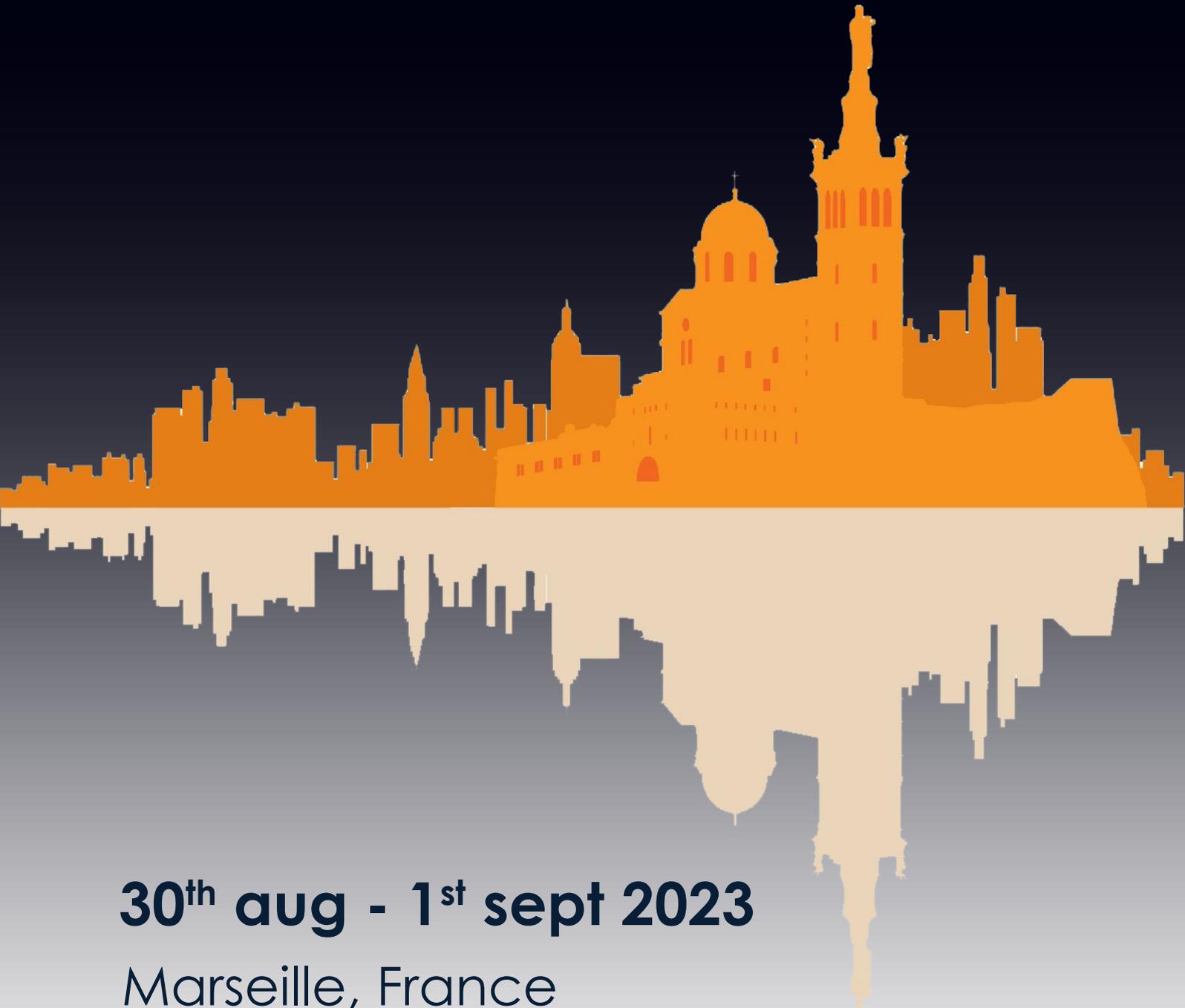




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FASE

20th Anniversary Symposium



30th aug - 1st sept 2023

Marseille, France



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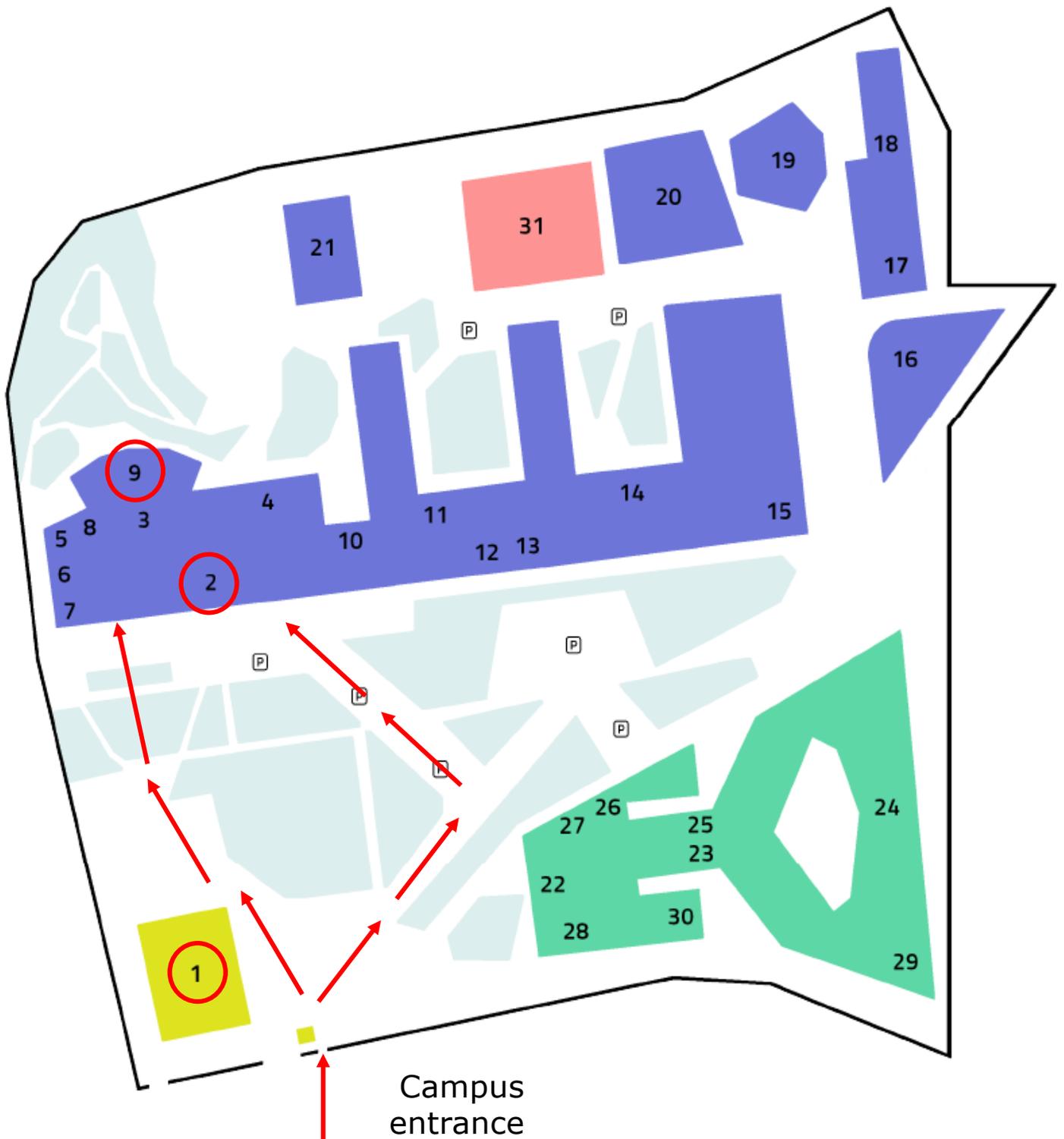
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- Bus: Lines 12, 12B, 12S, 40, 52, 54, 72, 91
- Public car parks: 248 rue Saint-Pierre / 145 boulevard Baille

Health Campus Map



1 : Educational building (helps to find the Campus entrance)

2 : Hall of the Medicine Faculty (welcome, posters, coffee breaks and lunches)

9 : TOGA amphitheatre (presentations)

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Wednesday 30 August 2023 – Morning

Session Presidents: Morris TIDBALL-BINZ (Argentina) and Oguzhan EKIZOGLU (Turkey)

09:00 10:15

Welcome Coffee

10:15 10:45

Welcoming – Faculty Dean, ADES laboratory director,
FASE President

KEYNOTE

10:45 11:15

**The 2023 earthquake in Turkey and Syria:
Concrete pitfalls of the Disaster Victims Identification**

Turkey

Oguzhan EKIZOGLU

KEYNOTE

11:15 12:00

**United Nations' guidance for death investigations:
Development, value and practical considerations of the
Minnesota Protocol**

Argentina

Morris TIDBALL-BINZ

12:00 12:15

**Those that fall between the cracks: A cry out for
interagency collaborations**

Greece

WE-01
Page 20

Despoina FLOURI, BOVIATSI E., TEZEPSIDIS G., KRANIOTI E.

12:15 12:30

**Humanitarian Forensic Anthropology in Italy:
A case of commingled remains from the largest mass
disaster of the migrant crisis in the Mediterranean Sea**

Italy
USA
Australia

WE-02
Page 38

*Andrea PALAMENGI, PAWASKAR S., MAZZARELLI D.,
BIEHLER-GOMEZ L., GIBELLI D., DAMANN F., LYNCH J.,
DE ANGELIS D., JANTZ R., CATTANEO C.*

12:30 12:45

**If the intentions are good:
Islamic burial customs & mass grave exhumations
in Somaliland**

Sweden
USA

WE-03
Page 19

Lucia ELGERUD

12:45 13:45

Lunch Break and Posters

Wednesday 30 August 2023 – Afternoon (Part 1)

Session Presidents: Ann ROSS (USA) and Maryna STEYN (South Africa)

13:45	14:00	"Secure" identification of the deceased. Interpol definitions versus police routines	Denmark	WE-04 Page 30
<i>Niels LYNERRUP, SKOV A., BOISEN OLSEN K., YLIJOKI-SØRENSEN S.</i>				
<hr/>				
14:00	14:15	Estimating socio-cultural identity within black South African groups using sub-specific discriminate 3D shape matrices	South Africa	WE-05 Page 41
<i>Alison RIDEL, L'ABBE E.</i>				
<hr/>				
14:15	14:30	Fluorescence imaging and fluorescence spectrometry as techniques for discriminating burnt bones from debris	Portugal	WE-06 Page 13
<i>Beatriz BARREIRO, FERREIRA M.T., MORGADO M.</i>				
<hr/>				
14:30	14:45	A comparative study of unidentified migrant and non-migrant remains across three medicolegal offices in Greece	Greece USA	WE-07 Page 32
<i>Sophia MAVROUDAS, FLOURI D., KRANIOTI E., MORAITIS K., KARYDI C., KARAKASI V.</i>				
<hr/>				
14:45	15:00	The practical significance of identification: Six family reunification cases	Italy	WE-08 Page 21
<i>Lorenzo FRANCESCHETTI, MAZZARELLI D., PALAMENGI A., D'APUZZO A., RAGNI C., SICCARDI C., D'AMICO M., VIARENGO I., CATTANEO C.</i>				
<hr/>				
15:00	15:15	Analysis of 14C and 13C in bones to assist identification of unknown human remains	Sweden	WE-09 Page 46
<i>Rebecka TEGLIND, BALKEFORS J., DRUID H., ALKASS K.</i>				
<hr/>				
15:15	15:45	Coffee Break and Posters		

Wednesday 30 August 2023 – Afternoon (Part 2)

Session Presidents: Philippe LEFEVRE (Belgium) and Eric BACCINO (France)

15:45	16:00	Testing the reliability of medial clavicle ossification assessment by conventional radiography: The use of Kellinghaus sub-stage system for age estimation in the living	Italy	WE-10 Page 45
<i>Stefano TAMBUZZI, CUMMAUDO M., MESSINA C., GIBELLI D., MAZZARELLI D., TRITELLA S., DE ANGELIS D., CATTANEO C.</i>				
<hr/>				
16:00	16:15	A deep learning approach to adult skeletal age-at-death estimation	Portugal	WE-11 Page 34
<i>David NAVEGA, COSTA E., CUNHA E.</i>				
<hr/>				
16:15	16:30	Combination of histomorphometric and morphological methods for age estimation from costal elements	UK Greece	WE-12 Page 22
<i>Julieta GARCIA DONAS, KRANIOTI E., BONICELLI A.</i>				
<hr/>				
16:30	16:45	Age estimation in a Western Australian population: A geometric morphometric and linear analysis of the subadult mandible	Australia	WE-13 Page 36
<i>PRINCE K., Zuzana OBERTOVA, FRANKLIN D.</i>				
<hr/>				
16:45	17:00	The accuracy of pelvic age estimation methods using CT scans in a Western Australian population	Australia	WE-14 Page 15
<i>BOISSEAU G., Zuzana OBERTOVA, FLAVEL A., FRANKLIN D.</i>				

Thursday 31 August 2023 – Morning

Session Presidents: Cristina CATTANEO (Italy) and Zuzana OBERTOVA (Australia)

09:00 10:30

FASE General Assembly

10:30 11:00

Coffee Break and Posters

11:00 11:15

Hacked, burned or both? Chemical trace analysis of sharp force trauma in unburned and burned bone

Joana ROSA, FERREIRA M.T., GONCALVES D., MARQUES M.P.,
BATISTA DE CARVALHO L., GIL F.

Portugal **TH-01**
Page 42

11:15 11:30

Current status of Forensic Anthropology in the Middle East and North Africa (MENA) Region

Cindy MANSOUR, BENITO SANCHEZ M., MARQUEZ-GRANT N.

Spain **TH-02**
UK Page 31

11:30 11:45

Development of Forensic Anthropology in Sweden

Anja PETAROS, ALFSDOTTER C.

Sweden **TH-03**
Page 39

11:45 12:00

Addressing the challenges of data collection bias in third molar analysis for age estimation

Ines OLIVEIRA-SANTOS, POARES BAPTISTA I.,
ALVES DA SILVA R.H., CUNHA E.

Portugal **TH-04**
Brazil Page 37

12:00 12:15

Dental calculus, an aid to geographic origin reconstruction on present populations

Giulia CACCIA, MAREGRANDE L., CACCIANIGA M.,
CAMPOBASSO C.P., CATTANEO C.

Italy **TH-05**
Page 18

12:15 12:30

Stable isotope analysis as a tool in forensic archaeological casework: Current status and a way forward

Jagmahender Singh SEHRAWAT

India **TH-06**
Page 43

12:30 12:45

Understanding the poorly preserved historic skeletons from the Crown Mines Cemetery, South Africa – the importance of the assessment of diagenesis

Desiré BRITS, LANDER S.L., HOSIE M.

South Africa **TH-07**
Page 17

12:45 14:00

Lunch Break and Posters + FASE Board meeting

Thursday 31 August 2023 – Afternoon

Session Presidents: Maria-Teresa FERREIRA (Portugal) and Desiré BRITS (South Africa)

14:00	14:15	The (un)coupling method: Principle and application on fetuses and infants' skeletal remains up to three postnatal months	France	TH-08 Page 35
<i>NIEL M., BONHOMME V., <u>Pascal ADALIAN</u></i>				
<hr/>				
14:15	14:30	Potential of the integration of multiple omics profiles for post-mortem interval estimation	UK USA Netherlands Italy	TH-09 Page 16
<i>Andrea <u>BONICELLI</u>, MICKELBURGH H.L., CHIGHINE A., LOCCI E., WESCOTT D.J., PROCOPIO N.</i>				
<hr/>				
14:30	14:45	Mice, foxes and cadavers: Forensic anthropological implications from an experimental study	Switzerland	TH-10 Page 24
<i>Lara <u>INDRA</u>, MOSER V., LÖSCH S.</i>				
<hr/>				
14:45	15:00	Violence against children: A review of forensic anthropological cases in Johannesburg, South Africa	South Africa	TH-11 Page 44
<i>Maryna <u>STEYN</u>, BRITS D., BOTHA D., HOLLAND S.</i>				
<hr/>				
15:00	15:15	Finding bones in Switzerland: Forensic Anthropology at the University Center of Legal Medicine Lausanne – Geneva	Switzerland	TH-12 Page 33
<i>Negahnaz <u>MOGHADDAM</u>, FRACASSO T., GENET P., GRABHERR S., VARLET V.</i>				
15:15	15:45	Coffee Break and Posters		
<hr/>				
KEYNOTE				
15:45	17:00	Interdisciplinary conference	France	
<i>Olivier <u>OULLIER</u></i>				
<hr/>				
19:00	Gala Dinner			

Friday 1st September 2023 – Morning (part 1)

Session Presidents: Niels LYNNERUP (Denmark) and Elena KRANIOTI (Greece)

KEYNOTE

09:00 09:45 **Imagery in Forensic Anthropology** Denmark
Niels LYNNERUP

09:45 10:00 **Virtual anthropology and the importance of using PMCT databases: Some applications** Denmark **FR-01**
China Page 47
Chiara VILLA, KHATAM-LASHGARI A., ZHANG Q., PAZ RODRIGUEZ A., LØNSTRUP HARVING M., BANNER J., JØRKOV M.L., TANGMOSE LARSEN S., LYNNERUP N.

10:00 10:15 **Exploring age-related trends in cortical and trabecular bone in an elderly Scottish sample: A pilot study on the clavicle** UK **FR-02**
Page 48
Corrina WILSON, GARCIA-DONAS J.G., CUNNINGHAM C.

10:15 10:30 **Age estimation in the living by the study of MRI-scan images of the knee: Application on a Tunisian population** Tunisia **FR-03**
Page 14
Sami BEN JOMAA, SAKLY T., CHEBBI E., ADBELALI M., ZRIG A., HAJ SALEM N.

10:30 10:45 **The use of Radiomics for potential bone pair-matching using post-mortem computed tomography images** Greece **FR-04**
Page 28
Eleni KONTZINOI, LEVENTIS D., FLOURI D., KLONTZAS M., SPANAKIS K., KARANTANAS A., KRANIOTI E.

10:45 11:00 **Immunohistochemical analysis in Forensic Anthropology: How far can we evaluate the vitality of perimortem bone trauma?** Spain **FR-05**
Page 23
Cristian GONZALES CASAS, SANT F., VERGARA C., DE LA TORRE N., ARMENTANO N., SCHWAB N., GALTES I., JORDANA X.

11:00 11:30 *Coffee Break and Posters*

Friday 1st September 2023 – Morning (part 2)

Session Presidents: Lucie BIEHLER-GOMEZ (Italy) and Benoit BERTRAND (France)

11:30	11:45	The big challenge of determining the vitality of perimortem trauma in Forensic Anthropology: A histomorphometric investigation	Spain	FR-06 Page 25
<i>Xavier JORDANA, GALTES I., SCHWAB N.</i>				

11:45	12:00	The application of narrow band light sources when investigating bone damage	Netherlands	FR-07 Page 29
<i>Tristan KRAP, AALDERS M.C.G, DUIJST W.</i>				

12:00	12:15	A three-year experimental study of outdoor human decomposition in Quebec: Towards establishing a regional taphonomic model	Canada USA	FR-08 Page 40
<i>Agathe RIBEREAU-GAYON, CARTER D., FORBES S.</i>				

12:15	12:30	The application of GIS technology in estimating the postmortem interval	Greece Netherlands	FR-09 Page 26
<i>Christina KARYDI, MONTESANTOS I., MORAITIS K.</i>				

12:30	12:45	Scavenging taphonomy in South Africa and the implications for skeletal recovery and analysis	South Africa	FR-10 Page 27
<i>Craig KEYES, BRITS D., MYBURGH J.</i>				

12:45 13:45 *Lunch Break and Posters*

Friday 1st September 2023 – Afternoon

Session Presidents: Eugenia CUNHA (Portugal), Anja PETAROS (Sweden), Hans DE BOER (Australia)

13:45	15:15	Round table about certification: International experiences
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15:15 15:45 *Coffee Break and Posters*

15:45	17:00	Round table about certification: FASE certification
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Posters

The population independency of stature estimation: Contribution to a debated issue	Greece	P-01 Page 50
<i>ARKOULI M., DELIGIANNI V., FLOURI D., KRANIOTI E.</i>		
The comprehensive analysis of skull sutures based on PMCT acquisition with respect to age estimation	Poland	P-02 Page 51
<i>BARSZCZ M.T., BADACH E., WOZNIAK K.</i>		
Age Estimation by CT Study of the Sternum, Clavicle and First Rib	Tunisia	P-03 Page 52
<i>BEN JOMAA S., CHEBBI E., SAKLY T., HMIDA B., ZRIG A., HADJ SALEM N.</i>		
Sexual dimorphism of the cranial base and the bony labyrinth: Archaeo-anthropological and forensic implications	Belgium	P-04 Page 53
<i>BOUCHERIE A., POLET C., LEFEVRE P., VERCAUTEREN M.</i>		
The study of microcracking pattern in fractured bones: Is this a proper method for distinguishing between gunshot trauma and blunt force trauma?	Spain	P-05 Page 54
<i>CASAS TONA A., ARMENTONA N., SCHWAB N., GALTES I., JORDANA X.</i>		
Craniofacial form and masseter muscle anatomy in relation to sex: A radiographical and cadaveric study	South Africa	P-06 Page 55
<i>CELE T., NAIDU L., ALADEYELU O., LAVAL S., RENNIE C.</i>		
PMCT of charred bodies: a case series from Crete, Greece	Greece	P-07 Page 56
<i>CHASAPI E., DASKALAKI E., KRANIOTI E.</i>		
Identification and species diagnosis of fingernails fragments in a forensic context through Raman spectroscopy contribution	Italy	P-08 Page 57
<i>D'APUZZO A., BRUNI S., CUMMAUDO M., MAZZARELLI D., SALSAROLA D., BIEHLER-GOMEZ L., CATTANEO C.</i>		
Weaponized pens: a potential nightmare in forensic investigations	Greece	P-09 Page 58
<i>DASKALAKI E., FLOURI D., CHASAPI E., KANAKI K., KRANIOTI E.</i>		

Time since death, skin color changes, and white bias?	USA	P-10 Page 59
<i>ELGERUD L., BOYD D.A., CAWLEY W.D., GRIFFIN T., BROCKETT M.</i>		
<hr/>		
Postmortem interval estimation – Luminol and its influence by taphonomic factors	Portugal	P-11 Page 60
<i>ERMIDA C., CUNHA E., FERREIRA M.T.</i>		
<hr/>		
Using XRF devices to detect metallic residues from gunshot wounds in charred bone: A technical report	Italy	P-12 Page 61
<i>FRANCESCHETTI L., MAZZARELLI D., VITALI C., AMADASI A., BONIZZONI L., CATTANEO C.</i>		
<hr/>		
Suicide by self-immolation: A case series from Crete, Greece	Greece	P-13 Page 62
<i>KOURGIANTAKI O., FLOURI D., KRANIOTI E.</i>		
<hr/>		
Exploring cortical histomorphometry along the length of the femur: A geometric morphometrics approach	UK South Africa	P-14 Page 63
<i>LEISS L., RAMPHALENG T., BACCI N., HOULTON T., GARCIA-DONAS J.G.</i>		
<hr/>		
Taphonomic indicators of former anatomical specimens recovered from forensic settings	Greece	P-15 Page 64
<i>MANALI M., KARAGEORGOU I., MORAITIS K.</i>		
<hr/>		
Exploring the feasibility of using synchrotron X-ray fluorescence analysis (SXRF) to identify the neonatal line in human primary teeth	Spain	P-16 Page 65
<i>MARTIROSYAN A., ALVAREZ H., SANDOVAL C., JONHSON N., IRURITA J., JUANHUIX J., MALGOSA A., JORDANA X., MOLERA J.</i>		
<hr/>		
Identification of unknown skeletal remains through AM and PM computed tomography (CT) – case report	Poland	P-17 Page 66
<i>MAZUR M., CZUBAK A.</i>		
<hr/>		
Analyzing commingled remains: Two case-studies from the Guatemalan internal armed conflict	Guatemala	P-18 Page 67
<i>MITTINO G.B., SAMAYOA A., RIVERA C.</i>		
<hr/>		

Morphometric sex estimation from pelvic CT scans: Comparison of Diagnose Sexuelle Probabiliste 2 (DSP2) and Franklin et al. (2014) methods in an Australian Population	Australia	P-19 Page 68
<i>MULLARD N., OBERTOVA Zuzana, FRANKLIN D.</i>		
Using X-ray fluorescence analysis to evaluate the composition of dental prostheses: A case study	Portugal	P-20 Page 69
<i>OLIVEIRA-SANTOS I., GOMES R.A.M.P., COELHO C., GIL F., CUNHA E., POIARES BAPTISTA I., FERREIRA M.T.</i>		
Application of 3D-3D superimposition and distance analysis on commingled scapulae: An additional tool for pair-matching	Italy	P-21 Page 70
<i>PALAMENGI A., MAZZARELLI D., CAPPELLA A., DE ANGELIS D., SFORZA C., GIBELLI D., CATTANEO C.</i>		
Contribution of post-mortem radiography to odontological identification through clinical cases	France	P-22 Page 71
<i>REBOUL C., BOURGEOIS C., DEREAU T.</i>		
Restoration of a fragmented cranium: A preliminary case study of 3D digital tools	Italy	P-23 Page 72
<i>RODELLA L., CACCIA G., CATTANEO C., MANZI G.</i>		
The Fast-human bone degradation in the Azores: The case Terceira island cemeteries	Portugal	P-24 Page 73
<i>RODRIGUES F., QUARESMA C., FERREIRA M.T., MATOS V., MENDES A., MADRUGA J.</i>		
Metric accuracy of different types of human bones comparing 3D structured light scans and physical specimens	Australia	P-25 Page 74
<i>SHANLEY C., OBERTOVA Z., FRANKLIN D.</i>		
Important findings related to the decomposition pattern and rate of small-sized pig cadavers in the Netherlands	Netherlands	P-26 Page 75
<i>SLUIS I., KRAP T., GELDERMAN T., DUIJST W.</i>		
When small details are crucial to unraveling Forensic Anthropology cases	Portugal	P-27 Page 76
<i>SOUSA S., AMARANTE A., GOMES C., CUNHA E.</i>		

**Evaluation of early vital changes and responses
on non-decalcified fractured human bone**

Italy

P-28
Page 77

*TAMBUZZI S., GRAZIANO D., DALCERRI E., PELLEGRINI G.,
DELLAVIA C., CATTANEO C.*

**Tracking of the relationship between the asymmetry of skull
and the surface of head for skull-based facial reconstructions**

Czech
Republic

P-29
Page 78

*THOTTUNGAL R.R., VELEMINSKA J., SKRYJOVA Z., HARNADKOVA K.,
BEDJOVA S., ZEDNIKOVA MALA P., RMOUTILOVA R., DUPEJ J.*

**Bones on fire: Differences in FTIR-ATR analysis on human
and animal burnt remains in controlled and
non-controlled experiments**

Portugal

P-30
Page 79

VASSALO A., GONCALVES D., CUNHA E., BATISTA DE CARVALHO L.

**Sorting successive thoracic vertebrae in commingled
contexts: A geometric morphometrics approach**

Greece

P-31
Page 80

*VOULGARI M., ANASTOPOULOU I., KRANIOTI E.,
PAPAGEORGOPOULOU C., MORAITIS K.*

ORAL

COMMUNICATIONS

WE-06

Fluorescence imaging and fluorescence spectrometry as techniques for discriminating burnt bones from debris

BARREIRO B. ^{1,2}, **FERREIRA M.T.** ^{1,2}, **MORGADO M.** ^{1,2}

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Contact: beatrizbarreiro15@gmail.com

Collecting and identifying bones with heat-induced alterations represents a challenging area of intervention in Forensic Anthropology. Bushfires and mass disasters are increasingly more frequently emphasising the importance of the development of research in this area. The effects of high temperatures on skeletal remains can hinder the recovery process, making it difficult to differentiate between burnt bones and debris. Bones may undergo modifications in terms of colour, shape, and even size, to the extent that they can be mistaken for debris and vice-versa. Consequently, it is very important to be thorough when collecting evidence at the scene to guarantee the maximum recovery of the remains. With this in mind, an exploratory study was conducted to evaluate the potential of applying reflectance and luminescence-based techniques to aid in the recovery of skeletal material in fire-related scenarios. The study focused on analyzing the reflectance and luminescence properties of bones to differentiate between burnt skeletal remains and debris. The sample included burnt human bones, non-human bones, and debris such as metal and fabric. The reflectance experiments were found to be ineffective in discriminating between skeletal remains and debris. Luminescence, on the other hand, showed promising results using three techniques: imaging with a camera, fluorescence spectrometry, and laser-induced fluorescence spectroscopy with excitation at 440 nm. The results were generally consistent across the different luminescence-based techniques. Nevertheless, limitations of the techniques were noted, such as the influence of burning conditions and individual characteristics like pathologies. These limitations suggest the need for further investigation and refinement of the techniques.

Keywords: Forensic Anthropology; Burnt bones; Reflectance; Luminescence; Forensic Taphonomy

FR-03

Age estimation in the living by the study of MRI-scan images of the knee: application on a Tunisian population

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Haj SALEM N.¹

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2 Department of Forensic Medicine of Monastir - Tunisia

3 Department of Radiology of Monastir – Tunisia

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The knee region is recently used in several radiological studies, owing to its reliability in forensic identification. Objectives: To establish MRI scan-based scores allowing age estimation and sex determination in the living Tunisian subjects from the study of the knee region, according to an anthropo-morphological approach. Materials and methods: We retrospectively collected and studied 605 MRI scans performed in the Department of Medical Imaging of living subjects (aged 10 to 57 years). We tested the applicability of the radiological methods of Dedouit and Schmelling Kellinghaus. We established a composite score of five criteria based on the Dedouit classification. We studied the correlation of the score as well as the Dedouit and Schmelling Kellinghaus radiological phases with chronological age (CA). We studied the relationship between the EA and the CA and calculated the confidence intervals of estimation at 95%. Results: The most correlated classification to CA was Dedouit's, the most correlated epiphysis to CA was the distal femoral epiphysis. The correlation between the composite score, using the Dedouit radiological phases, and the chronological age was good at 0.644. The composite score gives an age estimation with a Standard Error Estimation (SEE) of ± 1.47 years (males), ± 1.93 years (females) and a confidence interval (CI) of 95%. We used the morphological and volumetric variables to establish an unstandardised canonical discriminant function equation, which enabled sex determination with satisfying specificity and sensitivity. Conclusion: The age estimation score gave an estimation of age with a SEE from the CA of about 1.47 to 1.97 years. The score can be used reliably in the estimation of the age of Tunisian individuals.

Keywords: Forensic Anthropology; Age determination by skeleton; Sexual dimorphism; knee region; Magnetic resonance imaging

WE-14

The accuracy of pelvic age estimation methods using CT scans in a Western Australian population

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1 Centre for Forensic Anthropology, School of Social Sciences, The University of Western Australia

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The primary role of forensic anthropologists is to analyse human skeletal remains, with the aim of establishing positive identification, through the estimation of biological attributes such as age, sex, stature, and ancestry. Age-at-death estimations from adult skeletal remains are often regarded as one of the more challenging components of the biological profile. Age estimation methods rely on assessing the rate of bone degeneration, which varies across individuals and populations. Consequently, age estimation methods need to be tested on population-specific samples to account for this variation. In Australia, documented physical osteological collections are lacking, therefore virtual collections based on computed tomography (CT) scans have been commonly used as reference collections for the contemporary population. There are two aspects of the pelvic bone that have typically been used in morphoscopic age estimation of human remains, the pubic symphysis and the auricular surface. A widely used method for the ageing of the pubic symphysis is the Suchey-Brooks method, which has been shown to perform well also with CT scans. As for the auricular surface, traditional methods have not proven sufficient, therefore Merritt (2018) proposed revised criteria from the traditional aging methods by Lovejoy et al. (1985) and Buckberry & Chamberlain (2002). This study aims to assess the reliability and accuracy of the Suchey-Brooks and the Merritt method on 120 pelvic CT scans of 60 males and 60 females aged 25-60 years from Western Australia. The CT scans were deidentified upon collection and the required ethical approval has been granted. The results of this study will provide insight into the validity of the age estimation methods in an Australian sample as well as into using these methods in a multifactorial statistical framework, which has so far received little attention in Forensic Anthropology.

Keywords: Forensic Anthropology; Age; Morphoscopic methods; Pelvis; Computed tomography

TH-09

Potential of the integration of multiple omics profiles for post-mortem interval estimation

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WESCOTT D.J.³, **PROCOPIO N.**^{1,3,4}

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System biology has been largely employed to understand the complex mechanisms that determine a disease and its development while not commonly used in forensic sciences. We applied a combination of metabolomics, lipidomics and proteomics to human bones to evaluate their potential to estimate short post-mortem interval (PMI). The 'ForensOMICS' approach is expected to improve accuracy of PMI estimation by combining biomolecules with different physical and chemical properties, thereby helping forensic investigators to establish the timeline of events surrounding death. Fragments from the anterior midshaft tibial bone were collected from four female body donors before and after placement of the bodies to decompose outdoors (at PMIs =219-790-834-872days) at the Forensic Anthropology Research Facility, managed by the Forensic Anthropological Center at Texas State (FACTS). Liquid chromatography coupled with mass spectrometry was used to obtain untargeted metabolomic, lipidomic, and proteomic profiles from the homogenised tissue. The three omics blocks were investigated independently by univariate and multivariate analyses and integrated using a supervised N-integrative model based on latent components to identify the minimal number of markers describing post-mortem changes and discriminating the individuals based on their PMI. Results show that all profiles were clearly distinguishable from post-placement ones, and that the integration of the three blocks is extremely efficient in discriminating the individuals according to their PMI. These findings suggest that the integration of different omics techniques and the selection of specific compounds with different post-mortem stability, in the future, could be developed as an unbiased and efficient method for the assessment short PMIs, respecting criteria for witness admissibility.

Keywords: Bone; Lipidomics; Metabolomics; Proteomics; Post-mortem interval

TH-07

Understanding the poorly preserved historic skeletons from the Crown Mines Cemetery, South Africa – the importance of the assessment of diagenesis

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South Africa has a rich history in gold mining, tainted by the poor treatment of mine workers and the mistreatment of “native” mine cemeteries during Apartheid. Skeletons dating back to the early gold mining era in Johannesburg, South Africa were accidentally identified in 2010 after being intentionally covered/concealed by a mine dump. When the mine dump was later reclaimed, skeletons that were severely flattened, damaged, and fragmented were exposed. Regrettably little is known about these individuals and to better understand the extent of the bone degradation, as well as the postmortem treatment of these remains and how this specific environment affected the bone microstructure, a histological assessment was undertaken. Manual, thin bone sections from the anterior midshaft of fifty well-preserved femora, were assessed using normal and polarized light microscopy. Diagenetic alterations including bioerosion, microcracks, birefringence, inclusions, infiltrations, and staining were observed and recorded throughout the sample. Non-Wedl micro-foci of destruction (bacterial bioerosion) were most frequently recorded. These micro-foci were often filled with exogenous material and resulted in the staining of different areas of bone. The General Histological Index (GHI) was also recorded and indicated a mostly well-preserved intra-cortical zone, with various stages of degradation noted towards the periosteal and endosteal zones. The results indicated that the miners were initially interred in neutral soil and the bone initially began breaking down under normal conditions. Later however, the bone was exposed to an acidic environment, most likely associated with acid mine drainage which resulted in a corrosive environment. This corrosive environment led to very poorly preserved skeletal material, however, the histological integrity of the intra-cortical zone remained mostly intact. This provides an avenue of further investigations, especially with regards to better describing the estimation of age-at-death of these individuals and possibly identifying any underlying pathologies.

Keywords: Bone diagenesis; Bone histology; Crown Mine cemetery

TH-05

Dental calculus, an aid to geographic origin reconstruction on present populations

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The study of starch from dental calculus is a valuable tool long used for reconstructing the diets of past populations; however, such an investigation is underutilized in actual ones. Other tools allow the collection of such information; furthermore, diets are often highly globalized and, therefore, poorly characterized, and oral hygiene practices limit the deposits buildup. However, this is not the case for populations in the global south, such as those in Africa, whose diets are often territorially bound and who often have difficult access to dental care; so, diet reconstruction through dental calculus can be a valuable tool to aid in determining the geographic origin of populations and individuals. This project aims to test this hypothesis by analyzing the starch from 23 skulls from the April 18, 2015, shipwreck in the Mediterranean Sea, mainly from sub-Saharan Africa. This area differs between East and West Africa in the spread and consumption of grains and tubers, the identification of which could be very informative given the difficulty, even at the genetic and anthropological level, of discriminating between the two. After calculus dissolution, starch granules were observed under microscopy and identified using a specially developed "preliminary dichotomous key." The diet of the sample appears mainly based on African millets, sorghum and maize, wheat, barley, rye, and tubers such as yam, manioc, and sweet potato. The presence of starch from Sub-Saharan species suggests an origin from that area, thus confirming the initial hypothesis. The simultaneous presence of common species can be explained by a partially globalized diet or the "Nutritional Switch" hypothesis, where these individuals from the rural Sub-Saharan belt moved through North Africa to Europe. Finally, some individuals showed species with local distribution, such as fonio and taro, almost exclusive to West Africa, thus corroborating their origin in those areas.

Keywords: Calculus analysis; Starch granules; Diet; Geographic origin; Sub-Saharan Africa; Present populations; Migrants

WE-03

If the intentions are good: islamic burial customs & mass grave exhumations in Somaliland

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Recovering the dead after mass atrocities has proved imperative for survivor communities to hold perpetrators accountable, recover truth, and allow for mortuary care and reburial. Such efforts are often encouraged by families of the dead, but communities have also opposed exhumations on religious grounds based on e.g., restrictions against opening a grave. Somaliland, an autonomous region in northern Somalia has recently engaged in mass grave exhumations to recover some of the thousands killed under 1960s-90s dictator Mohamed Siad Barre. As in many other Muslim communities, there are religious restriction against opening graves in Somaliland as well as restrictions against keeping the dead above ground for extended periods of time, which is needed to analyze the remains. However, the Somaliland Government has deemed the investigations permissible due to the need for “proper” burials according to traditional burial customs. To understand whether family members of the dead supported the exhumations and the associated practices, the author conducted an ethnographic study amongst 74 family members. While families were generally unaware of the exhumations the majority supported finding the dead despite religious restrictions. Based on the principle that necessity (darurah) can help override a religious restriction if it is in the best interest of the community, most believed that the work was permissible to find and identify the dead. Families also emphasized that the exhumations were permissible if the forensic practitioners’ intentions (niyyah) were good. This presentation will account for the Islamic principles of darurah and niyyah and the ways in which families of the dead in Somaliland have negotiated religious principles and restrictions around mass grave exhumations. This study has implications for further mass grave exhumations in Somaliland and may offer insight into community needs as related to exhumations in other parts of the world.

Keywords: Mass graves; Exhumations; Somaliland; Islam; Religious restrictions; Necessity; Intention; Ethnography; Family needs

WE-01

Those that fall between the cracks : a cry out for interagency collaborations

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The Forensic Medicine Unit of the University of Crete, Greece was founded in 1989 and is tasked with handling forensic casework from Eastern Crete following police inquiries. This study presents a systematic overview of all casework involving unknown remains in the past 35 years, in an effort to depict challenges and advances in operational procedures. Forensic case files pertaining to unknown remains handled by the FMU were collected. Demographic data, cause and manner of death, location of discovery, post mortem interval, state of decomposition and ID hypotheses were evaluated in relation to the final outcome of each case. The data was cross – referenced with the corresponding case files of the Hellenic Police Archives. A total of 134 cases of unknown remains were recorded, 80 being of judicial significance: 29 were examined under a probable identity provided by the police while 51 cases were handled as unidentified remains, positive identification achieved in 22. A formed ID hypothesis introduces bias in the identification process regardless of the body's condition and post mortem interval, posing as the decisive factor towards case resolution. The remains that are most likely to be identified pertain to elderly Greeks and tourists that have been reported missing in proximity to the location of discovery, whereas bodies recovered from the sea or isolated locations exhibit lower identification rates. Oftentimes discrepancies are noted on the recorded method of identification across agencies. The present study revealed that ID hypotheses play a vital role in case resolution, however those must be considered with caution, especially in cases of badly decomposed remains. Despite the efforts for proper documentation and the use of various forensic identification methods, the lack of centralized databases and continuous interagency communication in Greece poses serious challenges in the establishment and validation of positive identification.

Keywords: Forensic Identification; Unidentified remains; Forensic Anthropology; Missing Persons; Forensic databases

WE-08

The practical significance of identification: six family reunification cases

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Over the past years, there has been an exponential increase in the phenomenon of migration and associated fatalities. Even when these episodes are large in proportion, they are often ignored or treated inadequately, which constitutes a continuous trampling of internationally recognized and protected rights. If there is no corpse, there can be no crime from a legal point of view. This means that family members also lose the right to be civil parties in criminal proceedings against those allegedly responsible for the shipwrecks. From an administrative point of view, in the absence of death certificates for parents or spouses, the administration of life cannot proceed. Moreover, the lack of a death certificate for orphans of the migration phenomenon often means that they cannot reunite with relatives in Europe and may remain abandoned in countries of war. Meanwhile, their mothers, in the absence of marital or widow status, remain marginalized and deprived of their right to social life. Starting from the shipwreck of October 3rd, 2013, near the Italian island of Lampedusa where 366 people died, we presented six cases in which the recognition of orphan or widowhood status was essential to ensure the protection of the rights of children and widowed women. We discussed the critical practical issues, ensuring that this burdensome problem does not remain a mere ethical, moral, and legal consideration. These emblematic cases demonstrate that much has been done, but much more must still be done to address the severity of this worsening situation. The limitation behind many reunifications, however, is the lack of opportunities to certify kinship ties, which can prevent children from being granted custody. The scale and serious consequences of this problem should be considered in view of the massive increase in migration and associated fatalities.

Keywords: Humanitarian forensic sciences; Dead migrants; Family reunification; Identification; Human rights

WE-12

Combination of histomorphometric and morphological methods for age estimation from costal elements

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Bone ageing has been proven not to be a linear process resulting in significant difference between the chronological age of bone and the tissue age at the microscopic level. More specifically, bone undergoes a development phase during which bone tissue mass, compositional and mechanical properties improve, that peaks between 30 and 40 years of age. This is followed by a degeneration phase that severely compromises bone quality. Therefore, the main limitation of age estimation methods (AAD) in Forensic Anthropology is to capture with enough accuracy age-related changes based on the age biomarkers, especially in old individuals. In the present study, we attempted to complement histomorphometric methods for AAD with morphological examination of the sternal ends largely used in biological profiling. Standard ribs from 31 females (mean and SD ,58.10±16.74 years) and 31 males (61.71±13.17 years) individuals were included in the study. Each individual was assigned to an age range between 17-35, 35-59 and 60-85 years according to the sternal end morphology. Histomorphometric variables commonly used for AAD estimation were also evaluated. Data partitioning was carried out by dividing the sample in 85% training and 15% test set and two models were created both including and excluding the age phase assigned using sternal end morphological examination. Supervised using machine learning regression modelling based on Ranger, a fast implementation of random forests. Both models developed on the same training set and tested on the remaining 15% of sample showed a clear improvement in accuracy of the estimation when the age phase was included with MAE=6.76 and RMSE=7.97 against MAE=10.48 and RMSE=11.43 for the model considering only microanatomical parameters. Results for this study suggest that the combination of morphological and laboratory based AAD methods could represent a solution to improve estimation of unknown skeletal remains.

Keywords: Ageing, Rib; Histomorphometry; Sternal end morphology; Age estimation; Forensic Anthropology

FR-05

Immunohistochemical analysis in Forensic Anthropology: how far can we evaluate the vitality of perimortem bone trauma?

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The timing of the bone fractures is a recurrent topic that a forensic anthropologist faces. One of the most difficult challenges is the determination of the injuring vitality during the perimortem period, where there are not morphological or macroscopic features for this evaluation. Recent preliminary research is exploring the possibility of detecting microscopic markers of hemorrhaging and early healing signs on skeletal remains using immunohistochemical techniques. Here we aim to analyze the presence of hemorrhaging as biomarker of trauma 'vital' reactions in skeletal remains with diverse degree of taphonomy and post-mortem interval. The anti-human glycophorin A (GPA) antibody is used in order to detect the presence of red blood cells (RBC), in addition to Hematoxylin and eosin staining (H&E). To achieve this goal, we analyse bone samples with different fracture timing, postmortem interval and taphonomy. The analysed sample includes individuals of a mass grave of Spanish civil war with perimortem gunshot trauma, real traumatic cases from forensic autopsies cadavers with different taphonomy conditions, experimental gunshot trauma (GST) bones (postmortem trauma) and ancient archaeological samples. Preliminary results in the autopsy samples clearly show the presence of RBC, even with debris of those cells outside the vessels, around the osteon, indicating sign of haemorrhagic extravasation. A similar osteon RBC pattern has been observed even in Spanish civil war samples but with less intensity due to the longer postmortem interval. This result indicates that the immunochemistry is a useful and accurate tool for the vitality determination, with a clear immunohistological pattern.

Keywords: Vitality; Glycophorin; Red blood cells; Trauma; Taphonomy; Postmortem interval

TH-10

Mice, foxes and cadavers: forensic anthropological implications from an experimental study

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Vertebrate scavengers are a common taphonomic variable that can severely affect human remains, especially outdoors. Their gnawing on soft tissue and bones can destroy perimortem injuries and create new lesions that mimic legally relevant alterations, hampering trauma analysis. Furthermore, vertebrate scavengers are capable of scattering or removing body parts and single skeletal elements, challenging the complete recovery of remains and the reconstruction of perimortem events. Being aware of the local scavenger fauna can be crucial in forensic casework. We monitored three caged and three exposed domestic pig (*Sus scrofa domestica*) cadavers in a temperate forest near Bern in Switzerland, for five months during summer and fall. We placed motion-activated camera traps to record all vertebrate activity at and near the cadavers, and described their activity. During on-site data collection events, we documented any scavenger-related alteration to the carcass to match it with the respective species via comparison with the camera footage. We captured 36 vertebrate species at and around the cadavers, with three of them scavenging the pigs: red fox (*Vulpes vulpes*), mouse (*Apodemus* sp.) and bank vole (*Myodes glareolus*). All pigs were scavenged and scavengers were mainly active during night and at tree-covered plots with caged specimens. Our documented scavenging modifications are congruent with published lesions. In addition, mice gnawed perimortem skin injuries and altered them beyond recognition. All three scavengers were recorded to remove bones from the deposition site and the recovery rate of the six pig skeletons was 77%. Our findings inform forensic casework, in particular, search and recovery efforts and trauma analysis of cadavers. Investigations on human remains recovered from European temperate forests should focus on rodents and foxes as the main scavengers and forensic practitioners should be aware of their ability to modify and mimic perimortem injuries, and scatter and remove bones.

Keywords: Vertebrate scavenging; Switzerland; Forensic taphonomy; Experiment; Scattering

FR-06

The big challenge of determining the vitality of perimortem trauma in Forensic Anthropology: A histomorphometric investigation

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The task of accurately determining the chronological events of trauma (peri- and postmortem) is still one of the most crucial challenges in Forensic Anthropology. Even more problematic is the diagnosis of the vitality of a wound. Based on the existing literature, no one morphological characteristic of bone fractures provides an accurate evaluation of injury vitality during perimortem period. This work explores the hypothesis that microcracking pattern in bone tissue might allow us to optimise the distinction between peri- and postmortem fractures, and even shorten the perimortem gap in terms of the vitality of the injury. We analysed the microcracking pattern in undecalcified bone thin section from long bones of real traumatic death cases (forensic autopsies) and experimental fractures in fresh and dry long bones (human donors). Microcrack count, length and their occurrence in relation to the microstructure, osteonal or interstitial area, were considered. Results show that dry bone trauma is characterized by a high number and length of interstitial microcracks and a low number of osteonal microcracks. In contrast, fresh bone fractures showed a lower number of microcracks, particularly in the interstitial area, but a higher proportion of osteonal microcracks. Our study suggests that microcracking distribution, length, and density in the cortical tissues of long bones may be useful traits to identify divergent patterns between fresh fractured (perimortem) and dry fractured (postmortem) bones. Furthermore, results support the concept that osteonal microcracks may not only be an indicator for perimortem trauma, but also for vital trauma. This leads us to conclude that osteonal microcracking may be a potential vitality marker in forensic anthropological fracture timing.

Keywords: Forensic Anthropology; Bone fractures; Blunt force trauma; Fracture timing; Perimortem trauma; Bone histology; Bone histomorphometry; Microcracking pattern; Osteonal microcracks

FR-09

The application of GIS technology in estimating the postmortem interval

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Context-specific information is of crucial importance in the estimation of the postmortem interval (PMI), since the rate of decomposition of a body is highly influenced by the environmental conditions at the recovery area. However, manually recording the environmental parameters and calculating weather-related indices, such as Accumulated Degree Days (ADD), is time-consuming and almost impossible to perform in large study samples or in everyday forensic casework. The current study applied the technology of Geographic Information Systems (GIS) to the study of the PMI. An ArcGIS-based coding script was developed with the aim of providing contextual information for bodies exposed outdoors in terrestrial environments in Greece. This script was tested on 95 cases of decomposing or skeletonized human remains examined in the Department of Forensic Medicine and Toxicology, National and Kapodistrian University of Athens and in Forensic Medical Service of Thessaloniki, between the years 1999 and 2022. A multi-layer map was created in ArcGIS Pro software using publicly available online data. Individual layers included high-resolution aerial images, European EUNIS ecosystem and World Köppen-Geiger climate classification raster files, world population spatial data and an elevation-tinted hillshade surface map. This multilayer map was enriched by adding 99 national weather stations with their corresponding meteorological data. Python programming language was used for coding. Based on the geographic coordinates of each case, the date of disappearance and recovery of the decedent, this script automatically generates information on the slope and height of the specific site, the habitat type, the Köppen-Geiger climatic type and the population density. Additionally, it calculates the ADD and Accumulated Humidity Days (AHD) values by drawing data from the nearest weather station. Overall, this study will enlighten the audience in the usefulness of computer-assisted methods in the study and estimation of the PMI.

Keywords: ADD; AHD; GIS technology; Decomposition; PMI estimation; Greece

FR-10

Scavenging taphonomy in South Africa and the implications for skeletal recovery and analysis

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Scavenging animals often modify and scatter human remains, which is an obstacle to forensic investigations. The scavenging and scattering of remains is a common occurrence in South Africa; therefore, knowledge of scavenging modifications and scattering patterns is necessary for accurate analysis of the remains. This study aimed to describe the bone modifications and recoverability of skeletal elements that were scavenged. Thirty pig carcasses (*Sus scrofa domesticus*) (40-80 kg) were placed at three different environments (urban, peri-urban, and rural). The scavenger species were identified and their behaviours, scattering patterns, bone modifications, and the recoverability of scavenged skeletal remains were described. Rural vultures skeletonized the remains rapidly (between 5 - 98 minutes) leaving very few bone modifications (nonspecific scores). The remains were diffusely scattered within a radius of 5.7 - 7.1 meters. Peri-urban black-backed jackals skeletonized the remains between 6 - 75 days: causing minimal bone modifications, (superficial, nonspecific scores and punctures). The remains were commonly scattered in two directions within a maximum radius of 73.7 meters. Urban slender mongooses created characteristic bone modifications to the mandible (parallel scores on the flat surfaces and the angle margin having a stepped appearance). The remains were scattered in two directions within a maximum radius of 10.5 meters. The cranium (97.5%), pelvis (82.6%), ulna (80.4%), humerus (76.1%), and femur (71.7%) were commonly recovered elements. The sternum (36.2%) and lumbar vertebrae (50.9%) were infrequently recovered. However, the recoverability of skeletal elements differed between environments (particularly the ribs, pelvis and scapulae) due to the selective scavenging behaviours and size of the animals in the local scavenger guilds. The described scattering patterns, bone modifications, and skeletal element recoverability will assist in the recovery and analysis of scavenged remains.

Keywords: Taphonomy; Scavenging; South Africa; Scattering; Recoverability; Animal

FR-04

The use of Radiomics for potential bone pair-matching using post-mortem computed tomography images

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Introduction: Forensic anthropologists are often faced with commingled remains and limited time and/or resources to perform accurate reconstruction of a body or skeleton from different body parts/fragments. Radiomics is a method that extracts a large amount of features from medical images using data-characterisation algorithms that has been used extensively for clinical diagnosis. In this study Radiomics is applied in post-mortem computed tomography images aiming to investigate its potential for bone pair-matching. Materials and methods Clavicle bones of 78 PMCT examinations were segmented using a semi-automatic methodology by establishing a Hounsfield Unit threshold between 235.5 and 2673.8. Radiomics features were extracted with the pyradiomics 3D Slicer plugin. In order to assess potential matching between the two sides, principal component analysis (PCA) and hierarchical clustering with Euclidean distance metric were applied. The percentage of clavicles where the right matched the left side was recorded. Results PCA and hierarchical clustering demonstrated that in 36/78 (46.1%) PMCT examinations, clavicles displayed absolute pair matching with their contralateral clavicle, being included in the same subcluster of the dendrogram. A total of 17/78 (21.8%) were included within the same supercluster but displayed similarities also to other clavicles of the dataset. Discussion Radiomics analysis has been extensively used as clinical diagnostic tool opening new avenues in medical research and practice. The current study showcases the potential of the method to be used in forensic applications such as pair-matching skeletal elements. A broader sample is need to explore the full potential of the method in sorting commingled remains and the possibilities for producing automated tools for this purpose.

Keywords: Forensic Anthropology; Commingled remains; Pair-matching; Radiomics; PMCT

FR-07

The application of narrow band light sources when investigating bone damage

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When investigating human remains, in either archaeological or medicolegal context, bone damage should be thoroughly analyzed. Damage, or traces, found on bone can be related to ante-, peri-, and postmortem events, like funerary practices, acts of violence or incorrect postburial handling. Traditionally, bone damage is analyzed with the aid of a microscope, and, based on the shape of the deformation and tool mark striae, a conclusion is drawn on the mechanism and object that might have created the damage. Often the question «when was the trace created» rises, either ante-, peri-, or postmortem. Currently, it is difficult, if not impossible, to differentiate between these moments. Bone has luminescent properties, when excited with a narrow band light source. By blocking the excited light with a long pass filter, the luminescent properties can be visualized and photographically documented. Since the luminescent property stems mainly from the organic component of the bone, it is expected that the intensity of the luminescence decreases with time due to taphonomic processes. Any damage occurred after the taphonomic alteration exposes a more fresh surface, which then could exhibit a higher intensity of luminescence than the rest of the undamaged bone surface. This hypothesis was tested in an experimental setting with bones (*Sus scrofa dom.*) with traces created with a thin saw, exposed to environmental variables on the surface, and on samples from archaeological excavations. Results show that the luminescent characteristic of bone can aid the investigation, it proved useful in differentiating between peri- and postmortem bone damage. The application of luminescence analysis and imaging is presented and substantiated with examples differing in taphonomic context and postmortem or burial time.

Keywords: Forensic Anthropology; Taphonomy; Trauma Damage; Bone; Luminescence Imaging

WE-04

“Secure” identification of the deceased: Interpol definitions versus police routines

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Internationally accepted primary methods of identification include forensic odontology, fingerprinting and DNA analysis. Secondary methods of identification, comprising visual identification based on photographs, description, personal characteristics, and belongings, are considered less reliable. In Denmark, the police are responsible for identifying a deceased. The identification of an unknown deceased is important not only for the next-of-kin but also for the society due to ethical and legal reasons. The aim of this study was to examine which identification methods are used by the police when a forensic autopsy is performed. Autopsy and police reports from 591 deaths, where a medico-legal autopsy was performed at the Department of Forensic Medicine at University of Copenhagen in 2020, were investigated. No bodies remained unidentified. Our results showed that the police considered identification assured in 93,4% of the cases, while in 6,6% of the cases there were doubts about the identity of the deceased. The most used method of identification was visual identification, primarily made by relatives or based on photographs of the deceased. This also included several cases with putrefaction, mummification or burns. Primary methods of identification were only used in 4,4% of the cases and only in two-thirds of the cases with doubtful identity. We suggest that it may be a cause for concern that poorly preserved bodies are identified using visual identification. Internationally accepted methods of identification should be used more routinely, and specifically the terminology involved should be clarified. The police routinely categorize a given identification as “secure” (assured), but not in the sense implied by Interpol (by the use of primary methods).

Keywords: Identification; Interpol; Visual recognition; Forensic autopsy

TH-02

Current status of Forensic Anthropology in the Middle East and North Africa (MENA) Region

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Forensic Anthropology practice is significantly developing worldwide. However, to date, there is no clear understanding of Forensic Anthropology overall for the Middle East and North Africa (MENA) region. For this reason, the objective of this study is to assess the current status of Forensic Anthropology in several Middle Eastern and North African countries including Egypt, Iraq, Lebanon, Syria, Turkey, Jordan, and others. This was achieved by conducting a literature review search in combination with a survey through online interviews with academics and practitioners in Forensic Anthropology or a closely related discipline. The interviews entailed questions related to the structure of medico-legal institutes, the forensic science capability, training, and capacity-building efforts, the presence of forensic anthropologists and the types of casework they are involved in, the methods employed when assessing the biological profile, the use of radiological imaging, academic availability, and the challenges and recommendations for future development of the discipline in each country. The results show that Forensic Anthropology is underutilized in the medico-legal death investigation system in most Middle Eastern and North African countries and this could be a result of human capital, awareness, procedures, legal, academic, political, and security reasons. Nevertheless, most specialists within the police and medical-legal institutes, indeed understand that this discipline should be enhanced through theoretical and practical training, scientific dissemination, more funding, and improving local capability by creating a revised framework, standard operating procedures, and recommendations for best practices.

Keywords: Forensic Anthropology; Forensic science; MENA region; Human identification

WE-07

A comparative study of unidentified migrant and non-migrant remains across three medicolegal offices in Greece

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This study presents a retrospective analysis of Greek medicolegal casework (N=770) from three separate forensic services between the years 1995 and 2022 to discern any patterns between migrant and non-migrant forensic profiles. The data were collected from the Forensic Medicine Unit of the University of Crete in Heraklion (1995-2022, n=99), the department of Forensic Medicine and Toxicology of the University of Athens (1999-2021, n=317), and the department of Forensic Medicine of the Democritus University of Thrace in Alexandroupoli (2011-2022, n=354). The demographic data for each set of unidentified remains from each forensic service were recorded when available including location of death, sex, age, nationality, migrant status, trauma, postmortem interval, cause of death, manner of death, status of identification, length of time to identification, method of identification, and deposition location post-analysis. Data within and between services were compared to generate forensic profiles for each service separately and the three as a whole. The results show that there were a total of 367 individuals considered migrants and 403 individuals considered non-migrants. Of the 403 non-migrants, 340 were forensically significant. Demographic results for the migrant remains indicated that 322 were males, 37 were females, and the average known age for the migrant group was 27.99 years. The forensic statistics for the migrant remains revealed that 99 of the 367 cases showed evidence of trauma and 172 individuals were positively identified (46.9% identification rate). Demographic results for the non-migrant remains indicated that 173 were male, 52 were female, and the average known age for the non-migrant group was 65.2 years. The forensic statistics for the non-migrant remains showed that 86 had documented trauma and 134 were positively identified (33.3% identification rate). The results also highlighted that the majority of unidentified migrants found deceased in Greece in the jurisdiction of these services are concentrated in the Thracian region. Finally, this project records the trends in methods of identification as well as the difficulties tracking unidentified human remains post-forensic analysis. Suggestions for future avenues of research will also be provided.

Keywords: Identification; Missing migrants; Case analysis; Unidentified remains management; Migrant mapping

TH-12

Finding bones in Switzerland: Forensic Anthropology at the University Center of Legal Medicine Lausanne - Geneva

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Located at two University Hospitals, the University Center of Legal Medicine Lausanne-Geneva (CURML) disposes worldwide recognition. Employing approximately 260 individuals, it actively engages in teaching and participates in interdisciplinary research projects in collaboration with international partners. Owing to its highly interdisciplinary nature, Forensic Anthropology at the CURML is based at two Units: the Swiss Human Institute of Forensic Taphonomy (SHIFT) and the Unit of Forensic Imaging and Anthropology (UIAF). Established in 2019, the SHIFT assists forensic pathologists with challenging forensic cases, such as those involving highly decomposed bodies. The SHIFT members possess extensive experience in anthropology, forensic medicine and genetics, toxicology, and, more recently, forensic biology. In contrast, the UIAF bridges the gap between Forensic Anthropology, forensic imaging, and legal medicine, offering a multitude of imaging technologies. Forensic cases in Switzerland that require anthropological investigations are diverse, encompassing e.g. research on heavily decomposed bodies, burnt remains, skeletal remains discovered in forested or mountainous areas, and bones unearthed at construction sites. The forensic anthropologists can in some instances be the connecting element between law enforcements, forensic pathologists and also to the various archaeological services. We are hereby presenting the interdisciplinary working group of Forensic Anthropology at the CURML.

Keywords: Forensic Anthropology; Forensic Imaging; Forensic Taphonomy; Forensic Medicine; Human Remains

WE-11

A deep learning approach to adult skeletal age-at-death estimation

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Skeletal age-at-death of adult human remains is one of the most challenging aspects of biological profile estimation in Forensic Anthropology and medicine. The complex and difficult nature of adult age-at-death estimation is the result of intertwined biological and methodological problems. Skeletal morphology and chronological age often show a feeble relationship and confounding factor such as sex, ancestry, or intra-personal variation play a significant role on skeletal morphology and its age-related expression. Methodologically anthropological approaches to age estimation are mostly characterized by their sparse nature in the skeletal markers analyzed, an overemphasis of specific skeletal traits (e.g., pubic symphysis), no formal procedure to combine information from multiple skeletal parts and produce age estimate that do not reflect individual variation. To overcome the methodological problems commonly found in adult skeletal age-at-death estimation we develop a new software tool, DRNNAGE, based on deep randomized neural network models. Deep randomized neural networks are a specific type of machine learning algorithm that combines randomization with representational learning for fast and accurate prediction. This new tool allows adult skeletal age-at-death estimation based on 64 developmental and degenerative traits markers covering all major joints and muscle attachment sites. New models can be re-fitted and cross-validated according to the skeletal traits available. Based on cross-validation analysis, results demonstrate that age estimation from skeletal remains can be accurately inferred across the entire adult age span, approximately with 6 years mean absolute error. Informative estimates and prediction intervals can be obtained for the elderly population. This new tool was developed using the R and C++ programming languages and following an open-source philosophy.

Keywords: Forensic Anthropology; Age-at-death estimation; Deep learning; Artificial neural networks; Open-source software

TH-08

The (un)coupling method: principle and application on fetuses and infants' skeletal remains up to two postnatal months

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The (un)coupling method is a two-step procedure tool available freely online for fetuses and infants up to three postnatal months. It is a method of (1) detection of a possible developmental anomaly and (2) estimation of age using the best *non-biased* predictor between the femur length and the maximal length/width of the pars basilaris. This presentation describes the principle of the method and gives some examples of application.

The sample is composed of 114 individuals aged 16 weeks in utero to 2 postnatal months and three methods are implemented. First, the (un)coupling method is applied on individuals to detect altered growth trajectories (*i.e.* possible developmental anomalies) and then one or the other of the age estimation method is used, depending on the coupling (method using the femur length) or uncoupling (method using the pars basilaris biometry) between maturation and growth.

The first step indicates that 22% of our sample's individuals showed an uncoupling, meaning they have a pathological condition affecting their growth. This would have generated an age estimation error for 42% of them using the femoral length. Thanks to the second step indicating the use of the age estimation method with the pars basilaris measurements, error drops to 12% for the Maximal Length (ML) and only 4% for the Maximal Width (MW).

In the event of a coupling between maturation and biometry, the femoral length can be used to estimate the individual's age since the method is more precise and there is no suspected developmental anomaly which could have led to a shorter femur. In case of uncoupling, and therefore suspicion of an altered growth trajectory, the ML and/or MW must be used since they are hardly ever affected by pathological condition. Our online tool can be used in both forensic and archaeological context to test coupling or uncoupling and helps to detect any anomalies that could bias the age estimate. Therefore, it ensures the user to apply the more efficient and reliable age estimation method.

Keywords: Biometry; Effect of diseases; Subadults; Automated tool; Skeletal ageing; Forensic Anthropology; Maturation stage; Geometric morphometrics

WE-13

Age estimation in a Western Australian population: a geometric morphometric and linear analysis of the subadult mandible

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Estimating age for unidentified subadult remains requires population-specific standards to ensure an accurate classification of age. Due to the vast ancestral diversity within contemporary Australia, applying methods developed from populations that are not similarly diverse, introduces an unknown error. At present, the availability of Australian-specific subadult age estimation methods are limited, with no available standards utilising the subadult mandible. Mandibular growth and development closely approximate dental development, which is considered an accurate measure of subadult age. Therefore, it is assumed that the metric assessment of subadult mandible can be similarly accurate. Previous research by Franklin and Cardini (2007), and Franklin et al. (2008) demonstrated that ramus height, and mandibular shape and size could predict age with standard error of ± 1.1 to ± 3.0 years in a subadult South African and African American population using geometric morphometric (GMM) analysis and inter-landmark distances. Similarly, Eberlein (2007) found that traditional linear measurements, ramus height, mandible maximum length and mandible body length produced a pooled standard error of ± 2.20 to ± 2.47 years in a subadult South African, African American and Caucasian population. The present study aims to evaluate estimation accuracy of the mandibular metric standards according to Eberlein (2007), Franklin and Cardini (2007), and Franklin et al. (2008) in a contemporary Western Australian population. Multi-detector computed tomography (MDCT) cranial scans from 72 subadults aged between 0 and 17 years are assessed using GMM with 38 three-dimensional mandibular landmarks and ten linear measurements. The MDCT scans were deidentified upon collection and the required ethical approval has been granted. This study will contribute to Australian forensic anthropological standards by providing error rates for subadult age estimation methods, thus satisfying the expert testimony requirements of Australian judiciaries.

Keywords: Forensic Anthropology; Age; juveniles; Morphometrics; Computed tomography

TH-04

Addressing the challenges of data collection bias in third molar analysis for age estimation

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Age estimation demands more accurate and reliable methods. Furthermore, considering the sensitive contexts in which these assessments are practiced, it is needed efficient and non-invasive (when considering living individuals) methods, that can be easily transferred between peers. This work has the aim of assessing the degree of difficulty in apprehending the method proposed by Mincer and collaborators (developmental stages for the tooth crown and root, adapted to the third molar), and the influence of different degrees of experience on the data collection process. A random sample of orthopantomographs from 102 individuals, aged between 12 and 25 years old ($\bar{x}=20.12$ y.o., $SD=3.49$; 65 females, 37 males), was analyzed. The retrospective analysis was performed by five observers (in the same sample) with different levels of experience: basic (two bachelor students with basic training in human osteology), average (one PhD student with experience in analyzing skeletal human remains), high (one PhD student with experience in age estimation dental methods, and an odontologist). Upper and lower third molars from both quadrants were analyzed and measurements of agreement were calculated. It was observed that differences in the performance of observers (with more or less experience) were less evident than the differences between observations of the upper and lower third molars. In fact, an overall balance was observed in the agreement correlation values attained between raters. This may be indicative that more than experience, good visibility of the structures is more important to achieve consistent observations. Furthermore, the good results of the agreement analysis ($ICC > 80\%$; $K > 0.7$) between observers are indicative that the analysis of the morphology of the crown and root of the third molar is an easy-to-apply and fast-learning assessment.

Keywords: Age assessment; Mincer method; Inter-rater; Forensic Anthropology

WE-02

Humanitarian Forensic Anthropology in Italy: a case of commingled remains from the largest mass disaster of the migrant crisis in the Mediterranean Sea

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On April 18th, 2015, a boat sank off the Libyan coast allegedly carrying 1000 migrants: with only 28 survivors, this is considered the most tragic event amongst the shipwrecks that daily occur in the Mediterranean Sea. This presentation focuses on the skeletal remains found in the engine room of the wreck and describes the elaboration of the biological profile and the segregation of the commingled remains that were found completely or partially disarticulated. The inventory and anthropometric data of the commingled remains were recorded on the CoRA (Commingled Remains Analytics) platform: 2,831 bones and teeth were entered into the database, 397 of which belong to articulated portions. Morphometric analyses were performed on the remains for the elaboration of the biological profile. The segregation of the mixed remains focused on the pair-matching of the long bones through a visual approach and osteometric sorting. 25 disarticulated crania and 25 individuals represented by pelvic bones were recovered from the engine room. The individuals were adult and subadult males. Morphometric ancestry identified both African and European forms. Minimum number of individuals (MNI) could amount to 25. However, 33 disarticulated mandibles and several supernumerary long bones were found, suggesting further intermixing of remains with other environments of the boat. Visual and osteometric pair-matching return partially discordant results, but the latter substantially reduces the number of comparisons that can then be evaluated through the visual approach. The engine room was supposed to be a closed space. However, evidence of further commingling was found because of the presence of supernumerary bones that could not be assigned to any of these individuals. The engine room is only a small portion of the boat, but it represents a starting point for the analysis of the commingled remains and the future identification of the victims of this shipwreck.

Keywords: Migrants; Commingled remains; Osteometric sorting; Pair-matching; Mediterranean Sea; Shipwrecks

TH-03

Development of Forensic Anthropology in Sweden

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Even though Sweden has a tradition of implementing principles of biological anthropology and osteoarchaeology into forensic practice dating back to the 1970's, Forensic Anthropology is not yet considered an independent discipline or a formalized profession. While osteoarchaeological education is available in Sweden, education and training indispensable to the practice of Forensic Anthropology is lacking. Consequently, the analyses of skeletal remains are often performed ad hoc by people lacking forensic anthropological expertise. This trend is also conditioned by the assumption that there are not enough cases that could justify positions in Forensic Anthropology, something that a recent analysis of Forensic Anthropology cases handled by the National Board of Forensic Medicine (NBFM, Sw. Rättsmedicinalverket) proved to be wrong. In recent years, the importance of having forensic anthropological and archaeological expertise at hand within both the Police and the NBFM has been pointed out, and steps to obtain an implementation of these disciplines in forensic practice have been made. In this presentation we will discuss the current situation of Forensic Anthropology in Sweden, including the development within the Police Authority and the NBFM, the role that the national association for forensic archaeology/anthropology has in easing collaboration and communication between different law enforcement actors, universities and companies, as well as ongoing research initiatives. Even though obstacles remain, we argue that the Swedish law enforcement organization is ideal for development of a national infrastructure for handling forensic anthropological cases. We argue that it is paramount to implement and formalize Forensic Anthropology in Swedish forensic practice and to keep on par with current international standards.

Keywords: Forensic Anthropology; Forensic archaeology; Forensic medicine; Organisation and infrastructure in forensics; Forensic Anthropology societies; Forensic Anthropology education

FR-08

A three-year experimental study of outdoor human decomposition in Quebec: towards establishing a regional taphonomic model

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The impact of climate and seasonality on the decomposition dynamics of exposed human remains and thereby on postmortem interval (PMI) estimation is yet to be determined experimentally in Quebec and more broadly in humid, continental (Dfb) climates. To address this gap, an experimental study was conducted across three calendar years (2021-2023) at the REST[ES] human taphonomy facility in southern Quebec. Following ethics approval, 12 human donors were deposited on the soil surface across the four seasons; 6 in 2021 and 6 in 2022. Decomposition was monitored using a purpose-developed scoring system. Overall, the results showed a clear trend towards extensive desiccation of soft tissues associated with differential preservation of certain body regions, the feet-ankle region being the most frequently preserved and the head-neck region the most frequently skeletonised. In Spring, Summer, and Autumn, desiccation was observed in all body regions within the first 21 days post-deposition—regardless of season—except in the head-neck where partial skeletonisation was observed in all donors. As decomposition progressed, skeletonisation was observed gradually in the pelvis, thorax, upper limbs, and then abdomen. The lower limbs were consistently more preserved due to desiccation than the upper limbs with 100% of donors showing preserved soft tissues in the feet. It was further identified that temperature alone does not account for the desiccation phenomenon. A cross analysis of the combined roles of other environmental factors (humidity, winds, sunlight exposure, soil composition) with cause of death and medical history of the donors will be presented. This study brings new insights on the dynamics of decomposition and the sequence of skeletonization of exposed human remains in southern Quebec. This regional data can serve as a baseline to help estimate the PMI of human remains recovered in forensic contexts in comparable Dfb climates, including in Central, Northern, and Eastern Europe.

Keywords: Decomposition; Taphonomy; Desiccation; Postmortem Interval; Canada

WE-05

Estimating socio-cultural identity within black South African groups using sub-specific discriminate 3D shape matrices

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The probable identification of an unknown individual is based on the presence of quantifiable phenotypic variations and the relationship of these variations to the individual's socio-cultural identity. Therefore, this study aims to create sub-specific discriminate shape matrices to estimate socio-cultural identity among black South Africans, with a particular emphasis on developing standards for predicting mid-facial variation within this population. A total of 191 adult South Africans, representing nine modern black South African socio-cultural groups, namely Pedi, Sotho, Swati, Tsonga, Tswana, Venda, Ndebele, Xhosa, and Zulu, were obtained from the Pretoria Bone Collection in the Department of Anatomy at the University of Pretoria. Three-dimensional (3D) modelling of the relevant anatomical area was performed using an EinScan H 3D scanner. The 3D anatomical extraction was performed by placing 41 standard craniometric landmarks and 378 sliding landmarks (interpolation factor = 1 mm) on 3D models using the Avizo 9.4 software. The analysis of variance showed that variations in midfacial shape were statistically significant ($p < 0.001$) for all shape configurations, including sub-specific discriminate shape matrices, separately. Additionally, cross-validated linear discriminant function analysis yielded an accuracy between 79.59% and 100% for all shape configurations and sub-specific discriminant shape matrices, thereby reflecting the discriminative power of socio-cultural groups within the black South African population. Finally, geometric morphometric approaches for socio-cultural estimation using the midface retain the objects' geometry and analyses subtle structural differences. Consequently, innovative 3D approaches may estimate socio-cultural identity within the modern black South African population more accurately.

Keywords: South Africans; Pretoria Bone Collection; Geometric Morphometric Methods; Socio-cultural identity; Shape matrices

TH-01

Hacked, burned or both? Chemical trace analysis of sharp force trauma in unburned and burned bone

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Skeletal remains can give important information on the identification of an individual and/or the reconstruction of circumstances of death. Those are commonly recovered after being subjected to burn events, either accidental or intentional. Although burned skeletal remains have been studied for several decades, they still offer significant challenges due to heat-induced alterations, namely heat-induced fractures. These are often hard to distinguish from trauma or fractures with other aetiologies, namely sharp force trauma (SFT). When dealing with violent deaths this can have an impact on medico-legal conclusions. The aim of this study was to investigate if blade chemical traces are transferred and thus possibly detected in bone, even after heat exposure. This was accomplished by producing SFT in 20 macerated fresh pig ribs with different instruments: a stainless-steel kitchen knife, an artisanal kitchen knife, a ceramic kitchen knife, and two different size axes. One additional rib was used as a control sample. All sharp force instruments (SFI) were probed by X-ray fluorescence (XRF) to determine the blades' compositions. We observed that, although having different compositions, all blades were mainly composed of iron. Bone samples were burned in an electric muffle at different temperatures (500, 700, 900 and 1100 °C) and probed by XRF and Fourier-transform infrared spectroscopy in attenuated total reflectance mode (FTIR-ATR), before and after burning. All SFI used left detectable chemical traces (iron, nickel, copper, chromium, and titanium) on unburned bone, although not in all samples. Most traces were still detected after burning. In some cases, previously undetected chemical traces were only then detected. Traces could only be detected using XRF. FTIR-ATR provided no useable information. Potentially, XRF can provide information regarding the aetiology of fractures in burned and unburned bones, however, the effect of soft tissues and diagenesis should be investigated.

Keywords: X-ray Fluorescence; Infrared spectroscopy; Heat-induced changes; Heat-induced fractures; Forensic Anthropology

TH-06

Stable isotope analysis as a tool in forensic archaeological casework: current status and a way forward

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Human bones and teeth have the longest post-mortem longevity and serve as crucial markers of human form and identity after death as the former harbor identity markers of the deceased in the form of their individualistic physical structures, molecular signatures and chemical compositions. These osseous and dental tissues have been increasingly used to figure out the biological profile of an individual/people who lived in the past. Stable isotope analysis of such remains retrieved from forensic archaeological contexts has proven to be a powerful tool to reveal their geolocations, migration patterns/residential mobilities, dietary practices and food sources/choices in the past and thus, contributing towards their provenance in archaeological sciences (Richards, 2020). Most of the stable isotope research from India has been reported from geological (rock or river-basin), water and grain samples discussing about the origin theories of such samples to the past times¹. Also, a plethora of fossilized remains have been reported from different strata of Siwalik hills in the Himalayan region, which are lying un-investigated or idle in academic museums and university laboratories. If such specimens are studied using the advanced techniques of stable isotope analysis, it can provide crucial evolutionary information about the ancient flora and fauna in the region. Hundreds and thousands of human skeletal remains, belonging to the past individuals/populations, have been retrieved from different bio-archaeological or forensic anthropological sites in India like Rakhigarhi, Vadnagar, Karnataka, Ladakh, Ajnala etc.²⁻⁵. However, only a very few of them has been analysed using stable isotope analysis to reconstruct their life-histories and past events as pace of such analyses has not gained momentum in India. There is a huge scope for use of stable isotopes for forensic and archaeological purposes in India, provided traditional analyses are seriously extended to the advanced chemical technologies. Indian population represent several heterogeneous clusters, so development of isocapes of different geographical regions is urgently needed for identification of any unknown human remain retrieved from any part of the country.

TH-11

Violence against children: a review of forensic anthropological cases in Johannesburg, South Africa

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South Africa is experiencing a scourge of abuse against women and children, with alarming levels of violence. It is not often that the remains of juveniles present in a forensic anthropological setting. The aim of this research was to assess the cases of juveniles (under 20 years) referred to HVIRU (Human Variation and Identification Research Unit) for a 6-year period (2016-2022), in order to assess patterns and types of cases referred. A total of 19 such cases were assessed, of which 10 were 16-20 years old and six less than five years. Of the 14 children with known sex, 12 were female suggesting that many fell prey to sexual violence. Only five individuals were known (and referred to for trauma analysis) or identified afterwards. Of the 19 juveniles, 11 (58%) had evidence of perimortem trauma (sharp and/or blunt), attesting to the violent nature of their deaths. Two cases had both sharp and blunt force trauma, of which one is a possible case of dismemberment. The remains of two individuals showed signs of perimortem burning, which may or may not be related to the cause or concealment of death. Three individuals had signs of antemortem (healed) trauma, which may suggest a longer period of abuse. Five of the individuals showed signs of disease – two had cribra orbitalia, while two others had various porous lesions indicative of poor health, chronic disease or malnutrition. Two had very severe enamel hypoplastic lesions, while one had advanced osteomyelitis, suggesting that some may have died of natural causes. The signs of poor health and trauma demonstrate the neglect and violence against children in South Africa. The results of individual case studies, with successful prosecutions in some of them, highlight the importance of forensic anthropological analyses of these cases.

Keywords: Child abuse; Personal identification; Perimortem trauma; Pathology

WE-10

Testing the reliability of medial clavicle ossification assessment by conventional radiography: the use of Kellinghaus sub-stage system for age estimation in the living

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The steady migration phenomenon leads to thousands of unaccompanied foreign minors entering Europe each year. In the absence of valid documents, authorities are increasingly asking to ascertain their biological age. The scientific literature agrees that this process cannot disregard a medical evaluation combined with radiological examinations. When bones of the hand and wrist, and wisdom teeth have completed their growth, the degree of ossification of the medial clavicle should be examined. In recent years, research in the area of the clavicle has favored its evaluation by computed tomography (CT), arguing the unreliability of using conventional radiography mainly because of the overlap with other bony structures (e.g., ribs) and the difficulties in obtaining an optimal projection. It is undeniable that computed tomography involves high exposure to ionizing radiation, and although in recent studies the possibility of using a low-dose CT has been explored, this still remains higher than that for conventional radiography. Building on Schmeling's classification (5 stages), Kellinghaus and colleagues developed a sub-classification of stages 2 and 3, with stage 3c appearing as the threshold to distinguish between minor and adult. The present study aimed to test whether the Kellinghaus sub-stage system (developed on CT scan images) can be used effectively on conventional radiography. To this end, we included two radiologists, two anthropologists, and two forensic pathologists who received eighty blinded postero-anterior chest radiographs for evaluation. These were radiographs taken for clinical purposes in the hospital, and chronological age of the patient was known. An excellent correlation was observed among observers (k greater than 0.9) and a general tendency to slightly underestimate the age of the subjects. The cases in which the age was overestimated can be attributed in large part to the insufficient data in the literature regarding stage 2c. Overall, our preliminary results suggest that conventional radiography can be effectively used to assess the degree of ossification of the clavicle. This could be another step in making age determination more accessible and less invasive for all.

Keywords: Age estimation; Unaccompanied foreign minors; Medial clavicle ossification; Conventional radiography; Sub-stage system

WE-09

Analysis of 14C and 13C in bones to assist identification of unknown human remains

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Disaster victim identification represents a central goal for forensic professionals, involving forensic pathologists, anthropologists and the police force, especially in mass disasters and victims of crime. If there are no indications as to the identity of the deceased, the sex, age and origin are especially critical information to limit the search for potential matching persons. In practical casework, the focus is to determine whether the find is of human origin, and whether it is recent or old, demanding a further police investigation or not. In tooth enamel, which has not exchanged any carbon since its formation, analysis of increased levels of 14C can allow an accurate birth dating of an individual, a so-called bomb-pulse radiocarbon dating. However, if there are only bones available, which continuously turns over carbon, such analysis will not tell a precise birth or death date of an individual, but only if a person was alive, or not, after 1955 when the 14C levels began to rise in the atmosphere. Though, the levels of 14C in bones will show varying levels depending on the time window of exposure during the bomb-pulse curve, and possibly on the individuals age during this exposure. We have analysed 14C in bones from well-known deceased subjects to tell if the date of birth and date of death can be assessed by mathematical modelling. To this day, we used a pre-analytical extraction protocol to obtain three fractions, the carbonate, collagen and lipid fractions, which were then analysed independently. We have discovered that the lipid fraction consistently shows more recent 14C levels than the collagen and carbonate fractions. Therefore, it could be achievable to assess the year of death from the lipid fraction 14C levels using simple calculation of lag times. Our initial results show that the carbon turnover is comparable in the bone types analysed; pars petrosa of the temporal bone, femur and thoracic vertebra. The estimation of year of birth and death demands a larger dataset for mathematical modelling.

FR-01

Virtual anthropology and the importance of using PMCT databases: some applications

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Whole-body CT scanning before autopsy (also called post-mortem CT scanning, PMCT) has become routine in many forensic departments with the great advantage of creating modern, up-to-date virtual collections. Focusing on skeletal tissue, these virtual collections can be used to test and improve the traditional physical anthropological methods for, e.g., aging and sexing, and to develop and calibrate new methodologies. Dry-bone collections often reflect bony changes in humans who lived more than 100 years ago, raising the question of whether they are fully applicable to modern forensic cases. We will present a range of studies where we used the PMCT database of the Department of Forensic Medicine at the University of Copenhagen (Denmark) to redefine and validate methods for stature, age, and sex estimation on the Danish population. We developed and validated new regression equations for stature from PMCT femoral measurements, since both Trotter and Gleser's and Boldsen's equations underestimated the stature on Danish forensic cases. We demonstrated that the Probabilistic Sex Diagnosis method (DSP: Diagnose Sexuelle Probabiliste) is a robust method that can be applied to 3D virtual models obtained from PMCT scans of the modern Danish population. We evaluated the ossification stages of the knee, a skeletal trait used for age estimation of living individuals, on cadavers using different imaging modalities (Computed Tomography, MRI, Digital Radiography) finding that they are not interchangeable and, thus, separated reference material based on the modality should be created before its use in forensic cases. Finally, we will discuss the importance of PMCT in forensic anthropological studies as a powerful tool for testing different mathematical and statistical models to better assess the relation among the different skeletal traits and to help making anthropological methods more uniform in their application.

Keywords: PMCT; 3D; Age; Sex; Stature; Virtual database

FR-02

Exploring age-related trends in cortical and trabecular bone in an elderly Scottish sample: a pilot study on the clavicle

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Understanding bone ageing in the elderly is crucial as life span increases globally and can provide valuable clinical and anthropological information about bone quantity and quality. This study aims to explore age-related changes by combining 2D and 3D approaches on both cortical and trabecular bone in the clavicle in an elderly sample. 30 left clavicles (mean age = 83 years, 15 males and 15 females) were collected from Scottish donors from CAHID (University of Dundee). 5 trabecular variables were assessed using micro-CT with two volumes of interest (VOIs, superior and inferior locations). 14 cortical bone parameters were evaluated using traditional 2D histology, with osteon frequency variables measured on 8 periosteal sampling areas. Intra-observer error was assessed using intra-class correlation coefficient. Correlations with age were examined; comparisons were conducted between age groups (sample divided by decades and under/over 85 years of age) and between the sexes using parametric and non-parametric statistical tests. Linear regression was used to explore the relationship between all parameters and age. Repeatability was overall achieved. Trabecular bone volume fraction differed between the superior and inferior locations. Cortical area parameters, intact osteons, and connectivity density were significantly correlated to age. For decades, trabecular thickness and bone volume fraction differed statistically between individuals in their 70s and 80s. Relative cortical area was the only parameter showing differences between under and over 85 years groups. Sex differences were found for cortical area related parameters. 30% of the variation in age was explained by relative cortical area and inferior trabecular connectivity. Examining 2D cortical and 3D trabecular bone histomorphometric parameters revealed more insights about age-related changes, assisting with understanding bone health status and ageing patterns in the elderly. This study contributes to research on bone histology, further exploring microscopic ageing in different populations, particularly in individuals over 60 years old.

Keywords: Bone histomorphometry; Cortical bone; Trabecular bone; Clavicle; Micro-CT; Elderly; Ageing

POSTERS

P-01

The population independency of stature estimation: Contribution to a debated issue

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Stature is one of four biological profile parameters and as such it has been studied extensively by anthropologists, usually employing long bone lengths, most commonly the femur. In 2016 Albanese et al published an article attempting to build a population-independent formula for stature estimation. The purpose of this study is to examine the efficacy of the method on a sample consisting of adults that were examined at the Forensic Medicine Unit of the University of Crete for which post mortem CT scanning was performed. A total of 50 maximum femur lengths were measured using segmented 3D left femurs from PMCT scans of forensic cases (38 Greeks, 12 Foreigners) with documented stature. The sample consisted of adult females (N=18) and males (N=32) aged between 18-91 years old. The estimated statures were calculated using the male, female and generic equations by Albanese et al. Absolute error of estimate (AEE) was calculated. Regression analysis was performed for the Greek sample and the two methods were compared. AEE ranged from 0.18 to 21.64 cm for the pooled sample exhibiting a mean AEE of 6.04cm. Only 46% of the recorded stature fell within the range of estimated stature. The generic equation underestimates stature for both Greeks and Foreigners. The regression analysis on the Greek sample resulted in $R^2=0.772$ with $SEE=5.5$ cm. When the sample was split by sex, females exhibited higher correlation of stature with femur length. Albanese et al. equation results in a marked underestimation of stature in both the pooled and the Greek sample despite the relatively low mean AEE. This can result in erroneous estimates of the biological profile that can impede positive identification. Thus, when possible, population-specific standards should be recorded and applied in forensic casework. However, a wider sample is needed to verify these preliminary results.

Keywords: Stature estimation; Biological profile; Post Mortem CT; Population specificity; Regression analysis

P-02

The comprehensive analysis of skull sutures based on PMCT acquisition with respect to age estimation

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Age assessment, aside from stature and sex estimation, is a basic element of anthropological profiling, which is important not only in case of corpses but also in a living persons as well. Age estimation results in children are more accurate, whereas in adults the accuracy is sometimes still problematic. The methods of age estimation based on evaluation of skull sutures are still debated due to conflicting results, different authors and different populations. Thanks to new technological developments it is possible to deeply and more accurately analyse human bones without conventional methods, for example, of maceration. Post-mortem computed tomography (PMCT) gives such new opportunities. Aim: To show and discuss the results of neurocranium sutures' research based on post-mortem computed tomography evaluation of Polish males group. Multiplanar reconstructions (MPR) and volume rendering technique (VR) were applied to analyse skull sutures (coronal, sagittal and lambdoid) of 113 males with known metrical ages. A correlation was searched for between the age at the time of death and suture closure as well as between the obliteration processes in the right and left even sutures (coronary and lambdoid). All post-mortem imaging studies and medicolegal post-mortem examinations were conducted between March 2019 and January 2021 in the Department of Forensic Medicine, Jagiellonian University Medical College, Krakow, Poland. Skull sutures cannot be used as a strong indicator of age estimation, it may be rather utilised as a "guidance" only. Indubitably, it is important to remember that this method may have a high error rate.

Keywords: PMCT; Age assessment; Skull sutures; Post-mortem computed tomography; Biological profile; Modern population

P-03

Age estimation using multislice computed tomography of the sternum, the clavicle and the first rib

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The chest area has shown in several studies its reliability in forensic identification. CT scan is now seen as a tool of great value in the field of physical anthropology. To develop an age estimation model based on the anthropometric measurements using computed tomography approach as a numerical score from the sternum, the clavicle and the first rib. Material and methods: This is a prospective study including 104 CT scans of plate samples (the sternal manubrium, the internal third of the clavicle and the anterior arch of the first rib). We established a score by nine criteria. We studied the correlation of each criterion as well as the total score with chronological age. There was no significant difference between the right side and the left one for rib and clavicle. We found a significant correlation ($p < 10^{-3}$) between age and each criterion of the score. The correlation between the total score and chronological age was good (0.788) and improved using the score interval (0.791). We had a better correlation with real age for two criteria: the length of the ossified lower edge of the first rib (0.725) and the total volume of the first costal cartilage (0.707). The criteria least correlated with age are the lower cortical thickness of the clavicle and the volume of non-ossified cartilage of the first rib. The study of the reproducibility and the repeatability of all criteria was good and sometimes very good. We found that a score above 22 corresponds to an actual age greater than 18 years with a confidence interval of 95%. The established score estimated the age of a Tunisian male population with a good correlation. This is one of method that can be applied especially in living subjects.

Keywords: Forensic medicine; Anthropology; Identification; Age estimation; Tomography; Sternum; Clavicle; Rib; Ossification

P-04

Sexual dimorphism of the cranial base and the bony labyrinth: archaeo-anthropological and forensic implications

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Estimating the biological sex of an individual from its skeletal remains is a fundamental task of any anthropologist working in archaeological and forensic contexts and it must be done using reproducible, reliable, and validated methods. Nevertheless, when the optimal preservation of the remains is affected, availability and accuracy of such methods are compromised, even more for subadults or burnt remains. In that matter, a promising path for sex identification of fragmentary remains lies in relying on a highly dimorphic bony element that show taphonomic assets. Combining osteometry and new digital tools, this research contributes to this discussion by investigating the sexual dimorphism of the cranial base (i.e., occipital and temporal bones) and the bony labyrinth of the inner ear. The analysis was performed on 611 skulls and 121 bony labyrinths of Western-European individuals, subadults and adults, of known age and sex. It reveals how the sexual dimorphism of the temporal bone, especially around the mastoid process, is hugely marked as soon as the puberty sets off. It also shows that the dimorphism of the adult cranial base is visible and quantifiable in a virtual environment. Besides, this study demonstrates that an age-independent sex estimation method cannot be designed on the bony labyrinth due to postnatal significant changes. Thanks to this research, new sex predictive models adapted to human fragmentary remains have been established and validated, using a decision threshold of 0.70. The accuracy of sex estimation equations was found to be as follows: 13 models on the adult cranial base (77-87%), 3 models on the adult bony labyrinth (76-83%) and 4 on the subadult labyrinth (76-84%). Thus, this work provides new insights on cranial sexual dimorphism and discusses minimal standard requirements that are necessary for guaranteeing valuable future sexing methods.

Keywords: Bioarcheology; Forensic Anthropology; Sexual diagnosis; Morphometry; Surface scanner; Geometric morphometrics; Temporal bone; Occipital bone; Bony labyrinth

P-05

The study of microcracking pattern in fractured bones: is this a proper method for distinguishing between gunshot trauma and blunt force trauma?

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Timing and determining the type of trauma that has caused a fracture is one of the most challenging tasks of a forensic anthropologist. Because of that, many studies have been done in this field, however, most of them are based on macroscopic methods. Since now, the histological study was used as a complementary technique, but in the last years some researches have proven that the microscopic study of the microcracks (MCK) is a proper method to establish the differential diagnosis between peri and postmortem bone fractures and to determine the vitality of fresh bone fractures. However, all the investigations have been focused on timing but none on the type of trauma, so this study aims to determine if the MCK pattern differs in cases of gunshot trauma (GST) and blunt force trauma (BFT). To this purpose, we are histologically comparing the number, length, proportion, and structural distribution of MCK in a long bones sample with both types of fractures: GST bone sample including long bones from a mass grave of the Spanish Civil War and experimental fractures in fresh long bones of human donors. BFT bone sample is composed of long bones of real traumatic cases from forensic autopsies. We expect to find a different MCK pattern in both types of traumas as the weapon, implied area and the force and velocity of the shock are different, so the deformation of the bone may be different too. Our preliminary results show that the MCK pattern differs in both types of injuries. We generally have observed that in GST the proportion of MCK is lower and they used to be longer, we find them in the interstitial area following the cement line. So, the study of MCK pattern probably can be used as a tool to distinguish between both types of trauma.

Keywords: Blunt force trauma; Gunshot trauma; Microcracking pattern; Interstitial microcracks; Cement line; Bone histology; Perimortem trauma; Mass graves

P-06

Craniofacial form and masseter muscle anatomy in relation to sex: a radiographical and cadaveric study

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The masseter muscle, being the strongest masticatory muscle, elevates and protracts the mandible while exerting masticatory forces during eating. Unlike facial skeletal growth, the masseter anthropometry in the South African population has received less attention in research. Growth of the masseter as soft tissue is dependent on the growth of the related facial skeleton. This study aimed to document the morphometrical differences of the masseter in relation to facial morphology according to sex. Twenty embalmed adult cadavers were dissected bilaterally (n=40). In addition, fifty CT scans were analysed bilaterally (n=100). The masseter length and width were measured on cadavers in relation to facial height, bizygomatic width and bigonial width. The masseter width and thickness were measured on CT scans in relation to the widths of the hard palate and maxillary sinus, and bizygomatic and bicondylar widths. Three points of origin were observed: anterior, posterior and on the zygomaticotemporal suture. The common insertion point of the masseter was the body of the mandible (70%). Masseter width and thickness were greater on the left side (40.49±6.20 mm and 14.30±4.07 mm, respectively). Males possessed greater mean values for masseter thickness (15.34±2.99 mm), width (42.44±6.92 mm), and length (68.28±6.50 mm) than females. The overall study showed differences in the morphometry of the masseter muscle with respect to all population groups (Black, Indian and White). The thickness of the masseter muscle was greatly affected by facial skeletal morphometry. Knowledge of the morphology and morphometry of the masseter is useful in surgical procedures of the face and forensic facial reconstruction.

P-07

PMCT of charred bodies: A case series from Crete, Greece

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Post-mortem CT (PMCT) is a new trend in forensic investigation of death that has been proven to be extremely valuable in various cases such as traumatic deaths, heavily decomposed and charred bodies amongst others. Herein, we report four cases of fire-related deaths where the bodies were recovered beyond recognition in a charred state. In total 4 bodies with advanced thermal destruction were recovered from the archive of the Forensic Medicine Unit of the University of Crete since 2016, when PMCT was introduced in the forensic investigation of death. PMCT was done at a slice thickness of 0.625 using both soft tissue and bone windows. The inspection of CT images and 3d reconstructions of the bodies contributed to the detection of foreign bodies, the identification of the body, the differential diagnosis of ante- and post mortem injuries and the determination of cause of death prior to external examination and autopsy. While plain radiographs are efficient tools for the detection of foreign bodies, the application of PMCT opens new avenues in forensic investigations by providing both absolute and preliminary findings that contribute to the final resolution of a case. The examination of body parts in situ guides forensic experts during autopsy while at the same time preserves immortal evidence for a future trial. An additional advantage is that PMCT findings are diagnosed quickly thus giving the authorities quick leads when foul play is suspected. Our observations are in line with published studies that suggest the inclusion of PMCT in protocols set for the investigation of charred bodies.

Keywords: PMCT; Charred; Bodies; Thermal injuries; Identification; Forensic investigation

P-08

Identification and species diagnosis of fingernails fragments in a forensic context through Raman spectroscopy contribution

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In 2019, archaeo-forensic excavations were conducted at an agricultural structure in order to find a missing person. Sieving operations carried out in a pigsty brought to light the presence of 19 finds that were macroscopically similar to fingernails. In forensic contexts, the lack of adequate literature makes it difficult to distinguish taphonomically challenged fingernails and fingernails fragments from other types of organic and inorganics debris or human fingernails from non-human ones. This can be an important limitation for investigations. The aim of this study is to provide a modus operandi that can be reproduced in forensic scenarios similar in complexity. An experimental test was therefore conducted by analysing known human and pig nails, both fresh and buried for several months or years. Two specimens per type (human and pig, fresh and buried) for a total of eight samples were considered. The nails underwent macroscopic, microscopic, undecalcified histological and chemical analysis. Chemical investigations using RAMAN spectroscopy with SSE™ (Sequentially Shifted Excitation) technology proved to be the keystone in species diagnosis, successfully differentiating human from pig's samples, regardless of the different PMI of the findings. The 19 artefacts recovered in the forensic case were therefore preliminarily analysed macro- and microscopically. Then Raman spectroscopy and micro-FTIR in reflection analysis were carried out. In only one case the spectroscopy failed to obtain a meaningful spectrum due to the degraded state of the material. These non-destructive and cost-effective investigations not only excluded the possibility that the suspected fragments were fingernails but also guided the identification of the nature of 18 out of 19 samples and the selection of the 7 samples that were subsequently referred for histological and genetic further investigation. Most of the finds turned out to be pig bones, but genetic results were greatly limited by the contamination of the find site.

Keywords: Human nails; Pig hoof wall; Forensic identification; Spectroscopy; Raman; Species identification

P-09

Weaponised pens: a potential nightmare in forensic investigations

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Firearms and wound ballistics are often encountered in routine forensic practice in homicides, accidents and/or suicidal deaths especially in countries with loosen firearm legislation. When handcrafted firearms and missiles are used the reconstruction of the event may be hindered due to the lack of known/recorded characteristics. The current study presents two cases of gunshot-related deaths caused by "pen-guns". Archives of the Forensic Medicine Unit of the University Hospital of Crete for the years 1990-2022 were searched for cases that involved handmade firearms, specifically pen-guns. Photographs, sketches, reports and postmortem CT data were used to evaluate wound ballistics. A literature search was also performed using PubMed to discover similar cases. Two cases of adult males that had committed suicide with "pen-guns" were recorded. "Pen-guns" retrieved from the scene in both cases. The entrance wounds were located consistently on the right temporal areas and showed similar morphology compatible with contact range wounds. Wound trajectories were also similar, indicating a direction from front, right and upwards to back, left and downwards causing severe craniocerebral injuries. No exit wound was found in any of the cases. Postmortem CT scan revealed the presence of the missile inside the cranial cavity in one case. Pen-guns exhibit the same lethal potential as slow-loading short-barreled firearms, despite having a shorter range of fire. At the same time, their easy use and concealment, in addition to their simple mechanism and manufacturing, render them even more dangerous. Recording wound and bullet characteristics in handmade firearms can contribute in the broader understanding and interpretation of relevant scenes and ballistic injuries.

Keywords: Pen-guns; Firearms; Wound ballistics; Postmortem CT; Gunshot death; Handcrafted firearm

P-10

Time since death, skin color changes, and white bias?

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Forensic practitioners commonly use the Total Body Scoring (TBS) system developed by Megyesi et al. (2005) to estimate the postmortem interval (PMI); however, such studies rarely consider macroscopic variation in decomposition associated with skin color. Previous observations of human decomposition at the University of Tennessee, Knoxville (UTK) outdoor Anthropology Research Facility (ARF) have called into question the ability of the TBS method to accurately predict PMI for black, indigenous, and people of color (BIPOC) decedents, especially during the earlier stages of decomposition that are dominated by soft tissue color changes. Here, we present preliminary findings from an ongoing study aimed at better understanding variation in soft tissue color changes among BIPOC donors at the ARF and thus improving upon existing or create new PMI estimation methods that are more inclusive and representative of decedent populations within the medicolegal system in the U.S.A. The study has included intra- and interobserver error tests of White and BIPOC donor TBS scores based on photographs curated by the Forensic Anthropology Center at UTK, as well as case study analyses of nine BIPOC donors. In addition, this study has included a ten-day detailed analyses of decomposition changes in one donor at the ARF focusing on color changes, an experiential learning initiative conducted by a UTK undergraduate student (Brockett). This poster will present our ongoing study and findings as related to skin color changes and preliminary recommendations for TBS based methods to better estimate PMI amongst BIPOC decedents. It will also demonstrate the importance of incorporating perspectives from undergraduate trainees into methods development in Forensic Anthropology. Finally, the poster will present shortcomings in terms of sample size along with a discussion regarding the lack of BIPOC donors at taphonomic facilities including the ARF.

Keywords: Decomposition; Skin color changes; TBS; PMI; BIPOC decedents; Experiential learning

P-11

Postmortem interval estimation – Luminol and its influence by taphonomic factors

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The estimation of the postmortem interval (PMI) is one of the main challenges in forensic sciences, especially when human remains are skeletonized. Although several referenced methods exist for its estimation, none is sufficiently effective. One of the main reasons for the difficulty of this task is the influence of taphonomic factors. The study of the Luminol technique has emerged as a promising method for estimating PMI, as it is an economical, easy, and reproducible method that operates as a presumptive test. However, there is a lack of studies including the taphonomic factors that can influence the results obtained by this technique. Our work aims to test the influence of taphonomic factors on the estimation of the postmortem interval by the Luminol technique. The sample includes 30 clavicles from autopsies performed at the Portuguese National Institute of Legal Medicine and Forensic Sciences. It comprises adults of both sexes, aged between 25 and 86 years, without known pathologies, and with known and similar time since death. In order to test the influence of the taphonomic factors, the sample was distributed as equitably as possible among 6 containers and subjected to different decomposition conditions for a period of 12 months. After exhumation, the sample was processed and the technique was applied. Differences in the results were observed, revealing the influence of the studied taphonomic factors on decomposition. The clavicles decomposing in containers in a closed environment showed higher chemiluminescence intensity. The bones buried in sandy soils exhibited the most intense chemiluminescent reactions. Burned clavicles, as expected, did not show any chemiluminescence reaction. It is possible to conclude that the results obtained through the Luminol technique can be influenced by taphonomic factors such as temperature, humidity, or soil type. Therefore, the context in which a corpse is found should always be taken into consideration.

Keywords: Postmortem interval; Luminol; Taphonomy; Influencing factors

P-12

Using XRF devices to detect metallic residues from gunshot wounds in charred bone: a technical report

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The analysis of possible traces of injuries can be very difficult in cases of charred human remains, where the alteration and fragmentation are very high. The aim of this study is to explore the use of X-Ray Fluorescence (XRF) technique as a screening tool for detecting and analyzing any residues of gunshot residue (GSR) on cremated and highly fragmented materials, as it is a technique that allows for easy analysis timing and especially without altering the sample or necessarily requiring sample preparation. Nine adult bovine ribs were subjected to a shooting test using two types of projectiles, 9 mm full metal jacketed bullets and 9 mmunjacketed bullets. Four ribs retained soft tissue, while the other five were completely skeletonised. The ribs were then burnt in an electric furnace, reaching complete calcination at 800°C. The entry wound of each rib was analyzed using XRF, which revealed the presence of metal residues surrounding the wound under investigation. The XRF analysis showed that all samples, with the exception of one, contained Pb and/or Sb near the lesion. Furthermore, the samples hit by an unjacketed bullet had a more significant presence of Pb in yellow macroscopic areas, which persisted even when moving away from the point of impact. This was particularly evident in the skeletonised ribs hit by an unjacketed bullet. While these are preliminary results, they demonstrate the potential use of XRF devices in forensic pathology. Previous studies successfully used SEM-EDX and radiological experiments to investigate cremated bone. This study provides valuable insights into the use of XRF devices in the detection and analysis of GSR in charred materials. These findings could pave the way for the use of XRF technology in forensic pathology. Nevertheless, further research is necessary to determine the full capabilities of this method.

Keywords: Gunshot residues; X-Ray Fluorescence; Charred bones; Technical note; Cremation

P-13

Suicide by self-immolation : A case series from Crete, Greece

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Self-immolation is an uncommon mechanism of death that is rarely encountered in western countries, even though it appears to be more common in developing countries. The aim of this study is to present a case series of suicides by self-immolation that happened in the island of Greece, Crete between 1999 and 2022 and record the characteristics of the victims.

A retrospective search of suicidal fire deaths was performed on the case files of the Department of Forensic Sciences, University of Crete, and a psychological reconstruction of the victims' profile was attempted. Other relevant studies were identified by searching the electronic bibliographic databases, including PubMed.

In total 20 cases of self-immolation suicides were recorded between 1999 and 2022. In Crete, the prevalence is higher in males, contrary to western countries, where is higher in females. The suicide location is divided equally indoors and outdoors in agreement with data from Eastern countries. In this study, the mean age was 71 years old, while in other countries was 40-50. Alcohol or other substances were found in some victims, while others had psychiatric history. In Crete the victims were unemployed, however in other countries, were employed. In 20% of Cretan victims extensive burns were recorded as cause of death. Other common causes of death were CO inhalation, multiple organ failure, multiple traumas, and heart failure.

Suicide by self-immolation is overall rare in European societies; however, it appears to be more common in countries with different social and religious backgrounds. The profile of the Cretan victim falls in the elder male group and seems to associate more with psychiatric disorders rather than religious motives.

Keywords: Forensic autopsy; Suicide; Self-immolation; Suicidal fire deaths; Extensive burns

P-14

Exploring cortical histomorphometry along the length of the femur: a geometric morphometrics approach

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Shape analysis using geometric morphometrics (GM) has been applied to study morphological changes in a variety of biological structures including the human skeletal anatomy. Yet, research exploring cortical bone histomorphometry using GM is very limited. This study aims to explore secondary osteon shape variation along the length of the femur by applying a landmark-based GM method. Six adult human femora were included (mean age=80, three males and three females). Cross-sections were extracted from three representative anatomical locations from the femoral diaphysis (proximal, midshaft and distal). Four landmarks and 12 semi-landmarks were placed on a total of 864 intact secondary osteons in eight regions of interest (ROIs). Intra-observer error was tested using Procrustes ANOVA. Principal component analysis (PCA) and canonical variate analysis (CVA) were used to test for differences in osteonal shape variation between anatomical locations, within cross-sections, and between sexes. The effect of size on shape was also explored. Repeatability was achieved. Procrustes superimposition showed an average elliptical osteonal shape, with PC1 accounting for 31.28% of variation representing a more circular structure. Similarly, PC1 in the distal section suggested more circular osteons while PC1 in the proximal section showed a more elliptical shape. Inter-sectional variation in osteon shape was found between the proximal and the distal section. Moreover, within the proximal and the midshaft section differences were found between several ROIs. Sex differences in osteon shape were not found and regression analysis suggested no influence of osteon size on osteon shape. Although a larger sample is needed to confirm these preliminary results, the landmark-based GM approach offered interesting information on osteon shape variation along the femoral diaphysis. Osteon circularity is influenced by age and biomechanics, so the potential of GM for further understanding osteonal shape expands our knowledge on cortical microstructure in relation to age and loading.

Keywords: Geometric Morphometrics; Bone Histomorphometry; Osteons; Cortical Bone; Age; Biomechanics

P-15

Taphonomic indicators of former anatomical specimens recovered from forensic settings

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The term anatomical specimen is used to describe the human remains which are used by medical students for the study of human anatomy. In Greece, medical students have the statutory right to use unclaimed skeletons for their osteology classes which are donated to them from local cemeteries. After the completion of their purpose these skeletons are often discarded by the students, hence it is not uncommon for anatomical specimens to be discovered outside of their original context. This highlights the need to establish certain criteria, which will minimize the risk of false identification of their origin. A number of nine cases involving eighteen former anatomical specimens submitted at the Department of Forensic Medicine and Toxicology of National and Kapodistrian University of Athens for anthropological examination is presented. In all these cases, the remains were falsely thought by the investigative police authorities to be of forensic interest. The taphonomic alterations recorded during the examination of the remains have been sorted into the following categories: a) changes related to the inhumation of bones, b) to skeletal preparation, c) to display and use, and d) to curation. Apart from the taphonomic modifications present, the location, season and circumstances of recovery of the remains have also been recorded and the biological profile of the individuals has been assessed. The overall taphonomic patterns in conjunction with the biological profile and contextual information may facilitate the recognition of unknown human remains received at medicolegal offices as former anatomical specimens.

Keywords: Anatomical specimen; Taphonomy; Post-mortem modification; Cemetery remains; Cranium

P-16

Exploring the feasibility of using synchrotron X-ray fluorescence analysis (SXRF) to identify the neonatal line in human primary teeth

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The neonatal line (NNL) in tooth enamel and dentine is a well-known developmental marker that forms at birth and can provide important information about birth survival and chronological age at death. Traditionally, histological analysis has been used to identify the NNL, but this can be challenging in cases where teeth have undergone taphonomic alterations or present several stress lines. Recent studies have shown that (SXRF) can be used to identify the neonatal line by analyzing the distribution of zinc (Zn) and calcium (Ca) across the enamel and dentin layers in deciduous teeth. In this study, we aimed to validate the feasibility and effectiveness of using Zn and Ca analysis from SXRF to identify NNL in human primary teeth while attempting to locate other elements. We analyzed a deciduous lower central incisor from an infant with a known age at death of 62 days using both histological and element (SXRF) analysis. SXRF analysis has been carried out at the BL13-XALOC of ALBA Synchrotron. Our results show a substantial decrease in Ca and P concentration in the enamel NNL related to the postnatal hypocalcemic period and a considerable increase of Cu which may reflect the demand during fetal development and its importance for proper growth and development. We also observed a steady increase in Zn concentration across the NNL, providing further confirmation of its presence. Our study provides support for the potential of combining histological analysis with elemental SXRF to provide a more reliable and accurate way to identify the NNL. Further research is needed to fully establish the validity of this method, but our findings suggest that it is a promising tool for chronological age estimation in Forensic Anthropology.

Keywords: Neonatal line; Tooth histology; Synchrotron radiation; Elemental analysis; Age at death estimation

P-17

Identification of unknown skeletal remains through AM and PM computed tomography (CT) – case report

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In August 2021 partially skeletonized body of a male individual was found in the city of Nowy Sacz, Poland and sent to the Institute of Forensic Research (IES), Krakow in order to perform an anthropological examination and facial reconstruction. During primary forensic examination of the body, it was noted that the individual has ripped ECG electrodes attached to the torso. Skull, four cervical vertebrae, autopsy report, and CD with DICOM file from computed tomography of an unconscious patient (who had been admitted to hospital in the same city a few weeks earlier without any ID) were provided to IES. When patient regained consciousness, he escaped the hospital and has gone missing. The aim of the research was to answer whether the remains found a few weeks after disappearance of the man belong to him. Skeletal remains were macerated and then anthropological examination was performed. In order to obtain comparative data for analysis of CT scans, we did a PMCT of the skull at Diagnostic Imaging Department of the University Hospital in Krakow using Canon Aquilion Prime SP CT with slice thickness of 2 mm. AM and PM scans were compared focusing on shape of the frontal sinuses, the presence of rare anatomical variants and other individual features. The analysis revealed compatibility of the structures visible on both scans. No significant discrepancies were observed that could undermine the result of the comparison. Facial reconstruction was also performed in order to help restore identity of the deceased man. Post-mortem imaging is an important identification and comparative tool when antemortem reference material is available. Furthermore, a positive result of the comparative analysis allows to reduce the number of expensive and time-consuming DNA analysis, becoming an effective typing tool.

Keywords: Human identification; Forensic Anthropology; Forensic radiology; Computed tomography; Antemortem CT; Postmortem CT

P-18

Analysing commingled remains: two case-studies from the guatemalan internal armed conflict

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The analysis of commingled remains is to these days one of the most challenging aspects of the work of forensic anthropologists. DVI contexts require greater efforts in terms of logistics and time required. Despite the advances in DNA analysis, various are the circumstances in which sampling every evidence recovered would not be possible for both practical and economical reasons. It is in these instances that the ability of the forensic anthropologist to associate osteologically the different skeletal elements can be a key aspect in obtaining positive identifications. PurposeThe present project aims to describe the analysis of commingled remains in a Guatemalan sample, by presenting two unpublished cases performed by the authors with the goal of setting standards of analysis to be applied in different countries. Case Study 1Communal burial from which 22 skulls, 22 mandible and 22 femurs have been recovered. All identified as male, within a similar age range. Reassociation by metric analysis, evaluation of taphonomy, pathological evidence and articulation has allowed the analyst to attribute a MNI of 22. Which has been confirmed genetically. Case Study 2Construction site where skeletal elements have been found by accident. Through anthropological analysis, based on metric methods, articulation of the joints and pathological/taphonomical analysis, two almost intact skeletons have been reconstructed and each assigned a biological profile.ConclusionThese case studies suggest that a combination of osteological and genetical analysis can be considered the best multidisciplinary approach in the presence of commingled remains. This type of approach could be expanded in order to create a series of protocols to guide the anthropologists in the different contexts of DVI investigations. This protocol is highly case dependent, thus the importance of sharing as many example as possible internationally so that a database can be created with case references to guide in the process.

Keywords: Commingled remains; Guatemalan; Armed conflicts; Articulation; Characteristics for separation; Osteology; Bone pairing

P-19

**Morphometric sex estimation from pelvic CT scans:
Comparison of Diagnose Sexuelle Probabiliste 2
(DSP2) and Franklin et al. (2014) methods in an
Australian population**

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Sex estimation is one of the key components of the biological profile which is assessed by a forensic anthropologist and used to help assist with identification. The pelvis is considered to be the most accurate skeletal element for sex estimation due to the sexually dimorphic characteristics observed as a result of functional differences. Typically, metric methods for sex estimation using the os coxae are population specific. However, the DSP2 method is based on a global reference sample and therefore claims validity across different populations. The aim of this study is to compare the validity of the DSP2, which does not include an Australian subsample, and Franklin et al. (2014) method, which is based on an Australian reference sample in a contemporary Australian population using computed tomography (CT) scans. The sample consists of 120 pelvic CT scans from three Australian States/Territories from 60 males and 60 females aged 30-49 years. The CT scans were deidentified upon collections and the necessary ethical approval has been granted for this study. The results of this study will provide forensic anthropologists with statistical information regarding method accuracy needed for decision-making around the appropriate method selection and use of metric reference data when assessing sex in Australian human remains.

Keywords: Forensic Anthropology; Sex; Metrics; Pelvis; Computed tomography

P-20

Using X-ray fluorescence analysis to evaluate the composition of dental prostheses: a case study

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When dealing with human skeletal remains a thorough awareness of details is paramount, which can only be achieved when a multidisciplinary approach is employed. In human identification, the wide range of medical devices deserves in-depth consideration given the amount of fundamental information they can provide. However, there are still certain groups of equipment on which their full potential is not explored, for example, the use of dental prostheses in the identification process has been hampered by a lack of sufficient study on the topic. In this work, after a misclassification of a dental prosthesis with corrosion marks found in a CEI/XXI 53 years-old male, the use of X-ray fluorescence for elemental analysis was explored in an attempt to correctly describe the device. Results were indicative of a copper-aluminium alloy, presenting similar elemental concentrations to those measured in similar devices. Although this kind of alloy has been utilized as a replacement for traditional gold alloys since the 1980s, it is not usually seen in Portuguese dental practice. This corroborates the individual's biographic information available and justifies the corrosion observed on the device. It was recognized that due to its speed, non-destructiveness, and simple interpretation, this method is very interesting for forensic investigation, and can lead to a more precise analysis of human remains aiding in the reconstruction of geographic and chronological context.

Keywords: Human identification; Chemical analysis; Oral prosthesis; Forensic Anthropology

P-21

Application of 3D-3D superimposition and distance analysis on commingled scapulae: an additional tool for pair-matching

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Resolution of commingled assemblages is a demanding task for forensic anthropologists, yet an essential procedure for the elaboration of accurate biological profiles. Three-dimensional (3D) techniques have brought about novel approaches for the pair-matching of bilateral commingled bones. This study applies 3D-3D superimposition and distance analysis to the pair-matching of commingled scapulae. 20 well-preserved scapulae were selected from 10 adult skeletons, and the respective 3D bone models were acquired with a handheld scanner (Artec Space Spider, Artec 3D, Luxembourg). Each left scapula model was mirrored and superimposed on matching (contralateral element from the same individual) and mismatching right scapulae (contralateral elements from different individuals), using the VECTRA Analysis Module (VAM) software. The point-to-point distance (in millimetres) was automatically calculated through VAM and the Root Mean Square (RMS) distance value was used as proxy to evaluate the sensitivity and specificity of the 3D pair-matching. Statistical differences between RMS distance values were evaluated with a Mann-Whitney test ($p < 0.05$). RMS of matches are significantly lower than those of mismatches ($p < 0.01$). The threshold of 1.32 mm allows to distinguish all true matches (RMS equal or under the threshold) from true mismatches (RMS above threshold), so that the test is 100% sensitive and 100% specific. This study provided novel data on the valuable potential of 3D-3D superimposition and distance analysis for the pair-matching of scapulae. Further research will consider increasing the sample, investigating the performance according to different taphonomic conditions, and eventually assessing the applicability to real cases.

Keywords: Commingled remains; 3D models; Virtual anthropology; Pair-matching analysis

P-22

Contribution of post-mortem radiography to odontological identification through clinical cases

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The progress of post-mortem radiographic technologies allows the expert to make ante-mortem radiography speak in an amplified way. Indeed, the principle of comparative identification presupposes a comparison of ante-mortem and post-mortem elements for which the evolution of radiographic technologies constitutes a plus in the identification and analysis of comparative indices.

This study would like to try to show it through 3 clinical cases. The object is to confirm that the expert's use of post-mortem radiography plays a determining and often decisive, role in the success of the mission.

Keywords: Identification; Odontology; Prosthetic; Comparative; Expert

P-23

Restoration of a fragmented cranium: a preliminary case study of 3D digital tools

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New digital technologies have had a great impact on the work of forensic experts. Especially in the more recent years, new tools and software programs have been valuable allies to scientists and professional figures, helping in the acquisition and analysis of materials. Among these tools, 3D technologies have shown interesting outcomes and they are being investigated and eventually used in multiple and different fields and applications. Laser scanners are among these promising tools. In forensic cases, anthropologists may need to restore a specimen in order to study the osteological human remains, which might have been recovered completely or partially fragmented. Usually the tools used to complete the task are traditional, such as glue and tape. However, these traditional means present some limits, for example they could cause some damage to the bone. In this case study, the Artec 3D Spider Scanner, that allows to scan an object and produce an accurate textured 3D mesh, and Artec Studio Professional Software were used to acquire the scan of a skull that was recovered fragmented. This preliminary study investigates the results of two different restoring and scanning processes of the same skull. Firstly, the cranium and mandible were manually assembled. They were then scanned and a 3D mesh was obtained. Then, the specimen was again disassembled and the fragments were individually scanned using the same tools. The single 3D meshes were then digitally assembled, in order to obtain the complete skull again. Lastly, an analysis of the morphology of the skull from the final 3D meshes was carried out, with the aim to assess the differences in the two final 3D volumes and more deeply understand how these technologies can impact, and possibly help, the work of forensic anthropologists. Digital restoration can bypass physical limits of stability, shorten the process and allow simultaneous observation of both inside and outside details avoiding laborious disconnections.

Keywords: Forensic Anthropology; 3D laser scanner; Skull restoration; Cranial morphology; Digital technologies

P-24

The Fast human bone degradation in the Azores: The case Terceira island cemeteries

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The Azores islands constitute an Atlantic Portuguese archipelago of 9 volcanic islands, each with its specific natural features and geological ages. The Portuguese settled these islands in the early 1400's, following a rich but turbulent history, mostly due to its intrinsic geostrategic importance. However, little is known about Azorean human remains or the factors influencing their conservation. Only few previous archeological interventions, mostly in old religious buildings scattered through different islands, mention human remains in various states of conservation. Nevertheless, no further investigations were conducted on this subject. Here we attempt a first systematic record of human bone conservation for one of the Azores islands, the Terceira island. Therefore, we evaluated 67 primary burials from 7 different local cemeteries. Bone conservation was recorded using Dutour's (1989) Anatomical Conservation Index (ACI). Post mortem interval (PMI), sex, age at death, grave and coffin type, burial depth, soil pH, humidity and organic matter content were also analyzed. The ACI varied between poor (almost no bones preserved) and excellent (almost complete skeleton). Excellent ACI was only observed in the first 20 years, followed by rapid conservation decline afterwards. We observed a strong Pearson correlation between ACI and PMI ($r=-0,817$), a moderate correlation with soil pH ($r=0,51$) and mild with age at death ($r=-0,3$). Differences between cemeteries and grave types ($p<0,01$) were also observed. Unexpectedly, no correlations or differences were found between the ACI and sex, soil organic matter, humidity and burial depth. A predominant neutral soil (pH mean = 6,6) was also unexpected since other authors identified Terceira soils as acidic. Secondary burials might be contributing to grave soil neutralization through diagenesis. Although we found correlations and differences between ACI and some environmental variables, further investigation is needed in order to understand the multitude of factors influencing the fast bone degradation in Terceira cemeteries.

Keywords: Bone preservation; Taphonomy; Post mortem interval; Volcanic island; Soil features

P-25

Metric accuracy of different types of human bones comparing 3D structured light scans and physical specimens

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Documentation is an integral part of a forensic anthropologist's role to ensure permanent recording of the original condition of skeletal remains in case of future alteration, damage, or archiving. Surface scanning has been recognised as a beneficial documentation technique because it can rapidly image the complete surface of an object. Resulting 3D models facilitate continued analysis, research, and data sharing without risk of damage to the original bone. As the application of surface scans in Forensic Anthropology is relatively novel, there is a need to statistically quantify its accuracy, i.e., how well the models reflect the true dimensions of the skeletal element they were derived from. Similar studies have so far focused exclusively on human skulls. However, any skeletal element can become evidence in a forensic investigation. Therefore, this study aims to quantify the concordance of linear measurements from ten different skeletal elements, including the cranium, mandible, second cervical vertebra, clavicle, scapula, capitate, 2nd metacarpal, os coxae, femoral head, and patella, with measurements taken on corresponding surface scanned virtual models, and assess the magnitude of differences (if any) according to the type of bone. Traditional linear measurements according to Martin and Saller (1957), Susman (1979), Martin and Knussmann (1988), Buikstra and Ubelaker (1994), and Wescott (2000) are taken on skeletal specimens and virtual models. Each bone is defined by at least three measurements. An open-access software CloudCompare is used to visualize and measure the virtual models of the surface scans. The results of this study will identify error rates, which is one of the provisions of evidence admissibility in court.

Keywords: Forensic Anthropology; Surface scanning; Human remains; Metrics; Imaging

P-26

Important findings related to the decomposition pattern and rate of small-sized pig cadavers in the Netherlands

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On average three times a year, the remains of babies are found in the Netherlands, making knowledge on the decomposition pattern and rate of small sized-remains important in order to be able to estimate the Post-Mortem Interval (PMI). Scoring models and PMI formulas for decomposition are based on the remains of adults and there is limited literature on small-sized human remains. Since estimating the time since death from decomposition stages is one of the, in the literature, proposed methods used by a forensic physician, gaining knowledge on the decomposition pattern and rate of children's bodies is important. This is also important as this may deviates from the pattern and rate of adults. Method To investigate this, a decomposition study was conducted with small pig cadavers as a proxy. The main findings of the study were compared with the international literature to determine the similarities and discrepancies with decomposition studies in other contexts and whether the findings are specific to small cadavers or the Dutch context. Results The results showed that there were findings, regarding the decomposition pattern and rate of small cadavers, specific for the Dutch context as well as for small cadavers. This is related to the variables weight, temperature, season, rainfall and entomology. Furthermore, the findings had an effect on the decomposition pattern and resulted in a higher or lower decomposition rate. Conclusion When estimating the PMI, these results must therefore be considered in order to avoid under- or overestimation of the PMI. Follow-up research into the decomposition pattern and rate of small cadavers is recommended to gain more knowledge and insights and to ultimately be able to apply this in forensic practice and subsequently in the judicial system.

Keywords: Forensic taphonomy; Seasonal decomposition; Small-sized piglets; Post-mortem interval; Subaerial decomposition; The Netherlands

P-27

When small details are crucial to unraveling Forensic Anthropology cases

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Tiny details can make a difference when dealing with cases without any suspicion of identity. This presentation aims to highlight the importance of the holistic approach in Forensic Anthropology cases where everything matters from the very beginning of the case. We discuss two cases that were unraveled by circumstantial data. In the first case, a skeletonized body was found in a bushy area after a fire. The skeleton was little affected by the fire and kept the clothes and personal belongings, namely a gold necklace. That belonging made the media disseminate that a female body was detected in the aftermath of a fire. While carefully undressing the body during the Forensic Anthropology expertise, some euros from 2002 were found inside the pockets highly oxidized. As the body was found in a small town, when asking about missing persons from about 20 years ago, a man went mysteriously missing 16 years ago with, purportedly, all the keys of the building where he worked as a doorman. A keychain with multiple keys was also recovered inside another pocket. That said, we contacted the victim's next of kin. One of the relatives remembered the gold necklace. In the meantime, the Forensic Anthropology exam determined the biological profile of the victim as well as some identification factors, such as advanced osteoarthritis. All the features matched the missing person in question, a man older than 65 y. A genetic analysis was performed, and the victim, missing for 16 years, was identified. In the second case, a body was recovered in a bushy park in a big town. Again, inside his pockets, some "escudos", the money in use before the euro, were found, creating the suspicion that the case was older than 22 years old. With that time since death estimation, a missing person with the same biological profile as the victim was found. In this case, one of the relatives never gave up on his next of kin, and once more, the genetic analysis confirmed the ID.

Keywords: Study Case; Identification; Biological profile; Circumstantial data; Forensic Anthropology

P-28

Evaluation of early vital changes and responses on non-decalcified fractured human bone

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When a bone is broken, the healing processes are set in motion almost instantaneously. Knowledge of these phenomena may allow optimization of forensic diagnostics in the correct assessment of fractures. To date, the analysis of decalcified bone has been used almost exclusively, but the analysis of non-decalcified bone has proven to be a useful and high-performance technique, especially in archaeology. Therefore, a study was conducted to evaluate the changes and early vital responses (within 24 hours) that occur in bone tissue at the fracture site. In addition, bone was analyzed without decalcification to determine if such an approach is feasible in forensic science. Four samples of human ribs with pre-mortem fractures and different survival times (between 0 and 22 hours) and a negative control were examined. Histological sections of non-decalcified bone tissue were colored with toluidine blue and pyronine yellow staining. From a methodological point of view, the technique used was effective in obtaining high-quality specimens. In all study samples, the fracture extremities appeared non-linear, ragged, irregular, and characterized by a distinct staining along the entire fracture edge, in contrast to what was observed in the control specimen. In particular, this staining allowed the detection of traces of blood extravasated at the time of trauma and of blood clots. Another peculiarity was the presence of spindle cells in the sample after 22 hours of survival, embedded in a filiform tissue and with a structure different from bone trabeculae. Observation under polarized light confirmed that it was newly deposited reparative tissue. This evidence may prove to be an important finding that would preempt the phase of tissue redeposition noted in previous studies. Overall, these preliminary results add to the evidence of changes at the site of a fracture and underscore the importance of further investigation to detect the earliest signs of a vital response in bone.

Keywords: Bone fracture; Early changes; Non-decalcified bone; Histological analysis; Forensics

P-29

Tracking of the relationship between the asymmetry of skull and the surface of head for skull-based facial reconstructions

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Asymmetry of the human head can act as a marker of phenotypic, genetic quality and attractiveness, therefore, highlighting its relevance in clinical, forensic and sociocultural fields. The main aims of the study were to (1) track asymmetry on the entire soft and hard tissue surfaces of human heads with respect to sexual dimorphism, (2) evaluate the difference in asymmetry between these tissues. Head and skull surfaces segmented out from transverse head CT images of a healthy adult Czech population, age ranging from 21-84 years (50 men and 48 women divided into three age groups: up to 39 years, 40-59 years and > 60 years) were evaluated using geometric morphometric methods (CPD -DCA, asymmetry analysis, super-projection). Results were visualized using color-coded maps showing asymmetry and statistical significance.

Neurocranial asymmetry showed highly significant right protrusion of forehead, in both sexes of all age groups. This was accompanied by significant occipitoparietal flattening on the ipsilateral side, which is same for both the surfaces. In contrast to the neurocranium, the same trend of asymmetry between soft and hard tissues was observed in the upper third of the face, favouring the right side. The rest of the soft-tissue and hard-tissue surfaces were protrusive on the left and the contralateral sides, respectively. Sexual dimorphism of facial asymmetry was very low and mostly statistically insignificant. Normally, in smaller soft-tissue depth areas, asymmetry of both surfaces is consistent, and laterality corresponds to each other. However, in areas with greater soft -tissue depth (buccal and mandibular area), the asymmetry of both surfaces is inconsistent. From the obtained results it is likely to accept the possible existence of a compensatory mechanism, where soft tissues try to balance the asymmetry of the bone surfaces by having the area more or less prominent and vice-versa. Supported by the project GACR 23-06822S.

Keywords: Asymmetry; Soft tissues; Hard tissues; Geometric- morphometrics; Computed tomography; Polygonal-mesh analysis

P-30

Bones on fire : differences in FTIR-ATR analysis on human and animal burnt remains in controlled and non-controlled experiments

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FTIR-ATR analysis on burnt bones has been used to estimate at which temperature they were subjected to, by accessing the organic and inorganic components. Heat-altered human remains are found in forensic contexts and present challenges to the anthropological analysis, so it is important to accurately identify heat events. Most studies have been done under controlled experiments in muffles with animal bones. Although they are paramount as reference work, it is important to understand how extrapolable to non-controlled burn events they are. Four non-controlled experiments were conducted, each consisting the burning of six human ribs from four unidentified skeletons and four fresh and dried animal ribs from cow, goat, sheep, and pig with natural fuel (pine needles, straw, weeds). The burn temperature/duration, and the loss of fuel mass were recorded. Muffle experiments at 500°, 600°, 700°, and 800 °C were performed as control utilizing 12 human bones and 32 dried animal bones. FTIR-ATR analyses were performed on bone powder, previously and after burning. Bones burnt on the same non-controlled experiment were affected in different ways, but more similarities were presented by those closest to each other. Spectral data showed good correlation with temperature (200-850 °C). Fresh bones presented more macroscopic changes and cow bones were less vulnerable to the burning dynamic, both macroscopically and chemiometrically. Sheep and goat spectra were very similar. Each type of experiment presented very diverse burn dynamics. Control spectra of bones burned at the same temperature were quite similar. The spectra of pig bones were more similar to human bones in both controlled and non-controlled experiments. The two experimental conditions resulted in similar spectral data regarding the maximum temperature record. FTIR-ATR is a capable technique to analyse burned bones but must be considered potential species differences in burn effect and different temperatures on the same burn event.

Keywords: Forensic Anthropology; Heat-changed human remains; Animal bones; Vibrational spectroscopy; Burning temperature

P-31

Sorting successive thoracic vertebrae in commingled contexts: a geometric morphometrics approach

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Commingling refers to intermixed skeletal material derived from different contexts. Until recently, sorting methods were focused on optical similarities or metric reassociation. Nevertheless, a novel method for reassociation based on geometric morphometrics shape analysis has shown promising results. Given that an approach that utilizes new methods of sorting designed for 3D models would minimize the human factor error and reach more reliable and reproducible results. Two of the typical thoracic vertebrae (T4-T5), which was the most frequent pair in the sample from sixty-five individuals were scanned by using a structured-light 3D scanner. The sample derived from three skeletal collections of different geo-chronological contexts. Namely, the skeletal material was obtained from modern collections from the Universities of Athens and Crete and from an archaeological assemblage of the Democritus University, Greece. Fourteen landmarks were placed on the rim of the body and the articular facets of the thoracic vertebrae. The landmarks' raw coordinates were transformed into Procrustes coordinates for removing the factor of size. The adjoining skeletal elements (T4 and T5) that resembled the most based on their shape were the ones that presented the smallest Procrustes distance across the sample and therefore it was expected to belong to the same individual. The results showed that in 66.2% of the cases the correct match was found between the three first skeletal elements. It is recommended that the method be used in rejecting an approximate 70% of the possible matches based on shape differences and to reevaluate the remaining 30%. A further investigation on more of the typical vertebrae with more landmarks and/or semi-landmarks could possibly improve the results. This approach adds valuable information to the existing sorting methods through the ability of the method to retrieve and evaluate shape information for each skeletal element of the sample.

Keywords: Forensic Anthropology; Commingled remains; Sorting; Geometric morphometrics

Oral Communication Code and Page number

WE-01.....	20	TH-05.....	18
WE-02.....	38	TH-06.....	43
WE-03.....	19	TH-07.....	17
WE-04.....	30	TH-08.....	35
WE-05.....	41	TH-09.....	16
WE-06.....	13	TH-10.....	24
WE-07.....	32	TH-11.....	44
WE-08.....	21	TH-12.....	33
WE-09.....	46	FR-01.....	47
WE-10.....	45	FR-02.....	48
WE-11.....	34	FR-03.....	14
WE-12.....	22	FR-04.....	28
WE-13.....	36	FR-05.....	23
WE-14.....	15	FR-06.....	25
TH-01.....	42	FR-07.....	29
TH-02.....	31	FR-08.....	40
TH-03.....	39	FR-09.....	26
TH-04.....	37	FR-10.....	27

Posters start on page 50