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Forensic age assessment of unaccompanied minor refugees in Germany under aspects of social law

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Background. The use of imaging techniques in forensic age estimation in the field of social law is regarded as controversial. Nevertheless, due to special legal requirements, it has been possible to use radiological procedures for those purposes and to show their significance on a large number of cases.
Material and methods. In the period of 2012 to 2016, a total of 151 (m = 144, f = 7) age estimations, mainly commissioned by the youth welfare office, were analysed (target figure: 18 years). The assessment was carried out according to the recommendations of the Study Group on Forensic Age Diagnostics and following the guidelines of the Administrative Court Göttingen, including physical examination, dental evaluation, X-rays of the left hand and the denture as well as a CT-scan of the sternoclavicular joints. In addition to the epidemiological data the results of the different partial methods were also evaluated.
Results. The majority of the examined unaccompanied minor refugees came from Afghanistan (60.3%) and Eritrea (29.8%). The self-reported average age was 16.7 years (min: 12.4, max: 17.7). In 62.3% ($n = 94$) the estimated minimum age and in 82.8% ($n = 125$) the probable age resulted in ≥ 18 years. In only 21.9% ($n = 33$) the stated age matched the age estimation. In two of these cases the diagnostics even showed a probably smaller age than the stated one.
Regarding the physical examination, 90.1% ($n = 136$) displayed a completed sexual maturity. No developmental disorders were detected. An odontological examination could be used in 84.8% ($n = 128$) of the cases. An X-ray examination of the left hand showed a completed ossification in 68.9% ($n = 104$). In these cases, a CT-scan of the sternoclavicular joints allowed a purposeful age estimate.
Discussion and conclusions. The data shows a strong discrepancy between self-reported age and age determination. The age limit of 18 years, which is decisive in German social law, could, however, sometimes only be validated by using radiological methods. Here, the analysis of the sternoclavicular joints showed the highest validity.
Radiological methods are meaningful in social law for proving a minimum age of 18 years with sufficient certainty.

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Osteometric sex estimation on the femur of Austrians and other Europeans

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Background. Osteometric sex estimation on the femur provides a basic but quick approach in the identification process of unknown bodies. This study compares already published femoral dimensions of Europeans with additional data from Austrians born in the 19th to the middle of the 20th century. Three main determinants were investigated: i) comparison of sexual dimorphism in Europa; ii) distance in femoral dimensions of Austrian males and females and iii) development of discriminant functions for sex estimation of the Austrians.
Material and methods. Nine dimensions on the femora of 72 female and 55 male adults from Austria were measured. The relative distances between the weighted means of both sexes, as measure for the sexual dimorphism, were calculated and compared to the corresponding data extracted from 14 previous studies on European populations. For the Austrian sample the discriminating power of sex estimation functions developed by multivariate (cross-validated) discriminant analysis for the femur measurements were evaluated.
Results. Following relative distances in the Austrian sample were found, European ranges are given in brackets: Maximum length [ML] 8.3% (5.8–11.1), head circumference 10.5% (10.5–12.7), vertical head diameter [VHD] 11.5% (10.7–13.6), transverse head diameter 10.9% (10.9–14.2), maximum head diameter [MHD] 11.1% (11.1–16.3), condylar width 10.1% (8.6–22.6) as well as sagittal 7.4% (7.4–14.0), transverse 6.5% (4.9–10.5) and maximum midshaft diameter [MMD] 5.7% (5.7–10.1). With regard to a multivariate analysis, a stepwise selection procedure favored a combination of maximum length and vertical head diameter ($F1 = 0.076 \times ML + 1.05 \times VHD - 79.23$) with 90.1% being correctly classified. A combination of maximum length, maximum head diameter and maximum midshaft diameter ($F2 = 0.069 \times ML + 1.05 \times MHD + 0.215 \times MMD - 82.27$) resulted in a cross-validated classification rate of 91.5%.
Discussion and conclusions. Comparative analysis of the European data sets revealed for the Austrian femora an average sexual dimorphism in the length of the femora and relatively low sexual dimorphism in all other femur dimensions. Nevertheless, using multivariate discrimination functions (F1 & F2), correct sex classification rates comparable with rates reported for other European populations could be achieved.

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Morphological characteristics of the lower extremity long bones in forensic-medical practice

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Background. Contemporary researchers prove that mechanical safety factor of these bones is rather high. Such parameters of morphological characteristics of the bones as circumference, thickness of the compact osseous substance, size of the medullary canal play an important role in the formation of firmness and stability to the influence of mechanical environmental factors. Therefore contemporary forensic practice requires evaluation of the influence of long bones macroarchitecture on the mechanics of their destruction in case of blunt injuries, which finally might enhance validity and evidence of expert's reports.
Material and methods. Objective of the study: to obtain new scientific knowledge concerning macroarchitectural characteristics of the major portions of long bones of the lower limbs, detection of their influence on the regularities of destructive processes of bones in case of blunt injuries. The material for the study was 128 long bones of the lower limbs removed from male and female bio mannequins aged from 18 to 65 while conducting forensic expertise. The thickness of the compact osseous substance and the size of the medullary canal were measured by means of calipers. Interrelations between the major morphological components of macroarchitecture of the main portions of long bones in the lower limbs were detected by means of frequency analysis.
Morphological parameters obtained for every sample of a tubular bone possessed topographical characteristics along the whole length of the femoral bones, tibias and fibulas in their proximal, distal and middle thirds, and at the same time along the whole circumference – anterior, posterior, medial and lateral sectors.
Results. Comparison of circumference parameters of certain portions of the lower limb bones has found that the largest values were characteristic for the circumference of the lower third of the femoral bone and upper third of the tibia.
The analysis of the bones in a vertical position has found that along the anterior surface the bone is thickest in the middle portion of the tibia. It possesses a reliable difference ($p < 0.05$) with tibia diaphysis. At the same time the whole bone demonstrates a large thickness along this surface as compared to the femoral bone and fibula ($p < 0.05$), performing protective function for the vascular-nerve bundle. The thickness of the femoral bone

does not differ much in different portions, but it is reliably thicker as compared to the fibula ($p < 0.05$).
The shear section of the medullar canal (in cm^2) performed by the yellow bone marrow in the group of individuals examined possessed somewhat different spatial characteristics with the largest sizes in the well vascularized area of the knee joint.
Discussion and conclusions. Different portions of the lower limb long bones possess considerable amount of the structural-functional characteristics. The sizes of the medullar canal (in the form of medullar parameter) and its square influence on the formation of fracture the most considerably among morphological characteristics.

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Feasibility of height estimation using skull bone thickness as measured by computed tomography and image density values

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Background. Our laboratory has been using computed tomography (CT) data taken at autopsy to obtain bone morphology and image density values of various parts of the body and applying them to determine measurements such as height and weight. In this study, we investigated whether skull bone thickness and CT values can be used for height estimation.
Material and methods. We excluded patients with head trauma or advanced decomposition and included 100 patients [50 men and 50 women, age: 20–92 (median, 53) years, height: 134–179 (median, 160) cm]. After CT imaging, the skull bone was three-dimensionally reconstructed, and skull bone thickness was continuously measured at multiple points at the pixel level. When sagittal sections were used for confirmation, the thickest and thinnest parts were found to be commonly located in the occipital and parietal bones, respectively. Therefore, (a) the thickness of the occipital bone on an extension of the line from the frontonasal suture to the dorsal region of the sella turcica and (b) the thickness of the parietal bone on a vertical extension of the line from the frontonasal suture to the dorsal region of the sella turcica were measured and analyzed to test for a correlation with height. In addition, CT values at locations corresponding to (a) and (b) were measured.
Results. The thickest part of (a) measured 10.6–26.1 (median, 17.0) mm and was located at the occipital protuberance in all patients studied. The thickest part of (a) exhibited a moderate correlation with height in men ($r = 0.44$, $p < 0.01$) and no correlation in women. Meanwhile, the thinnest part was identified in (b) in 76 of the 100 patients examined and measured 3.4–9.9 (median, 6.9) mm and showed no correlation with height regardless of gender. CT values were (a) 442–1005 (median, 745) HU and (b) 552–1056 (median, 861) HU. While no correlation was noted between CT values and height in males, a moderate correlation was found in (b) in females ($r = 0.52$, $p < 0.001$).
Discussion and conclusions. These results suggest that height can be estimated based on skull bone thickness and CT values.

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Forensic aspects of an inca child mummy

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Background. We examined an Inca bundle using computed tomography (CT). The bundle belongs to the Museum of Cultures in Basel, Switzerland. Radiocarbon dating of the superficial textile yielded a calibrated age between 1480 and 1650 AD. The primary aim was to determine the preservation status of bony and soft tissues, sex and age at the time of death, possible indicators for disease or even the cause of death, as well as the kind of mummification. A secondary aim was to obtain a brief overview of the wrapping in order to gain additional information on the cultural background.
Material and methods. The mummy was investigated using multi-slice CT with slice thickness of 0.75 mm and 110 kilovolt.
Results. Inside the bundle the CT images revealed an intact and very carefully performed inner wrapping of a male child mummy with superior bony and soft tissue preservation. Based on bones and teeth the age was estimated of about 8 years. From a forensic point of view we found some evidence of perimortem violence. Most remarkable was a penetrating sharp force injury to the chest and the abdominal wall. The incision cuts parasternal on the right side in a straight line through the cartilage of the second to sixth rib and led directly into a large defect of the anterior abdominal wall. The fragmented liver erupted through the defect and some parts of the heart are missing. Furthermore, CT revealed signs of some pathological alterations.
Discussion and conclusions. Child sacrifice has been documented recently in the Andes of Peru. Another hypothesis to explain the death of this child, particularly the unusual, violent extraction of the liver could be organ divination. Divination, or the foreseeing of future outcomes, was practiced in the Inca culture by shamans after a ritual killing of animals. The careful wrapping of the mummy pointed to a ceremonial burial. Within the cultural background, hypothesis on the reason of this violence remained unclear and included war, battle, murder, accident, and even human sacrifice. CT examination of the Inca bundle proved to be an important non-destructive examination method. To clarify the new questions the investigation of this mummy will be continued after the end of the actual exhibition at the Natural History Museum of Basel.

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Ethics of forensic autopsy as seen by a psychiatrist. An account of Albert Moll, 1902

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Background. The German psychiatrist Albert Moll (1862–1939) was together with Iwan Bloch and Magnus Hirschfeld, one the founders of modern sexology. Moll was a strong critic of mysticism, occultism and spiritualism and offered naturalistic psychological explanations for paranormal phenomena. Moll wrote an account of the history of hypnotism in 1889, in collaboration with Auguste Forel and Max Dessoir. In 1902, he published a comprehensive book on medical ethics: *Ärztliche Ethik. Die Pflichten des Arztes in allen Beziehungen seiner Thätigkeit.*
Material and methods. The purpose of this presentation is to analyze the way, Moll is summarizing the relevant ethical and forensic standards of medico-legal practice by the end of 19th century.