NMDID has over 1000 users from 58 countries resulting in 2 subsidiary datasets, 10 theses and dissertations, and 34 peer-reviewed publications using NMDID data (metadata and images); this does not include many published abstracts. Publications have been diverse, focusing on forensic applications and bioprofile (15), human variation (6), health research (6), evolutionary anthropology (2), developmental (2), computer science and machine learning (5) among other fields.

NMDID can serve as a model for other similar large data sharing resources. This presentation will summarize the process of the development of NMDID, related ethical issues, and the uses of this resource to date. We will also discuss plans for future improvements, including the incorporation of greater demographic diversity and pre-segmented 3D images.

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*Speaker

Personal Identification from AM and PMCT Derived 3D Lumbar Models

Jonathan Ford * [1], Zackery Beauchamp [1], Mike Jp Biggs [2], Daniel Martin[1], Guy Rutty [2], Summer Decker [1]

[1] *University of South Florida Radiology – United States*
[2] *University of Leicester – United Kingdom*

In DVI situations, personal identification of unknown persons can be hampered by the fragmentary or disturbed state of the remains. The University of Leicester and the University of South Florida partnered to examine the utilization of CT derived 3D models of the L1-L5 vertebra of antemortem CT (AMCT) scans of known individuals and compare them against postmortem CT (PMCT) scans for personal identification. To date, Leicester has acquired 40 matching AM scans for individuals that passed through their facility for PMCT scanning. Additional paired scans were supplemented from the University of South Florida's Forensic Research database to bring the total number to 75. All scans were coded and anonymized so researchers performing the modelling and analysis were blinded to the identities of the AM and PM scans. Each scan was imported into the *Mimics Innovation Suite v. 25* (Materialise) where the L1-L5 vertebra were individually modelled via segmentation and thresholding. All 75 sets of the AM vertebrae were registered with a target unknown PMCT derived vertebra. A part- to-part comparison was conducted for each vertebra and a match ratio was recorded using a threshold of +/- 1 mm. All unknown individuals were correctly identified with no false positives.

*Speaker

Friday 26th May

14:00 - 15:30 Sessions IAFR
12th Annual Meeting of the International Association of Forensic Radiographers

Capitouls Room

Current forensic imaging practices in Australia and New Zealand: Results from ANZ IAFR survey

Courtney Steels * [1], Edel Doyle [1], Anthony Buxton [1]

[1] IAFR – Australia

Forensic imaging is frequently utilised to aid medico-legal investigations worldwide, but little is published or known about current forensic imaging practices across Australia and New Zealand (ANZ). The ANZ branch of the International Association of Forensic Radiographers (IAFR) aimed to gather information on current forensic imaging practices across ANZ, focusing on examinations, training, staffing and how participants felt they could benefit from training and guidance in the future. An online survey was distributed to members of the ANZ-IAFR, NZMIRT, ASMIRT and to a range of forensic and imaging facilities in 2020. 47 participants responded who answered 34 questions. The results showed that forensic imaging involved both the living and deceased in a variety of environments. Participants felt the need for more forensic imaging training, including the most commonly performed forensic imaging examinations. Departmental training, policies and procedures for forensic imaging and related examinations varied widely. The results indicated a lack of standardisation across imaging facilities in ANZ. The region would benefit from forensic imaging guidelines, as well as further training and re- sources to support practitioners performing these examinations.

*Speaker

Stature estimation of the South African male population using the postmortem Lodox imaging.

Marise Heyns * [1], Calvin Mole [2], Yomika Venketsamy [2]

[1] Ulster University – United Kingdom
[2] University of Cape Town – South Africa

The usefulness of stature estimation using conventional x-rays, magnetic resonance imaging and computed tomography measurements of long bones has been researched however, there has been limited research conducted on Lodox® bone scans as an added tool for stature estimation in the South African population.

Forty-nine deceased males were scanned with Lodox® within 24 hours of entering Salt River Mortuary for a scheduled autopsy. Total stature was initially measured with an embedded ruler. The body underwent a full body digital x-ray using the Lodox® Xmplar DR device. Five long bone lengths i.e. humerus, radius, ulnar, femur and tibia of the bodies were digitally measured using the integrated software.

The humerus, femur and tibia were the most statistically significant correlators of stature, individually. The univariate linear regression showed strong statistical significance for the humerus, femur and tibia with determining stature. Multiple linear regression with the combination of humerus and ulna; femur and tibia; humerus, femur and tibia were statistically significant in determining stature. However, a combination of ulna and radius and the combination of all five bones overall regression was not statistically significant. Univariate and multiple linear regression formulas were created for the South African male population using Lodox® image scan measurements.

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*Speaker

From Yugoslavia to Ukraine? - The role of radiography in the forensic investigation and victim identification of war crimes

Mark Viner * [1], Roland Wessling [1], Caroline Barker [2]

[1] Cranfield University – United Kingdom
[2] International Criminal Court – Netherlands

Mass graves are a frequent legacy of conflict and human rights abuses. Survivors have a need to know the truth about the fate of their loved ones, and they have the right under international and domestic law to the pursuit of truth, justice and reparation. Governments have statutory obligations to survivors, including the obligation to ensure that the human remains of victims are identified and returned to families so that they can be buried with dignity, and appropriate memorialization can take place.

Radiology plays a key role in the forensic investigation of war crimes and mass graves. Drawing on experience of investigating and analysing forensic evidence from mass graves and clandestine burials in the former Yugoslavia, Sierra Leone, Iraq, Cyprus, and France, this presentation will outline the painstaking processes followed in order to preserve and record the evidence. It will discuss the political and logistical challenges presented, and examine the role played by radiology and radiographers.

With significant advantages now offered by the increased portability of advanced radiological equipment, together with digital image processing and communications, it will discuss how the lessons learned from these historical incidents may be applied within the context of possible future investigations.

*Speaker

Proposed radiation doses from a phantom study for an NAI skeletal survey X-ray series

Edel Doyle* [1], Richard Bassed [1,2], Matthew Dimmock [1,3], Kam Lee [4],
Peter Thomas [4]

[1] Monash university – Australia
[2] Victorian Institute of Forensic Medicine (VIFM) – Australia
[3] Keele University [Keele] – United Kingdom
[4] Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) – Australia

Background
A series of 31 X-rays is recommended by the Royal College of Radiologists (RCR) when investigating non-accidental injury (NAI). In order to establish if a low-dose CT Skeletal Survey could replace the X-ray series, the effective radiation dose must be calculated for comparative purposes.

Materials and methods
A 5-year-old paediatric NAI phantom was X-rayed at five radiology sites using both the RCR recommended protocol and where applicable, the local departmental NAI protocol. The radiation doses were measured, recorded and scaled down to estimate the effective radiation doses for a 2-year-old child using the PCXMC software. Radiation risks were estimated using the BEIR VII report.

Results
The median cumulative "true" KAP measured across the 5 sites for the RCR protocol was 238 milliGray centimetre squared (mGy.cm2), whereas the corresponding effective doses was 0.09 milliSieverts (mSv).

The estimated risk of radiation-induced cancer for a 2-year-old child having a Skeletal Survey X-ray series is 1 in 90,000 to 1 in 40,000.

Conclusion
The median effective radiation dose to the phantom when using the RCR protocol was 0.09 mSv. The authors will now aim to acquire a diagnostic low-dose CT skeletal survey with a similar effective radiation dose.

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*Speaker

Confirmation of Cardiomegaly from the Cardiothoracic Ratio in Post Mortem Lodox® Imaging

Marise Heyns * [1], Rosemarie Hoffler [2], Calvin Mole [2]

[1] *Ulster University – United Kingdom*
[2] *University of Cape Town – South Africa*

In clinical practice and medico-legal post mortem investigations a cardiothoracic ratio of greater than or equal to the 50% threshold is deemed to be the most reliable and easiest method for the detection of an enlarged heart. This study investigates the accuracy and reliability of the CTR threshold measured from the radiographs produced by the Lodox® Xmplar-dr scanner at Salt River Laboratory.

A retrospective component investigated past use of the CTR in autopsy reports and the prospective component compared the diagnosis obtained from the CTR calculated from the Lodox im- ages with the recorded heart weights. This CTR was then compared to the CTR calculated with the heart in-situ in the pericardial sac to determine how accurate the Lodox radiograph is for diagnosing an enlarged heart.

The results showed a significant difference with the CTR from the Lodox images being better at detecting enlarged hearts, at 76%, whereas the CTR calculated in-situ was better for detecting normal heart weights, at 84%. Increasing the 50% threshold would increase the specificity, thereby increasing the number of correctly identified normal heart weights as well as enlarged hearts.
A CTR threshold of 52% is recommended for the Lodox scanner for diagnosing an enlarged heart.

*Speaker

Friday 26th May

16:00 - 17:15 Session: Identification /anthropology

Amphitheatre

Standards of practice in forensic age estimation with CT of the medial clavicular epiphysis – a systematic review

Thomas D Ruder[*1], Saskia C Kuhnen[1], Wolf-Dieter Zech[2], Jeremias B Klaus[2,3,4], Paolo Lombardo[1], Michael Ith[5,6]

[1] Institute of Diagnostic, Interventional and Pediatric Radiology, Inselspital, Bern University Hospital, University of Bern, Bern – Switzerland
[2] Institute of Forensic Medicine, University of Bern, Bern – Switzerland
[3] Institute of Diagnostic, Interventional and Pediatric Radiology, Inselspital, Bern University Hospital, University of Bern, Bern – Switzerland
[4] Roentgen Institute Thun, Thun – Switzerland
[5] Institute of Diagnostic, Interventional and Pediatric Radiology, Inselspital, Bern University Hospital, University of Bern, Bern – Switzerland
[6] Radiation Protection, Image Processing Systems Radiological Processes, Hirslanden Private Hospital Group, Zurich – Switzerland

The AGFAD (Arbeitsgemeinschaft für Forensische Alterdiagnostik, Study Group on Forensic Age Diagnostics) has published several recommendations regarding both technical aspects of computed tomography (CT) of the medial clavicular epiphysis (MCE) and the process of reading and interpreting the CT images for forensic age estimations (FAE). There are, however, no published recommendations regarding CT scan protocols and no dose reference values for CT of the MCE.
The objective of this analysis was to assess adherence to AGFAD recommendations among practitioners of FAE and analyse reported dose-relevant CT scan parameters with the objective of helping to establish evidence based dose reference values for FAE.

A systematic literature search was conducted in MEDLINE with specific MeSH terms to identify original research articles on FAE with CT of the MCE from 1998 to 2022.

A total of 44 studies were included. Adherence to AGFAD recommendations among practitioners of FAE is high regarding the use of Schmeling main stages (91%), bone window (77%), ≤1 mm CT slices (73%), axial/coronal CT images (70%), and Kellinghaus sub-stages (58%). Reporting of CT technique and CT dose relevant scan parameters is heterogeneous and often incomplete in the current literature.
Considering the success achieved by the AGFAD in creating standards of practice of FAE in living subjects, there is potential for the AGFAD to establish standards for radiation protection in FAE as well.

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*Speaker

Unaccompanied Minors Automatic Forensic Age Estimation (UMAFAE): applying artificial intelligence-based methods to estimate legal age in undocumented minors

Stefano De Luca *[1], Javier Venema Rodríguez [2], Pablo Mesejo Santiago[3], Oscar Ibáñez Panizo [4]

[1] Panacea Cooperative Research S. Coop. − Spain
[2] Panacea Cooperative Research S. Coop.; Departamento de Ciencias de la Computación e Inteligencia Artificial, Universidad de Granada − Spain
[3] Departamento de Ciencias de la Computación e Inteligencia Artificial, Universidad de Granada; Instituto Andaluz Interuniversitario en Data Science and Computational Analysis;Panacea Cooperative
Research S. Coop. − Spain
[4] Facultad de Informática, Centro de Investigación en Tecnología de la Información y las Comunicaciones (CITIC), Universidad de A Coruña; Panacea Cooperative Research S. Coop. − Spain

The main aim of the EU-funded UMAFAE project is to develop and validate methods for estimating legal age by applying Artificial Intelligence (AI) techniques. We are collecting the largest-ever data set of radiographic images. The inclusion criteria are: age between 14 and 25 years, known biological sex and age, and good quality of the images. Images of subjects with dis- eases of endocrine or congenital origin are included to determine the degree of influence of these variables on the accuracy values. A multi-ethnic sample of 9903 orthopantomographies (Bosnia, Botswana, Chile, Dominican Republic, Kosovo, Lebanon, Malaysia, Italy, Turkey, Uganda and Russia) was analyzed. All images were pre-processed to remove inconsistencies and any back- ground noises elements. Several Convolutional Neural Networks (CNN) that extracted features from the images and merged them with sex and ethnicity were trained to estimate age. A Mean Absolute Error (MAE) of 1.155 years was obtained in the validation test and an accuracy of 88.8% for legal age classification (> 18 or not). Our findings are in agreement with previous studies. However, we are validating our model on a multi-ethnic sample from 11 different countries. Since further experiments are still being performed with new population, these results are considered only preliminary.

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*Speaker

Virtopsy of isolated bones: better fracture morphology by reducing bone surface CT artifacts through using a water bed

Wolf Schweitzer * [1], Michael Thali [1], Vasiliki Chatzaraki [1]

[1] Zurich Institute of Forensic Medicine – Switzerland

Reconstruction of CT data volumes is usually associated with artifacts, especially for inhomogeneous scan volumes. It has been suggested that the air-bone interface (when scanning isolated bone "as is") is responsible for lower accuracy of long bone diameters from air-surrounded (AS) compared to water-surrounded bones (WS) (Sumner et al., 1985). Therefore, we investigated how the immediate environment of air and water in isolated bone-specimens affects the morphology of bone-trauma. Two fractured skulls (S1, S2) were scanned at 120kV/ ˜1500mAs, first as AS, then as WS, using typical clinical CT-scanner. Visualization was performed using standard-software (Ebert et al. 2021). On volume-visualization, thin fracturelines in the AS bone appeared to be invisible, while WS bone showed significantly better fracture-morphology due to greater detail. Axial image comparison showed insufficiently low CT-density for a fractureline at about 0.4mm width (S1) and 0.2mm (S2) for the AS bonescan, while the signals of the fracturelines in the WS bone scans were significantly lower than those of the surrounding bone. However, improvements of WS were marginal, but it may be considered to CT-scan bone specimens while immersed in water, but only if small details such as fracture lines are really relevant.

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*Speaker

Postmortem CT: the experience of the Research Unit of Paleoradiology and Allied Sciences of Trieste

Martina Montanaro * [1], Fabio Cavalli [2], Fulvio Costantinides [2]

[1] *Department of Medical, Surgical and Health Sciences, University of Trieste, Graduate School of Forensic Medicine. Italy*
[2] *Research Unit of Paleoradiology an Allied Sciences, LTS - SCIT - ASUGI – Trieste. Italy*

Background: The activity of the Research Unit of Paleoradiology and Allied Sciences of Trieste in the field of post-mortem CT (PMCT) from 2005 to 2022 will be presented. During this experience, the PMCT and in particular the craniofacial superimposition (CFS) and craniofacial approximation (CFA) techniques, after acquisition of CT images and subsequent 3D reconstructions, contributed to solve particularly complex forensic cases.

Materials and Methods: 47 forensic cases were subjected to PMCT. 311 archaeological cases were also investigated, ranging from a period between the Neolithic and the modern age.

Results: In a relatively small reality like Trieste, from 2005 to 2022 there was a slow and continuous progression in terms of the number of forensic cases also for identification purposes. In this regard the execution of PMCTs has helped to resolve apparently complicated autopsy cases or sometimes even totally changed the initial considerations. The collateral experience with paleoradiological cases contributed to improve our technical and diagnostic skill.

Conclusions: In our experience the performance of PMCT in cases of forensic interest and the use of CFS and CFA in cases of unknown corpses, has proved to be a valuable aid.

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*Speaker

The practice of forensic anthropology and odontology

Fathéma zehra Bounif, Soumia Zergui* [1]

[1] *National Institute of Criminalistics and Criminology of the National Gendarmerie, Algiers, Algeria − Algeria*

Forensic anthropology consists in the application of biological and physical anthropology principles together with forensic archeology practices during investigations related to the discovery of mummies or human remains. This discipline is vital to forensic investigations and the reconstruction of historical facts, especially in countries rich in history, such as Algeria.

The work of the forensic anthropologist focuses primarily on the recovery and analysis of human remains. Laboratory analysis includes the distinction between human and non human bones, the use of regionally validated methods to establish the biological profile, the study of taphonomic effects, and analysis of trauma. Forensic odontology, on the other hand, is based on the study of teeth characteristics and bite-marks, to facilitate investigations and consolidate other forensic techniques.

The anthropological and odontological study of the human remains, especially in the presence of trauma, might provide useful information for the identification of the deceased and reconstruction of the death scenario and, therefore, allow the forensic scientist to provide the court with the necessary technical elements to render judgment.

*Speaker

Friday 26th May

16:00 - 17:15 Parallel Session II

Capitouls Room

Micro-CT imaging for forensic case work: A collaboration between West Midlands Police and WMG, Warwick University, UK

Charlotte Primeau [*][1], Sofia Goia [1], Danielle Norman [1], Waltraud Baier[1], Mark Williams [1]

[1] WMG - University of Warwick – United Kingdom

Micro-CT is an imaging technique that is increasingly becoming more utilised in medico-legal investigations and has shown to be a valuable tool in various types of forensic examinations. Its use is however, limited by access to micro-CT scanning facilities as well as expertise in producing and evaluating images at a micrometre scale resolution.

At WMG, University of Warwick, England, a wide range of micro-CT scanners are available comprising five different systems, each with their own specification and capabilities, allowing almost any type of material to be scanned and a wide range of sample sizes.

Through this specialist capability, a close working relationship has been developed between forensic imaging specialists at WMG and West Midlands Police, in providing micro-CT imaging for forensic investigations nationally and internationally. Case work includes paediatric cases evidencing child abuse, strangulation and hangings, adult cases evidencing elder abuse, blunt and sharp force trauma, cases of dismemberment, examination of 3D printed weapons and fire investigations.

This presentation will cover some of the case work conducted at WMG and will illustrate the advantages of micro-CT scanning in forensic investigations, to highlight this valuable imaging technique that will become a more established part of the criminal justice system.

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*Speaker

Development of water-soluble contrast agents for postmortem computed tomography angiography

Nishida Hinata *[1], Yamamoto Tomoaki [1], Isokawa Runa [1], Kanda Aina [1],
Takano Yuka [1], Matsutomo Norikazu [1], Fukami Mitsuha [1], Nagase Miki [2]

[1] Kyorin University [Tokyo, Japan] – Japan
[2] Kyorin University School of Medicine [Tokyo, Japan] – Japan

Purpose: Postmortem computed tomography (PMCT) has recently been used not only in the practice of forensic medicine, but also in medical education as an ancillary tool for teaching gross anatomy. However, whole-body PMCT angiography (PMCTA) using a water-soluble contrast agent is seldom performed in the field. Here, we aimed to develop novel water-soluble contrast agents and compare them with amidotrizoic acid.

Methods: Potassium dihydrogen phosphate and calcium iodide were selected in this study, and their concentrations were adjusted to give a CT value of approximately 300 HU using a cylindrical phantom and 16 Multi-slice CT. Also, the effect of the investigated contrast agents on vascular endothelial cells was examined by visually assessing hematoxylin-eosin-stained porcine carotid artery specimens.

Results: The optimum concentration of potassium dihydrogen phosphate and calcium iodide were 1.18 mol/L and 0.084 mol/L, respectively. Potassium dihydrogen phosphate caused shrinkage of vascular endothelial cells and thus could not be used in cadavers. We successfully performed whole-body PMCTA in donated cadavers using amidotrizoic acid or a novel water-soluble contrast agent made from calcium iodide.

Conclusion: A novel water-soluble contrast agent using calcium iodide could be easily adjusted to an appropriate concentration and then used in PMCTA.

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*Speaker

Novel water-soluble contrast agent for whole body postmortem magnetic resonance imaging

Tomoaki Yamamoto * [1], Hinata Nishida [1], Aina Kanda [1], Runa Isokawa [1], Yuka Takano [1], Norikazu Matsutomo [1], Mitsuha Fukami [1], Miki Nagase [2]

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[2] Kyorin University School of Medicine [Tokyo, Japan] – Japan

Purpose: Postmortem magnetic resonance imaging (PMMR) has not been widely used in forensic medical practice or gross anatomy training. Furthermore, contrast-enhanced PMMR is seldom performed using cadavers. Here we explored the possibility of contrast-enhanced PMMR by developing a novel water-soluble contrast agent for whole-body PMMR at an affordable cost.

Methods: Gadolinium acetate tetrahydrate was selected as the base compound of the water-soluble contrast agent. In a fundamental study, an original phantom with several cylindrical containers was prepared, and the optimal parameters for 3D field echo and contrast agent concentration were tested using the phantom. Also, the effect of the developed contrast agent on vascular endothelial cells was evaluated by visually assessing a hematoxylin-eosin-stained porcine carotid artery specimen.

Results: The optimal concentration of the novel water-soluble contrast agent was estimated as 1.0 to 1.5 mmol/L. Distortion of a few vascular endothelial cells was observed after soaking the porcine carotid artery specimen in the contrast agent for 24 h, but it was very limited. Whole-body PMMR was successfully performed using the novel contrast agent in 20 cadavers.

Conclusion: The developed water-soluble contrast agent was inexpensive, and whole-body PMMR produced satisfactory images.

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*Speaker

Importance of additional sequences and postprocessing techniques in postmortem MRI.

Masatoshi Kojima * [1], Yohsuke Makino [2], Daisuke Yajima [3], Naoki Saito [1], Ayumi Motomura [3], Yumi Hoshioka, Maiko Yoshida [1], Hirotaro Iwase 1

[1] *Chiba University – Japan*
[2] *The University of Tokyo – Japan*
[3] *International University of Health and Welfare – Japan*

MRI provides better tissue contrast compared to CT, and its usefulness has been widely reported. There are many sequences in MRI, and imaging sequences are being standardized for clinical examinations. However, case-by-case additional sequences are sometimes necessary for accurate diagnosis. This may be true even after death. We present three cases in which additional sequences were useful to diagnosis in postmortem MRI practices.

Case 1: a cervical spine injury case. Although routine T1- and T2-weighted sequences failed to show the fatal spinal cord injury, T1- and T2*- weighted 3D gradient echo sequences (3D- GRE) clearly showed the injury, which was the key to determine cause of death. Case 2: a fat embolism case. Additional fat-suppressed T1-weighted images and post-processed subtraction images were useful to detect fat in the peripheral pulmonary arteries. Case 3: an aortic injury case. Additional high contrast and high spatial resolution sequences were both necessary to locate the injured area. 3D-multiecho fast field echo was the most diagnostic sequence.

MRI operators may play an important role to provide diagnostic images by additional sequences and post-processing images.

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*Speaker

Saturday 27th May

08:30 - 11:00   Session: Forensic imaging and technology I

Amphitheatre

Postmortem Infrared Coronarography of the Human Heart – Results and Improved Technical Protocols

Yanko Kolev [*1,2], Nikolay Mirochnik [1], Aparajeya Shanker [3], Saheed Shittu [3], Sanjaya Narayana[3], Anuradha Biswakarma [3], Preslav-Geo Kolev [4]

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[3] *Student at Medical Faculty, Medical University of Pleven – Bulgaria*
[4] *Student at Medical Faculty, Sofia University – Bulgaria*

The postmortem diagnosis of unexpected and sudden cardiac death, is essential for practice. The aim of the present study is to develop, test and put into practice a new methodology, facilitating the diagnosis of coronary pathology postmortem, leading to more reliable results of the autopsy activity. It is important, not to violate the integrity of the researched object before its immediate dissection, as well as not to introduce substances that may affect other important studies. A harmless technique is used - FLIR Thermal sensor in a Cat S62 Pro mobile, a hot water is injected into the coronary vessels and the functional patency of the vessels is observed and recorded in their smallest macroscopically visible branches. This allows the further dissection of the heart to be performed with predictable results, focusing on anatomical areas of visible involvement. Technical improvements in the imaging methodology and visual results are presented. The expected contribution of the study is the development and testing of an optimally simplified method for the diagnosis of coronary pathology before the actual dissection of the heart, with the aim of avoiding possible errors and shortcomings of the autopsy technique and objectifying and documenting the results of the forensic examination.

*Speaker

Evaluation of subject-specific finite element analysis of skull fracture as a forensic tool

Mikkel Henningsen * [1], Natalia Lindgren [2], Svein Kleiven [2], Xiaogai Li [2], Christina Jacobsen [1], Chiara Villa [1]

[1] Department of Forensic Medicine, University of Copenhagen − Denmark
[2] Division of Neuronic Engineering, KTH Royal Institute of Technology − Sweden

Finite element analysis (FEA) is a numerical technique suitable for simulation of skull fracture. Reliable results require subject-specific head models that account for individual variation. Five cases of blunt force skull fracture in adults were simulated to evaluate the feasibility of subject-specific FEA as a tool in forensic pathology.

Skulls were semi-automatically segmented from PMCT scans using 3D Slicer and combined with a baseline ADAPT FE head model to generate subject-specific head models. Event kinematics were estimated from police reports, autopsy findings, and simulations using whole-body models. Simulated fracture patterns and actual fractures at autopsy/PMCT were compared and qualitatively evaluated.

The ADAPT model was successfully made subject-specific, maintaining individual geometry and good mesh quality. In three cases, the simulated fracture patterns were comparable in lo- cation and pattern to autopsy/PMCT. In one case, the simulation predicted a linear fracture in the parietal bone whereas the actual fracture was in the occipital bone. In one case, the simulation exaggerated the fractures, but early time steps of the simulation were comparable to autopsy/PMCT.

FEA may be feasible in routine cases of blunt force skull fracture in adults. The simulation is sensitive to assumed kinematics and results should be interpreted with caution.

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*Speaker

Micro Computed Tomography for Post Mortem Imaging

Daniel Docter [*] [1], Jaco Hagoort [2], Yousif Dawood [1,2,3], Karl Jacobs [2,3,4], Nick Lobe [5], Grzegorz Pyka [6,7], Greet Kerckhofs [6,7,8,9], Maurice Van Den Hoff [2,3], Bernadette De Bakker [1,3,10]

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[8] Department of Materials Engineering, KU Leuven, Heverlee, Belgium
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[10] Erasmus MC – Sophia Children's Hospital, University Medical Center Rotterdam, Dept. of Pediatric Surgery, Rotterdam, The Netherlands

The gold standard for determining cause of death is autopsy, however this technique has several limitations; e.g. small defects can be overseen and the technique is destructive making re-evaluations of structures difficult. Designated classical 2D histology can provide more insights, but is time-consuming and expends the sample. An interesting and relatively fast alternative is imaging samples using micro-focus X-ray computed tomography (micro-CT), which enables visualizing samples with an isotropic resolution of several micrometers, bridging the gap between dissection and histology. Micro-CT is progressively used in clinical research to study anatomy and pathology.

Our first micro-CT datasets of formalin-fixed human samples will be presented including pelvis, orbita, foot, larynx, and fetal samples. Soft tissue X-ray attenuation was enhanced using buffered Lugol's solution as X-ray contrast-enhancing staining agent (CESA). Because samples vary in size, individually tailored and optimized sample preparation and imaging protocols need to be used. To reduce staining time and aid vascular examination, alternative staining techniques are being explored. Among which intravascular delivery of the CESA.

We demonstrate the possibilities to image large CESA-stained samples in 3D with microscale resolution using micro-CT. With continued advancement of staining and scanning protocols, this method may prove invaluable for clinical sample evaluation.

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[*]Speaker

Virtopsy approaches forensic use of 3D radiological data to confirm suspected personal identity

Wolf Schweitzer * [1], Michael Thali

1 Zurich Institute of Forensic Medicine – Switzerland

When it comes to confirming radiological identification of a deceased person using ante-mortem (AM) radiological data, the most common approach so far has been to compare structures that are considered unique (e.g., unique pathology, ethmoid cell morphology, orthopedic implants). Outside the realm of such unique morphology, we encountered cases where we had to employ shape match with CT-CT or MRI-CT match-pairs. We modified the elegant approach of Decker&Ford (2019) (2), which describes the use of the distance between landmark-registered superimposed models from CT-data. We manually superimposed surface models from AM and PM scans and then mapped Euclidean distances onto the shapes. As slice-thickness and bone-surface-cutoff used to define the surface varied by data/case, we expected a larger error in each case. Thus, a positive shapematch was characterized by an excellent uniform distribution of error associated with the shape at hand. A mismatch would be visualized by error maps that did not match the shape on which they were projected and whose values differed inhomogenously. Thus, our approach requires an evaluation of the errormap in the context of the shape onto which it is projected. In the presentation we will explain the methodological aspects and show application examples.

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*Speaker

DECT and QCT-based Measurement of Bone-Volume Fraction - An Ex Vivo Pairwise Comparison

Patrik Wili * [1,2], Dominic Gascho [2], Michael Thali [2], Philippe Zysset [1]

[1] *ARTORG Center for Biomedical Engineering Research, University of Bern, Bern, Switzerland*
[2] *Institute of Forensic Medicine, University of Zurich, Zurich, Switzerland*

Quantifying bone volume fraction (BV/TV) is of interest for post-mortem forensic and anthropological studies. Among other morphological parameters, BV/TV is the dominant indicator of bone strength. Quantitative computed tomography (QCT) measures volumetric bone mineral density (vBMD) by using a reference phantom and converts to BV/TV by multiplying a constant. Yet, elevated fat concentrations and air/gas in the bone marrow may lead to measurement inaccuracies. Dual-energy CT (DECT), which enables direct assessment of BV/TV, could have the potential to overcome these limitations. This study explores the potential of DECT to evaluate BV/TV accurately and to avoid the pitfalls of QCT. We aimed a pairwise and quantitative comparison of the two techniques using bovine trabecular bone specimens. Using a sample-holder, we successively replaced the marrow of each sample with three different media: air, 0.9% NaCl and an adipose tissue surrogate, mimicking different marrow conditions. The results confirmed that elevated fat concentration or air leads to a systematic bias in bone mineral density measurement by QCT, but has no significant effect on DECT-based BV/TV assessment. To conclude, we present a DECT-based method for an accurate evaluation of BV/TV, which may be used for the forensic assessment of fracture force or studying evolutionary changes.

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*Speaker

In situ determination of pH in brain tissue using postmortem 1H-MRS

Sabina Frese * [1,2], Dominic Gascho [2], Michael Thali [2], Sebastian Kozerke[1], Niklaus Zölch *[2,3]

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Non-invasive in situ 1H-MRS has been conducted on decedents to study metabolic changes. In some of these postmortem spectra, we observed a shift in the resonance frequency of acetate, which is known to be pH-dependent below a pH of about 6.5. Here we investigated if this can be used to measure pH non-invasively and, if so, whether aspects on the agonal phase can be inferred from it. For this purpose, MRS measurements were performed in white matter of decedents (n=50) to determine pH based on the resonance frequency of acetate in each case. Later at autopsy, white matter samples were taken to measure pH using a conventional pH-meter. In addition, medical histories and causes of death were reviewed for medical reason for the observed postmortem brain pH. Our results showed that the resonance frequency of acetate accurately reflects the pH for pH values below 6.3. Above 6.3, the changes in the acetate resonance seem too small for a reliable pH measurement. Furthermore, decedents with a fatal metabolic disorder or carbon monoxide poisoning, as well as those on whom resuscitative measures were performed over an extended period, were found to have pH below 6.3.

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*Speaker

Automated classification of ballistic-related Post-Mortem CT reports using Natural Language Processing

Joseph Benzakoun * [1,2], Emilien Jupin-Delevaux [1,2], Laurence Legrand [1,2], Corentin Provost [1,2], Ghazi Hmeydia [1,2], Marie-Edith Richard [1,2], Lilia Hamza [3,4], Tania Delabarde [3,4], Bertrand Ludes [3,4], Catherine Oppenheim[1,2]

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Objective: Evaluate the feasibility of automated classification of post-mortem CT (PMCT) reports using Deep-Learning Natural Language Processing (NLP).

Material: 3182 PMCT reports were automatically extracted from the local database of the Medico-Legal Institute of Paris (2017-2022). Reports were manually classified as ballistic or non-ballistic-related then split into training and test sets with a 75%/25% ratio, stratified on ballistic-relatedness. A french-based NLP CamemBErT model was fine-tuned onto sentences extracted from the test-set, and trained to classify them as ballistic-related sentences or not. Performances of the percentage of sentences classified as ballistic-related in each report (Ballis- tic%) was evaluated for the prediction of ballistic-relatedness of each report.

Results: 15429 and 5158 sentences were extracted from respectively 2350 and 782 reports from the test and training sets. Among these reports, respectively 212 (9%) and 71 (9%) were ballistic-related. After training, the performances of Ballistic% for identifying ballistic-related reports was high in training and test sets (Area Under ROC curves: 1 (95%CI:0.99-1) and 0.98 (0.97-1), respectively). Ballistic% threshold maximizing classification accuracy was 35% in the test set, leading to high diagnostic performances in training and test sets (accuracy: 100% (99- 100%) and 97% (96-98%), respectively).

Conclusion: Automated classification of PMCT reports using NLP is feasible with high accuracy.

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*Speaker

Quantitative morphological analysis by Fourier elliptical descriptors in 3D

Pierre-Emmanuel Zorn * [1,2], Thibault Willaume [3], Guillaume Bierry [3,4], Jean-Philippe Dillenseger [1,2,4], André Constantinesco [2], Philippe Choquet[1,2,4]

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[3] *Les Hôpitaux Universitaires de Strasbourg (HUS) Pole imagerie-service de radiologie ostéo articulaire – Les Hôpitaux Universitaires de Strasbourg (HUS) – France*
[4] *Université de Strasbourg, faculté de médecine – université de Strasbourg – France*

The diagnosis of sex in humans is mainly based on the shape of the pelvis or parts of it. Published and recognised methods are mainly based on morphological analysis. The purpose of this study is to evaluate 3D Fourier elliptical descriptors (Fed) as a new method to per- form quantitative analysis of true pelvic (TP) and obturated foramen (OF) shapes in order to identify sexual dimorphisms. This method was tested on 300 abdomino pelvic Computed Tomography scans from patients (148 women and 152 men, mean age 36.4 years). Image v1.53a (http://imagej.nih.gov/ij) was used to process separately the two anatomical parts using home-made macro program. 2D Fed, applied to planar projections of the same regions, was also performed to compare with the proposed method, to see if adding a dimension improves the performance of diagnosis. Classification was based on Support Vector Machine algorithm: on the test data (150 exams: 76 males and 74 females) 3D Fed diagnosis was correct for 88% of the subjects versus 77% in 2D Fed on the TP. The third dimension was also more efficient on the OF region (82% using 3D Fed versus 74% for 2D Fed).

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*Speaker

Saturday 27th May

08:30 - 11:00   Forensic imaging and miscellaneous

Capitouls Room

Postmortem CT and forensic identification: the role of facial approximation and craniofacial superimposition techniques.

Fabio Cavalli[1]

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Post-mortem CT in case of unknown decomposed or more or less completely skeletonized corpses can be useful in the field of forensic identification because it allows to easily obtain the three-dimensional "virtual cast" of the subject's facial skeleton. This can be very useful to obtain a real identikit of the deceased through the techniques of facial traits approximation (FTA). However, FTA is subject to numerous sources of error deriving not only from anatomical uncertainties but also from the choice of the reconstructive technique. Indeed, a good FTA technique should be relatively fast, anatomically congruent, and possibly fully or largely automated to minimize its dependence on the operator. The craniofacial superimposition (CFS) is less prone to technical problems, it is fast and it is possible to use semi-automatic software, even though it cannot be used in cases where the identity of the corpse is totally ignored. In our experience it is possible to create a protocol in which FTA and CFS can be used to obtain an identification, after the post-mortem CT, with a good margin of probability, awaiting confirmation by genetic analysis.

Knowing the case inside out: The value of having CT available in the courtroom setting

Janette Verster* [1], Garyfalia Ampanozi[2], Stephan Bolliger[2], Michael Thali[2], Wolf Schweitzer[2]

1 Division of Forensic Medicine, Stellenbosch University – South Africa
2 Institut ƒü˙r Rechtsmedizin Zü˙rich, University of Zurich – Switzerland

Post-mortem Computed tomography (PMCT) is an invaluable tool in detecting skeletal injuries at autopsy, especially in anatomical areas that are not easily exposed. In the hospital trauma setting patients often undergo CT to provide rapid injury assessment. In the clinical forensic setting, trauma images could be re-visited to solve courtroom mysteries.

We describe a case of an adult male who was shot once in the head by armed forces two years prior to consultation. The court requested the opinion of a forensic pathologist to determine the directionality of the gunshot wound track, however medical records and photographs in the police docket were lacking. A CT Head, taken at the time of the injury, was available for perusal by the forensic investigative team.

Subsequent 3D Volume Rendering Technique (VRT) reconstruction not only depicted the gun- shot wound track, but could also proof beyond reasonable doubt in which direction the projectile was traveling through the head, two and a half years after the incident occurred.

This case report reveals that CT scans in isolation can provide the forensic pathologist with a definitive analysis in gunshot wound cases, especially where bone is involved, and can be used as an adequate tool for courtroom testimony.

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*Speaker

Correlation between PMCTA and autopsy findings in violent deaths

Fehmi Snène *[1]

[1] Centre Hospitalier Universitaire de Nîmes – Institut médico-légale de Nîmes – France

Purpose or Learning Objective:
To familiarize with post-mortem computed tomography angiography (PMCTA) as a valuable tool in forensic investigations of violent death. To illustrate the potential of PMCTA as a valid help in the evaluation of several types of lesions compared to the autopsy findings. To recognize and illustrate the artifacts and limits of this technique.

Methods:
A selection of 10 bodies underwent a post-mortem computed tomography angiography before the autopsy. The technique of realization of CT scans was almost the same (catheterisation of femoral or cervical artery and vein, injection of a mixture of PEG and contrast media, external cardiac massage...)

Results:
In our study, lesions of the large and medium vessels as well as solid organs lesions were revealed. Hematic infiltrations under the skin and muscles caused by contusions or stab wounds have also been demonstrated by the injection of contrast medium. A clear correlation and the between autopsy and PMCTA was achieved.

Conclusion:
Our study points the complementarity that can be achieved when performing PMCTA associated with conventional autopsy.

*Speaker

When Animals Attack: Forensic Imaging Unit

Jamie Elifritz * [1], Anna Medendorp [1], Joanna Shechtel [2], Nicholson Chadwick [2], Mariam Moshiri [2], Emily Helmrich [1], Natalie Adolphi [1], Lauren Decker [1], Jennifer Weaver [2]

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As long as humans have been in existence, there have been incidences of traumatic encounters with animals, including postmortem predation and scavenging. We will discuss traumatic injuries that may result from these encounters, including mechanisms and radiological manifestations. Cases will be obtained from both hospital and postmortem settings. Select cases will include anthropologic correlation.

Categories of animal vs human traumas include: agricultural, wild, domestic, and recreational. This presentation will explore cases ranging from domestic dog attacks and rodeo injuries to predation and scavenging from domestic and wild animals. Mechanisms of injury include blunt force injuries (comprising fractures and dislocations, solid organ injuries, and brain trauma) as well as soft tissue injuries (involving amputation/near amputation, impalement, lacerations, bites, subsequent infections, and predation).

The goals of this presentation are: to understand the ecology and context of animal vs human traumas, describe common and unique injury mechanisms related to animal vs human traumas, and recognize radiological manifestations of these encounters. Clinical histories and scene narratives will be included for depth of perspective.

Traumatic encounters between humans and animals are not uncommon. We will highlight the context of multiple resultant incidences of human injuries which are well documented with imaging.

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*Speaker

Detection of iodine using spectral imaging on PMCT

Chris O'donnell * [1,2], Catherine Vincent [1]

[1] *Victorian Institute of Forensic Medicine – Australia*
[2] *Monash University, Department of Forensic Medicine – Australia*

Introduction: Advanced clinical CT techniques are available for postmortem examination. Spectral imaging (dual energy CT) can be used to determine material composition including iodine.

Materials and Methods: Using a mortuary-based, dual source Siemens SOMATOM Definition Flash CT scanner, DE scans were obtained at 100 and 140 kVp, and post processed using a syngo.via workstation (version VB60A) DECT package. Cases were selected for the presence of parenchymal hyperdensity on the preliminary single energy PMCT, that could possibly be iodine. 22 cases were analysed.

Results: In all cases, iodine was confirmed as responsible for hyperdensity. Iodine concentration (mg/ml) was calculated using ROI analysis and virtual non-contrast images obtained, subtracting iodine from the background. These images were compared with conventional PMCT appearances.

Discussion: Radiographic iodine-based contrast is commonly administered to individuals as part of emergency CT work up prior to death. Due to insufficient time for renal excretion between injection and death, contrast can remain within blood vessels and organ parenchyma. Contrast staining of the brain can also occur in diffuse hypoxic ischemic injury. This can be confusing for interpretation on PMCT, especially the differentiation from hyperdense blood.

Conclusion: Spectral imaging for iodine detection is a technique that is readily applied to PMCT.

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*Speaker

Image Quality Assessment of Low-Dose Whole-Body Phantom CT Skeletal Surveys for NAI

Edel Doyle* [1], Richard Bassed [1,2], Kam Lee [3], Matthew Dimmock [1,4]

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[2] Victorian Institute of Forensic Medicine (VIFM) – Australia
[3] Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) – Australia
[4] Keele University [Keele] – United Kingdom

Background

With advances in low-dose CT technology, it has been proposed that a CT skeletal survey could replace a skeletal survey X-ray series in the investigation of non-accidental injury (NAI) or suspected physical abuse (SPA)1.

Objective

The aim was to perform a phantom study using whole body CT skeletal survey to establish the threshold below which image quality became undiagnostic.

Materials and methods

A paediatric NAI phantom was scanned using 2 different CT scanners at a range of dose levels. These datasets were screened to eliminate any undiagnostic scans as the fracture sites were known. The diagnostic data sets were then reviewed by paediatric radiologists using specific criteria in the DetectEDx software. The effective radiation doses for the diagnostic CT scans were calculated using NCI Dose. The radiation risks were then estimated using the BEIR VII report.

Results

TBC

Conclusion

TBC

Reference:
*Lawson M, Tully J, Ditchfield M, Kuganesan A, Badawy MK (2021) Using Computed Tomography skeletal surveys to evaluate for occult bony injury in suspected non-accidental in- jury cases – A preliminary experience. *Journal of Medical Imaging and Radiation Oncology* https://doi.org/10.1111/1754-9485.13271

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*Speaker

Utility of PMCT in a case of systemic silicone embolism

Denise Squecco * [1], Vittorio Gatto [2], Giovanni Battinelli [1], Luca Alemanno [1], Anna Laura Santunione [2], Silvia Ciuffreda [2], Maria Grazia Amorico [1], Pietro Torricelli [1], Enrico Silingardi [2]

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A 35-year-old woman was taken to the ER following an illness that occurred at home while an unauthorized person was giving her cosmetic injections to the breast. Despite the resuscitation maneuvers for over 1 hour, death was noted.

Before the autopsy, a PMCT was performed which highlighted the presence of a large collection of hyperdense material in correspondence with the right breast, at the level of pulmonary arteries and in the ventricular cavities as well as the presence of diffuse nodular formations filled with hyperdense material at the level of the mammary region bilaterally.

Dissection of the thorax showed the presence of multiple nodular formations containing oily material and marked fibrosclerotic alteration of the muscle. The pulmonary artery was opened and showed the leakage of fluid blood mixed with oily material, the same material was also found in the heart chambers. Histological and chemical investigations carried out the diagnosis of systemic silicone embolization.

In conclusion PMCT scanning can be proposed in the cases of suspected SES, as the screening procedure to produce preliminary information about the cause of death to rapidly develop the successive autopsy performance

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*Speaker

Artifacts in CT-imaging of the brain: A cooling effect?

F. Thicot * [1], V. Dunet [2], V. Magnin [3], C. Bruguier [2,4], J-A. Lobrinus [5],
S. Grabherr [3,6], P Genet [1,3]

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Switzerland

We would like to present two cases of middle-aged men found dead outdoor, in relatively low temperatures, whose postmortem CT scan of the brain revealed peculiar findings. The first case involved a man found dead in front of his house, with an ambient temperature of -1.8°C. Post mortem CT scan revealed a linear demarcation between the anterior and posterior regions of the brain, with hypodensity in the anterior region. The second case involved a man found dead on the bottom of a cliff, with temperatures approaching 9°C. However, a technical malfunction of the cooling cell occurred during the storage of the corpse. Post mortem CT-Scan showed a circular area of hypodensity across the periphery of the brain. Moreover, neuropathological examination didn't reveal any pathological findings correlating with the density differences observed on imaging. These two cases seem to highlight the mechanisms through which the cold might affect brain tissue. The few publications found in forensic literature regarding this type of phenomenon, only concerned experimental postmortem freezing of the brain with dry ice in altered corpses to hinder further decomposition. We aim to encourage further studies on this topic, to allow correct interpretation of such CT scan findings in forensic cases.

*Speaker

The use of Postmortem CT-scan and quick toxicology analysis as a supplementary screening method to the medicolegal inquest.

Lea Wold Kisbye * [1], Marianne Cathrine Rohde [1], Lene Warner Thorup Boel [1]

[1] *Department of Forensic Medicine, Aarhus University – Denmark*

Background: In Denmark the medicolegal inquest consists of information from the police investigation and an external examination. Cases are selected strictly by the police based on the recommendation for forensic autopsy as outlined in the Danish legislation. Available screening methods such as postmortem CT-scan (PMCT) and quick toxicological analysis have shown separately to predict manner and cause of death in certain subgroups. However, the combination of both methods performed at the time of the inquest have been sparsely researched.

Aim: The study goal is to investigate in which subgroups PMCT and quick toxicological analysis, offered as a part of the medicolegal inquest, can predict manner and cause of death.

Material and methods: Retrospective cross-sectional study of forensic autopsies including PMCT and toxicology analysis performed at the Department of Forensic Medicine, Aarhus Uni- versity (AU) in the period of 2017-2022.

Results: Preliminary results from a pilot study to identify relevant subgroups qualified for selection at the medicolegal inquest.

Conclusion: We expect PMCT and quick toxicology analysis in combination with the current medicolegal inquest to improve prediction of manner and cause of death.

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*Speaker

The Perils of Fentanyl: an update on Contraband Drug Smuggling and Abuse in 2023.

Barry Daly * [1]

[1] *University of Maryland – United States*

The recent rapid growth of Fentanyl abuse in many countries may be described as the unseen "Epidemic behind the Pandemic". In the last few years, quarantines, increased isolation and reduced access to mental health services have resulted in increasing addiction, with rapidly worsening overdose and related death rates in many countries, mainly caused by Fentanyl and related synthetic opioids. In 2022, there were at least 110,000 deaths from opioids in the U.S.A., more than the combined number of deaths from both gun violence and road accidents. A major focus of this talk is to describe the recent evolution of newer, more dangerous illegal drug formulations, including the clandestine haphazard mixing of Fentanyl with many other drugs of abuse, without the knowledge of the user. Recent advances in imaging and other techniques for drug detection and interdiction are addressed, as is the detection of concealed contraband drugs in hospital emergency rooms and in prisons. While the scourge of Fentanyl is encountered currently most often in the U.S.A., rising rates of abuse in Canada, Australia and many European countries should encourage forensic pathologists, radiologists and radiologic technologists to be aware of this serious and acute global health problem.

*Speaker

Saturday 27th May

11.30 - 13:00   Forensic imaging and technology II

Amphitheatre

An algorithm to display multiple CT windows simultaneously using machine learning

Lars Ebert * [1], Samson Apostolakis [1], Sabine Franckenberg [1,2], Akos Dobay [1,3]

[1] *3D Center Zurich, Institute of Forensic Medicine Zurich, University of Zurich – Switzerland*
[2] *Institute of Diagnostic and Interventional Radiology, University Hospital Zurich – Switzerland*
[3] *ForMalTec, Institute of Forensic Medicine Zurich, University of Zurich – Switzerland*

With the increasing number of computed tomography scans in forensic medicine and clinical settings, interpreting them requires more effort. To fully evaluate a radiological image, windowing is usually necessary, which involves displaying only a specific Hounsfield Range of interest. The required windowing settings vary depending on the organ or pathology being examined, such as bone, soft tissue, or lung, requiring multiple analyses of a CT dataset with different window settings. To address this limitation, we present a machine learning-based algorithm that allows for simultaneous visualization of each organ with its optimal window setting.

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*Speaker

Mobile 3D crime and accident scene documentation with Apple's LiDAR technology

Sören Kottner * [1], Michael J. Thali [1], Dominic Gascho [1]

[1] Institute of Forensic Medicine, University of Zurich, Zurich, Switzerland

The photographic documentation at a crime or accident scene provides a basis for the discussion and the review of a case prior to autopsy. Although 3D imaging is nowadays commonly used to improve the documentation procedure at the scene, the reconstructed 3D data is typically not readily accessible before autopsy. However, with the implementation of a light detection and ranging (LiDAR) sensor, Apple started equipping their high-end mobile devices with 3D scanning capabilities. In this study, we tested an iPhone 13 Pro together with an iOS application (app) called Recon-3D. The app is specifically targeted at crime and accident scene applications and makes use of the LiDAR sensor. This technology was tested based on three exemplary scenarios to see whether it is generally applicable to document crime or accident scenes. Each scenario was documented multiple times with an acquisition time of less than 2 min. On average, measurements within the scenes resulted in a mean absolute error of 0.22 cm and a standard deviation of 0.18 cm. The imaging workflow was simple and quick, allowing any forensic pathologist to capture 3D data at the scene. The 3D data can be reconstructed immediately and made available prior to autopsy.

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*Speaker

ImagingRing forensics – A cost-effective high-end mobile imaging robot for postmortem computed tomography and simultaneous 3D optical surface documentation

Dominic Gascho * [1], Phil Steininger [2], Felix Ginzinger [2], Sabrina Brückner [2], Julia Coste-Marin [2], Michael Thali [1], Sören Kottner [1]

[1] Institute of Forensic Medicine, University of Zurich, Zurich, Switzerland – Switzerland
[2] medPhoton GmbH, Salzburg, Austria

Over the past 20 years, the use of postmortem computed tomography (CT) has become well-established in forensic medicine. However, for many facilities, purchasing a clinical CT scanner and paying maintenance fees is often financially unsustainable. Therefore, we evaluated a cost-effective mobile imaging robot (*ImagingRing*), which was originally developed for targeted use in image-guided radiotherapy and surgery. This mobile *ImagingRing* features a tiltable, large- bore gantry (inner diameter: approx. 120 cm) with independently movable source and detector arms. It is also equipped with two cameras in the gantry and two cameras in the detector, which are used for monitoring during operation. The *ImagingRing* can be operated with a wireless control tablet and generates 3D cone-beam CT data as well as high-resolution 2D X-ray images. The aim of our study was to develop and validate a whole-body CT and 2D X-ray protocol with additional photogrammetric surface documentation for postmortem examinations. On the occasion of the annual meeting of the *International Society of Forensic Radiology and Imaging*, we present our first results and give an outlook on future developments and possibilities in the application of the *ImagingRing* in forensic and postmortem examinations

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*Speaker

Image analytics for biological profiling of human skeletal remains: the application of transfer learning-based image analysis using a user-friendly visual programming approach

Ivan Jerković * [1], Nika Jerković [2], Željana Bašić [1], Ivana Kružić [1], Tina Bareša [1], Saša Mladenović [2]

[1] *University of Split, University Department of Forensic Sciences – Croatia*
[2] *University of Split, Faculty of Science – Croatia*

Developing biological profiling methods based on morphological trait scores or skeletal measurements is a time-consuming process prone to observers' inconsistencies and, often, results of limited practical significance. To overcome such issues, artificial intelligence has been introduced to forensic anthropology, but initially without remarkable effect, as these, primarily neural network-based techniques, required large sample sizes and advanced computer science skills. The developments of user-friendly tools have brought these methods to scientists of different profiles, while introducing transfer learning methods has enabled the usage of more realistic sample sizes. In this paper, we present possibilities of applying Orange: Data Mining Toolbox to establish methods that can reconstruct the biological profile of individuals directly from images. In the presented cases, we will use cranial images from documented virtual skeletal collection obtained from medical MSCT scans to demonstrate how to transform images to a vector representation using neural networks previously trained on general image datasets. The data with extracted features will furtherly be used to explore sexual dimorphism using unsupervised machine learn- ing (ML) and construct prototypes of sex classification models by supervised ML methods. Finally, we will show how tools in Orange can help us visualize incorrectly classified specimens and interpret clusters.

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*Speaker

Closed or open? When X-rays help solve a forensic problem in a domestic fire case.

Mathilde Ducloyer [*1], Ronan Vinay [*2]

[1] *Department of forensic medicine – CHU Nantes, Nantes Université – France*
[2] *Senior station officer, Fire investigator, NANTES – SDIS 44 – France*

The advantages of imaging for the examination of cadavers are well established. But X-rays can also be a useful tool for studying specific materials in a forensic context. A man's body was found in a house fire behind the front door. Questioning of witnesses raised the question: was the man locked in the burning house? In other words, was the lock on the front door closed or open? We report an example of how X-rays helped to answer this question, in collaboration with a fire expert. We also describe the appearance of different types of amalgam extracted from fire pits, to highlight the value of X-rays for detecting specific materials in burnt remains. This first experience opens many perspectives for radiological expertise in the context of fires.

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*Speaker

Can micro-computed tomography (μ-CT) be informative for microscopic study on lung fragments? About a preliminary study on 13 hanging cases

Eulalie Pefferkorn [*][1,2], Céline Guilbeau-Frugier, Fabrice Dedouit, Agathe Bascou, Frédéric Savall, Norbert Telmon

[1] Service de médecine légale – Hôpital de Rangueil, CHU Toulouse [Toulouse] – France
[2] Hôpital Trousseau (Institut Médico-légal) – Centre Hospitalier Régional Universitaire de Tours – France

Studies based on micro-computed tomography imaging are numerous, but the few lung parenchymal studies use a long and complicated protocol to avoid alveolar collapse. The objective of our study was to test a simple and reproducible protocol for scanning the lung parenchyma with micro-computed tomography.

We have therefore developed a new protocol, based on formalin fixation associated with freezing in dry ice, tested on 13 lung fragments. This method allowed satisfying acquisitions on microCT, as it prevented alveolar collapse.

We performed qualitative and quantitative analysis in the images, to test whether it was possible to differentiate oedematous alveolitis from haemorrhagic alveolitis. We used XnView, Avizo, Quant 3D and ImageJ software.

This preliminary study showed promising results for considering the diagnosis of microscopic criteria of asphyxia in lungs with a microCT.

*Speaker

Spatial analysis of intimate partner violence against women in the city of Toulouse

Ryan Toutin [*] [1]

[1] Service de médecine légale, Hôpital Rangueil – CHU Toulouse [Toulouse],
Université Toulouse III - Paul Sabatier – France

In clinical forensics, non-radiological imaging can be of great importance. Thus, the use of mapping methods can contribute to a better understanding of medico-social phenomenon, especially in the context of violence. Intimate partner violence against women is internationally recognized as a public health and social policy issue. In particular, the occurrence of such violence would be correlated with the clustering of conditions of socioeconomic disadvantage. The objective of this study was to map the distribution of intimate partner violence against women in the city of Toulouse in order to highlight the spatial interactions. The postal addresses of women who consulted the medico-judicial unit of the Rangueil Hospital were geocoded and their spatial distribution was analysed using spatial smoothing functions, spatial correlation tests, and spatial risk estimation models. A heterogeneity was highlighted in the form of significant spatial groupings, some of which present an estimated relative excess risk of intimate partner violence against women. The use of the numerous available data associated with the use of innovative methods of spatial epidemiology would make it possible to improve the understanding of the mechanisms at play in order to facilitate the implementation of social and medical policies aiming at fighting against this violence.

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*Speaker

Saturday 27th May

11:30 - 13:00   **Session: Clinical forensic medicine /Asphyxia**

Capitouls Room

Imaging after non-fatal strangulation – retrospective analysis over 13 years

Thomas D Ruder * [1], Alexandra Gonzenbach [2,3], Jakob Heimer [4], Leonie Arneberg [5], Jolanta Klukowska-Rötzler, Simone Blunier [2,6], Aristomenis K Exadaktylos [2], Wolf-Dieter Zech [7], Franca Wagner [8]

[1] *Institute of Diagnostic, Interventional and Pediatric Radiology, Inselspital, Bern University Hospital, University of Bern, Bern – Switzerland*
[2] *Department of Emergency Medicine, Inselspital, Bern University Hospital, University of Bern, Bern – Switzerland*
[3] *Department of General Surgery, Hospital Linth, Uznach – Switzerland*
[4] *Department of Mathematics, Seminar for Statistics, ETH Zurich, Zurich – Switzerland*
[5] *Department of Emergency Medicine, Inselspital, Bern University Hospital, University of Bern, Bern, Switzerland – Switzerland*
[6] *Department of Medicine, Hospital Emmental, Burgdorf – Switzerland*
[7] *Institute of Forensic Medicine, University of Bern, Bern – Switzerland*
[8] *Institute of Diagnostic and Interventional Neuroradiology, Inselspital, Bern University Hospital, University of Bern, Bern – Switzerland*

Patients presenting for medical care after strangulation are usually young women and most of them have no or minor injuries. Because of the low prevalence of potentially dangerous injuries and the young patient age, there is ongoing debate about the appropriateness of CT angiography after non-fatal strangulation.
The aims of this study were to evaluate the use and value of CT and MRI after strangulation and assess the accuracy of original radiology reports.

This 13-year retrospective study includes an analysis of patient characteristics and strangulation details as well as a comparison of original radiology reports to expert read-outs all of CT and MRI studies after non-fatal strangulation at a single centre.

There were 116 NFS patients, 71% of them women, with an average age of 33.8, mostly presenting after manual strangulation. The leading context of strangulation was intimate partner violence for women and assault by unknown offender for men. Overall, 132 imaging studies (67 CT, 51% and 65 MRI, 49%) were reviewed and revealed potentially dangerous injuries in 7%, minor injuries in 22%, and no injuries in 71% of patients. Sensitivity of original reports was 30% for CT and 78% for MRI. Discrepancies between original reports and expert read-outs were found in nearly 20% of all patients and over 60% of patients with injuries.
The results indicate that MRI is superior to CT after non-fatal strangulation and highlight the need for radiologists with specialised knowledge to report these studies to enhance patient care and support future medico-legal investigations.

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*Speaker

Value of medical imaging re-reading in clinical forensics: About two intriguing cases.

Agathe Bascou * [1], Frédéric Savall [1], Rémi Costagliola [1], Norbert Telmon[1], Fabrice Dedouit [1]

[1] Service de médecine légale [CHU Toulouse] – CHU Toulouse [Toulouse] – France

The mechanism of injury is a common concern of the forensic specialist. Nevertheless, the original injuries are frequently altered by the medical care before the forensic examination. An analysis of the medical record, when available, is an integral part of the forensic report. However, the original injuries are often minimally described in the medical record. Moreover, clinical examination and additional medical tests (and especially imaging) are addressed through the lens of medical care, far from forensic concerns. Through two cases of trauma of the head and neck, we highlight the value of medical imaging reading by a trained forensic physician, especially in the identification of the mechanism of injury.

*Speaker

Diffuse idiopathic skeletal hyperostosis: a clinical case report

Anthony Ramirez * [1], Agathe Bascou [2], Frédéric Savall [1], Norbert Telmon [1], Fabrice Dedouit [1]

[1] Hôpital Rangueil, service de Médecine Légale – CHU Toulouse – France
[2] Hôpital Rangueil, service de Médecine Légale – CHU Toulouse – France

We report the case of a 70-year-old man, found in hypothermia on the side of a road and who suffered amnesia concerning circumstances of the trauma. The patient was admitted to the hospital and several complementary explorations were performed. The clinical CT-scan of the cervical spine revealed an unstable displaced C5-C6 fracture described on the report as a "Chance fracture" which was underwent an osteosynthesis. A clinical medicolegal examination asked by the prosecutor was performed. The central question was the possibility of a motor vehicle accident against a pedestrian victim, or a fight. The examination revealed that the patient was sedated, and no major tegumentary lesion was visible, except few erosions.

A new lecture of the CT revealed that the fracture was an C5-C6 interdiscal fracture and a pre-existing pathological disease: a diffuse idiopathic skeletal hyperostosis (DISH). It is characterized by thickening, calcification and ossification of soft tissues, mainly ligaments, joint capsules and entheses. The spines of patients with DISH generally become increasingly rigid and osteoporotic, and fractures may occur after even a relatively minor traumatic event such as a ground-level fall.

This case illustrates the importance of reviewing the images and not simply include radiological reports in forensic reports.

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*Speaker

Accuracy of post-mortem computed tomography (PMCT) in diagnosing fractures of the hyoid-larynx complex (HLC)

Sara Larsen [*][1], Josephine Ploug Hansen [1], Christina Jacobsen [1]

[1] Section of Forensic Pathology, Department of Forensic Medicine, University of Copenhagen – Denmark

Introduction:
This systematic review investigated the diagnostic accuracy of PMCT scan to diagnose fractures of the hyoid-larynx complex (HLC) compared to autopsy in cases of traumatic neck injuries. We hypothesize that a PMCT scan cannot replace the autopsy in these cases.

Method:
A systematic literature search was performed in PubMed using the search terms: (postmortem computed tomography) AND ((hyoid bone) OR (hyoid-larynx complex) OR (la- ryngeal cartilage) OR (arytenoid cartilage) OR (cricoid cartilage).

Studies comparing PMCT and autopsy were included.

Results:
The search provided 42 studies; 12 met inclusion criteria. Five studies reported the level of agreement between PMCT and autopsy using kappa. Reported values ranged from 0.286 to 0.91; most with moderate level of agreement. Higher levels of agreement were found for dis- located fractures and thinner slice thicknesses. Fissures/fractures in cartilaginous components were generally missed using PMCT.

Conclusion:
PMCT can be used to diagnose fractures of the HLC, especially dislocated fractures and when utilizing thinner slice thickness. Fissures/fractures in cartilaginous components are generally missed, and in such cases, PMCT cannot replace autopsy.

*Speaker

Cervical spine disc injuries evaluation using postmortem kinetic CT

Shogo Shimbashi* [1], Hideki Hyodoh [1]

[1] *University of Fukui – Japan*

Postmortem CT has limitations in identifying cervical spine injuries. Cases with injuries at the level of the intervertebral disc (anterior disc space widening) are difficult to distinguish from normal images depending on the imaging position. We performed postmortem kinetic CT (PKCT) of the cervical spine in the extended position in addition to CT in the neutral position. The difference in intervertebral angles between the neutral and extended positions was defined as the intervertebral range of motion (ROM), and the utility of PKCT of the cervical spine for the diagnosis of anterior disc space widening and its objective index were examined based on the intervertebral ROM. 14/120 cases had 17 lesions with anterior disc space widening. The intervertebral ROM for the 17 lesions was 11.85∘ ± 5.25∘.

The intervertebral ROM for the normal vertebrae was 3.78∘ ± 2.81∘, which showed a significant difference between the two. ROC analysis of the intervertebral ROM between vertebrae with anterior disc space widening and the normal vertebral spaces showed an AUC of 0.903 and a cutoff value of 8.61∘. PKCT of the cervical spine revealed that the intervertebral ROM of the anterior disc space widening was increased, which facilitated the identification of the injury

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*Speaker

The value of Micro-CT imaging in the forensic evaluation of neck trauma

Melanie Timmerman * [1], Alexia Van Goethem [2], Vidija Soerdjbalie-Maikoe [2], Daniël Docter [1], Jaco Hagoort [3], Yousif Dawood [1,3,4], Nick Lobe [5], Quinn Gunst [3], Maurice Van Den Hoff [3,4], Werner Jacobs [2], Bernadette De Bakker [1,4,6]

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[2] Antwerp University Hospital, Dept of Forensic Medicine and Forensic Pathology, Antwerp, Belgium – Belgium
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[4] Amsterdam Reproduction and Development research institute, Amsterdam, The Netherlands – Netherlands
[5] Amsterdam UMC location University of Amsterdam, Dept. of Radiology, Meibergdreef 9, Amsterdam, The Netherlands – Netherlands
[6] Erasmus MC – Sophia Children's Hospital, University Medical Center Rotterdam, Dept. of Pediatric Surgery, Rotterdam, The Netherlands – Netherlands

Forensic examination of the hyoid-larynx complex (HLC) is crucial in diagnosing neck trauma. Total-body CT scans of the non-calcified HLC in juvenile victims lack sensitivity for fracture detection. Micro-computed tomography(micro-CT) is an upcoming imaging modality capable of reaching microscale-resolution as small as 1μm. Soft-tissue contrast can be established with iodine staining, known as diffusible iodine-based contrast-enhanced CT (diceCT). We study the value of micro-CT and diceCT in detecting fractures and hemorrhages and imaging the non- calcified pediatric HLC in forensic cases, compared to classic imaging techniques.

Twenty excised HLCs of forensic cases, including five pediatric samples, were first scanned us- ing micro-CT, then stained with buffered Lugol's solution(B-Lugol) to perform diceCT. Scans were examined for presence of fractures, hemorrhages and anatomical features, and compared to total-body CT, optimized clinical CT of the explant and autopsy reports.

Several previously undiscovered suspect lesions were detected with micro-CT. DiceCT visu- alized probable hemorrhages around fractures and enabled detailed examination of the pediatric HLC. Histology is being performed to confirm our findings.

Micro- and diceCT show promise for detecting fractures, discriminating between ante- and postmortem trauma and imaging the pediatric HLC. With improved protocols and experience, micro-CT might become a valuable tool for forensic examination of neck trauma.

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*Speaker

Suspension-Associated Dislocation of the Jaw in Hanging.

Joanna Glengarry * [1], Megane Beaugeois [2], Lyndal Bugeja [2], Richard Huggins [1], Chris O'donnell[1]

[1] *Victorian Institute of Forensic Medicine – Australia*
[2] *Monash university – Australia*

Hanging is a common type of death and the role of the medical investigation of such deaths by a forensic pathologist not only requires determination of the cause of death, but providing information to assist in the determination of the manner of death. The forensic pathologist should be well-versed in the spectrum of injuries known to be associated with neck compression, in order to document injuries known to be associated with hanging, but also to identify those that are inconsistent with self-inflicted hanging, or that may suggest the involvement of a third party in the death. Correct interpretation of injury types means that the appropriate degree of police and coronial investigation can be undertaken. We present two cases of deaths believed to be caused by self-inflicted hanging that were observed to have unexpected unilateral dislocation of the temporomandibular joint identified on routine post-mortem computed tomography, without any suspicious circumstances surrounding the deaths. This injury was unexplained and had not been previously observed at our Forensic Institute, nor was it identified after a review of the scientific research literature. Issues regarding the cause of this abnormality, possible mechanisms and the medicolegal significance of this finding will be discussed.

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*Speaker

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