INTERNATIONAL SCIENTIFIC CONFERENCE

"ARCHIBALD REISS DAYS"

Belgrade, 2-3 October 2018

THEMATIC CONFERENCE PROCEEDINGS OF INTERNATIONAL SIGNIFICANCE

VOLUME II

Academy of Criminalistic and Police Studies
Belgrade, 2018

Publisher
ACADEMY OF CRIMINALISTIC AND POLICE STUDIES
Belgrade, 196 Cara Dušana Street (Zemun)

Computer Design
JOVAN PAVLOVIĆ
DRAGOLJUB MILUTINOVIĆ

Impression
200 copies

Print
Službeni glasnik, Belgrade

THE CONFERENCE AND THE PUBLISHING OF PROCEEDINGS WERE SUPPORTED BY THE MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGICAL DEVELOPMENT OF THE REPUBLIC OF SERBIA

ISBN 978-86-7020-405-8
ISBN 978-86-7020-190-3

HONORARY COMMITTEE

Goran Bošković, PhD, Academy of Criminalistic and Police Studies, Belgrade, **President**
Sima Avramović, LLD, Dean of the Faculty of Law, Belgrade
Ivica Radović, PhD, Dean of the Faculty of Security, Belgrade
Major-General Mladen Vuruna, PhD, Rector of the University of Defence, Belgrade
Branislav Đorđević, PhD, Director of the Institute of International Politics and Economics, Belgrade

International members

Olivier Ribaux, PhD, Director of the School of Criminal Justice, University of Laussane, Switzerland
Norbert Leitner, PhD, President of the Association of European Police Colleges,
Director of SIAK, Vienna, Austria
General Cao Shiquan, PhD, President of the Chinese National Police University,
Beijing, People's Republic of China
Hao Hongkui, PhD, President of the Criminal Investigation Police University of China,
Shenyang, People's Republic of China
Major-General Andrey Kochin, PhD, Acting Head of the St. Petersburg University
of the Ministry of Internal Affairs of the Russian Federation
Major-General Vladimir Tretyakov, PhD, Chief of the Volgograd Academy
of the Ministry of Internal Affairs of the Russian Federation
Police Colonel Roman Blaguta, PhD, Rector of the Lviv State University of Internal Affairs, Ukraine
Major-general Vladimir Bachila, PhD, Head of the Academy of the Interior Ministry of the Republic of Belarus
José García Molina, PhD, Director of Spanish Police Academy, Ávila
Police Colonel Marek Fałdowski, PhD, Commandant-Rector of Police Academy, Szczytno, Poland
Lucia Kurilovská, PhD, Rector of the Academy of the Police Force, Bratislava, Slovakia
Major-General Panagiotis Kordolaimis, Commander of the Hellenic Police Academy, Athens, Greece
Yilmaz Çolak, PhD, President of the Turkish National Police Academy, Ankara
Adrian Iacob, PhD, Rector of the Police Academy "Alexandru Ioan Cuza", Bucharest, Romania
Simion Carp, PhD, Rector of the Academy "Ştefan cel Mare",
Ministry of the Interior of the Republic of Moldova, Kishinev
Zoltán Rajnai, PhD, Dean of the Donát Bánki Faculty of Mechanical and Safety Engineering,
Óbuda University, Hungary
Andrej Sotlar, PhD, Dean of the Faculty of Criminal Justice and Security, Ljubljana, Slovenia
Nikola Dujovski, PhD, Dean of Faculty of Security, Skopje, Macedonia
Predrag Ćeranić, PhD, Dean of the Faculty of Security Science, University of Banja Luka, BiH
Nedžad Korajlić, PhD, Dean of the Faculty for Criminal Justice, Criminology and Security Studies,
University of Sarajevo, BiH
Velimir Rakočević, PhD, Dean of the Faculty of Law, Podgorica, Montenegro
Boban Saranović, Director of Police Academy, Danilovgrad, Montenegro

PROGRAMME COMMITTEE

Biljana Simeunović-Patić, PhD, UCIPS, Belgrade, **President**
Aleksey Bashan, PhD, Academy of MoI of Belarus
Andy Bécue, PhD, University of Lausanne, Switzerland
Jay Dawes, PhD, University of Colorado, Colorado Springs, USA
Gorazd Meško, PhD, Faculty of Criminal Justice and Security, Ljubljana,
University of Maribor, Slovenia
Jozef Meteňko, PhD, Academy of Police Force, Bratislava, Slovakia
Imre Rudas, PhD, Obuda University, Budapest, Hungary
Slobodan Simonović, PhD, Western University, London, Canada
David D. Stephens, M.S., Forensic Science Consultants, Inc., USA
John Winterdyk, PhD, Mount Royal University, Calgary, Canada
Đorđe Đorđević, PhD, UCIPS, Belgrade
Zoran Đurđević, PhD, UCIPS, Belgrade
Stevo Jaćimovski, PhD, UCIPS, Belgrade
Saša Mijalković, PhD, UCIPS, Belgrade
Dragan Mlađan, PhD, UCIPS, Belgrade
Obrad Stevanović, PhD, UCIPS, Belgrade
Dane Subošić, PhD, UCIPS, Belgrade
Slaviša Vuković, PhD, UCIPS, Belgrade
Petar Čisar, PhD, UCIPS, Belgrade
Smilja Teodorović, PhD, UCIPS, Belgrade
Jelena Radović-Stojanović, PhD, UCIPS, Belgrade
Dragoslava Mićović, PhD, UCIPS, Belgrade

ORGANIZING COMMITTEE

Darko Simović, PhD, UCIPS, Belgrade, **President**
Saša Milojević, PhD, UCIPS, Belgrade
Aleksandar Bošković, PhD, UCIPS, Belgrade
Valentina Baić, PhD, UCIPS, Belgrade
Nenad Koropanovski, PhD, UCIPS, Belgrade
Aleksandra Ljuština, PhD, UCIPS, Belgrade
Nikola Milašinović, PhD, UCIPS, Belgrade
Brankica Popović, PhD, UCIPS, Belgrade

BONES AS FORENSIC EVIDENCE

Božidar Banović, PhD[1]

Jovana Vujošević, MSc

Faculty of Security Studies, University of Belgrade

Abstract: Forensic anthropologists use the theory and techniques of biological anthropology to determine how recently individuals lived and died. They study skeletal remains from crime scenes, wars and mass disasters within the very recent past to reveal the life history and identity of an individual, and to understand the context in which death occurred. During excavation, in order to ensure full recovery and good contextual information, osteologists rely on archaeological techniques to find, document and remove skeletal remains from their *in situ* conditions. At the crime scene, an anthropologist makes a preliminary determination of whether the remains are human or nonhuman and whether more than one individual is present. Once exposed and mapped, individual bones are tagged, bagged, and removed to the laboratory for more detailed curation and examination. A strict chain of custody is established to ensure that the remains cannot be tampered with, in case they represent evidence in a court of law. Once the initial inventory has been completed, a scientist sets about evaluating the clues that the skeleton reveals about the life and death of the individual. The first step in this process is constructing the biological profile of the individual, which includes determining the age, sex, height, ancestry and disease status. Ultimately, forensic anthropologists try to establish the identity of a victim. Once they have several possibilities, they can compare a number of different ante-mortem records (dental records, surgical implants, DNA records, and the matching of ante-mortem and post-mortem X-rays) to try to establish a person's identity. Although forensic anthropologists most often work on cases of lone victims of homicide, suicide, or accidental death, they are also called to the scenes of mass fatalities, to search for soldiers killed in combat, and to investigate human rights abuses that result in hidden or mass graves.

Keywords*:* forensic anthropology, crime scene, skeletal remains, biological profile, identification.

INTRODUCTION

Forensic anthropology represents the examination of human skeletal remains for law enforcement and helps in determining the identity of unidentified bones since they often survive the process of decay and provide the main evidence for the human form after death (Steadman, 2009). Forensic anthropology uses methods and techniques developed from osteology and skeletal biology and applies them to cases of forensic importance (Iscan, 2001; Snow, 1982). Applying these methods to unknown modern human remains, forensic anthropologists can establish minimum number of individuals (MNI), identity or manner of death,

1 banovicb@fb.bg.ac.rs

as well as help law enforcement in forming a biological profile from the unidentified remains. The biological profile includes determination of sex, age, ancestry, height, length of time since death, and sometimes the assessment of traumas on bones (Steadman, 2009; White, Black, & Folkens, 2012).

SCENE PROCESSING

When forensic anthropologists arrive at the crime scene, they must engage in specific roles. The anthropologists must conduct on-site identification of skeletal remains so they can determine whether they are human (Bass, 1995; Correia & Beattie, 2002). This detection allows the anthropologist to proceed with a planned search strategy in response to emerging anatomical scatter patterns, as well as to notify the search team once the remains are completely gathered and if the search can be discontinued (James & Nordby, 2009). Every crime scene is subtle in nature, and the possibility of contamination is continuously an issue. This is primarily due to the destruction of the skeletal remains by the biological and physical agents, such as perpetrators, animals, plants, or time, which makes identification of the individual difficult, if not impossible (Dupras, Schultz, Wheeler, & Williams, 2006). With the intention of preserving the crime scene, grids are placed around the area. Subsequently, an anthropologist sets up a screening area where skeletal material from the crime scene and surroundings will be systematically sifted through a screen to uncover human remains and other associated evidences (Dupras, Schultz, Wheeler, & Williams, 2006; James & Nordby, 2009; Stanford, Allen, & Anton, 2013).

ESTIMATING TIME OF DEATH AND TAPHONOMY

Estimated time of death is essential evidence for crime scene investigators. Once the osteological experts have determined the bones are human, they must proceed with a taphonomic valuation (White, Black, & Folkens, 2012). Taphonomic analysis involves events from time of death until bone discovery, which is determined by estimating the post-mortem period, environmental reconstruction, as well as reconstruction of post-mortem events, and differentiating traces of criminal action from alterations caused by taphonomic elements (Dirkmaat D. , 2002; Steadman, 2009).

Animal and plant activities can destroy the context of the crime scene and actual skeletal remains. Also, the acidity of soil and micro-organisms can have an effect on bone (Behrensmeyer, 1978; Wolf, 1986). For skeletal material, techniques vary based on the condition of the remains: fresh, decomposed, mummified, or skeletalised. Also, forensic procedures can include analysis using entomology, chemical tests and investigation of context and associated artifacts (Adebisi, 2008; White, Black, & Folkens, 2012).

BIOLOGICAL PROFILE

Forensic anthropologists determine deceased individuals' identity by developing a biological profile to depict their physical characteristics. There are various contributing factors that help these professionals establish an individual's age, sex, stature, ancestry and traumas (White, Black, & Folkens, 2012).

Sex determination

The skeletal remains provide evidence of sex and age: the bones of the female individuals are often less robust than those of the males and the ridges with attachments for muscles and tendons are less prominent in the females (Walker & Lovejoy, 1985). The pelvis, thigh bones and skull are particularly distinctive in terms of sexual characteristics. The female pelvis, evolutionary constructed for child-bearing, has particular features – visually wider hips – which separate it from the male pelvis. Apart from visual appearance, a number of measurements are always taken of skull and pelvic bones which help to establish sex (Walker, 2005; Mays & Cox, 2000).

If certain parts of the skeleton are preserved, identification of the biological sex of adult individuals is easier than estimating the age at time of death (Mays & Cox, 2000). If DNA can be taken from the bone remains, the sex of any individual (regardless of age) can be determined with high precision. This is possible even for very fragmented bones. The determination of sex based on the bones in the forensic context, therefore, has been drastically changed by the introduction of molecular techniques in osteology (Stone, 2000; Stojković, 2008).

Age determination

While determining an individual's age, forensic anthropologists must apply their understanding of skeletal and dental development to their conclusions (Sherwood, Meindl, Robinson, & Mayo, 2000). Primarily, ossification centres in bones - cranial bones, teeth or postcranial elements - help determine age in individuals (Ubelaker, 1989). These developments are patterned, relying on age, sex, present skeletal elements, nutritional and hormonal status, and individual variation (James & Nordby, 2009).

Age determination of skeletal remains means estimating the individual's age at the time of death, as opposed to the time elapsed since death. It is important to bear in mind that individuals of the same chronological age can show different degrees of development. Therefore, even when the osteological standards based on known patterns are perfect, there is always a percentage of inaccuracy in determining the age of the bones (White, Black, & Folkens, 2012).

Since bones grow rapidly during childhood, estimating the age of younger individuals up to 18 years is easier and often more accurate than estimating the age of an adult (Sherwood, Meindl, Robinson, & Mayo, 2000). Teeth eruption and long bone growth are most often used as a means of assessing the age of the younger population (Ubelaker, 1989). Teeth may indicate the difference between children of different ages and between adolescents and adult individuals (Lovejoy, Meindl, Mensforth, & Barton, 1985). Also, forensic anthropologists proceed with odontological identification of the individual using previously established dental records and support radiographs, which assists them in determining the age range of the individual (Weedn, 1997). The degree of destruction of the skull sutures can give a relative sense of age among older individuals (Buikstra, 1994).

Stature and weight determination

The position of the body reflects the length of the bones that contribute to the height of a person (Owsley, 2001). While establishing the stature of a subject, forensic anthropologists use many allometry formulas such as the Regression Formula for Estimating Maximum Living Stature (with standard errors) - obtained from the average of the Maximum Long Bone

Length of both right and left humerii, ulnae and radii, femurii, tibiae and fibulae (Trotter, 1970). By estimating the deceased's height, the weight can also be assessed.

Weight is more difficult to determine because of its variations over the life of an individual. Using the entire skeleton, we can calculate body weight based on formulas that look at correlations of height, geographical environment, and the weight of different types of bodies in populations (White, Black, & Folkens, 2012).

Ancestry determination

Knowing the origin of a deceased person is important for precise assessment of sex, age and stature. The geographical conditions in which our ancestors evolved influence the anatomy of their descendants. Diversely, there is no human skeleton marker that perfectly matches geographical origin (Adebisi, 2008).

An isolated skull can be measured and compared using multivariate statistics using a skull of a known origin. This process provides the most likely view of ancestry and a series of possible errors (Iscan & Helmer, 1993). Skeletal determination of ancestry can indicate a matching which can be confirmed by other techniques such as dental records or DNA analysis (Weedn, 1997).

When DNA can be taken from osteological remains, there is a possibility of accurately determining the ancestral population and even family relationships. Mitochondrial DNA (mtDNA) is a small part of the human genome inherited only through the mother's linage. Mitochondrial DNA evolves about 10 times faster than nuclear DNA, which makes mtDNA a useful tool for eliminating even closely related populations (Stojković, 2008; Stanford, Allen, & Anton, 2013).

One of the important tools in estimating the metric characteristics of the skeleton is the Fordisc program, which allows a forensic anthropologist to compare specific characteristics based on an ethnic profile or to process data using discriminatory function analysis (DFA).

Determining race category is usually difficult and less accurate than gender, age, and growth estimates. The question of racial affiliation is difficult to answer because, even though racial classification has some biological components, it is based primarily on social affiliation (Adebisi, 2008).

Manner and cause of death

Forensic anthropologists' analysis of trauma left on bones can contribute to the medical pathologist in estimating the cause and manner of death. Interesting enough, even cremated skeletal remains can provide an astonishing amount of information about the deceased individual (Correia & Beattie, 2002).

The manner of death refers to the five possibilities: homicide, suicide, accidental, natural and unknown. The cause of death refers to injuries or diseases, or their combination that results in death and could take months or years.

Forensic anthropologists commonly classify traumatic events as resulting from sharp force, gunshot or blunt force before death (ante-mortem), near the time of death (peri-mortem), or after death (post-mortem). Analysing the marks on the bone, forensic anthropologists could potentially estimate general class characteristics of the used weapon (Adebisi, 2008).

Blunt force damage produces impact marks or fractures, and can fragment bone, which can eventually help in determining shape, type of trauma, or class of weapon (Dupras, Schultz, Wheeler, & Williams, 2006). During gunshot investigation, a forensic anthropologist reconstructs a skull fractured by a firearm in order to evaluate the injuries. These calculations help the forensic specialist to determine the entrance and exit wounds, as well as the number of fired shots. Blunt and sharp force damages, along with gunshot wounds generate unique skeletal parts that are typically identifiable in unmodified state (Haglund & Sorg, 2001).

Figure 1. *Bullet entry and exit wounds on a modern homicide victim (Zpanič-Pajnič, Petaros, Balažić, & Geršak, 2016).*

Ante-mortem

Older injuries, such as fractures of long bones and even wounds from guns, leave their mark and are key indicators of a person's life. Multiple fractures, especially of ribs and typical defensive wounds, can indicate long-term violence, which is often the case in child abuse. Old injuries can be compared to X-rays if the victim had requested medical assistance, which further facilitates identification (Owsley, 2001).

Characteristics of bone injury differ depending on the part of the skeleton and the characteristics of the object. Particular fractures are caused by force applied in one spot that radiates or becomes concentrated elsewhere.

Fractures occurring ante-mortem can be distinguished from post-mortem fractures only when there is a callus, the hard tissue formed at the broken spot on the bone during the healing process. Also, interventions such as amputations leave traces of bone injuries. The distinction between ante-mortem and peri-mortem amputations again depends on the presence of healing or bone tissue infection at the site of the trauma.

Peri-mortem

Peri-mortem traces are physical evidence of activity immediately before, during or after death (Burns, 2012). They help experts in investigating causes and ways of death (murder, suicide or accident) and can help determine the intentions of the murderer. Also, in osteological analysis, it is necessary to identify bone injuries from the normal state and to distinguish between injuries caused by pathological and taphonomic agents (Skinner, Alempijević, & Đurić-Srejić, 2003). The most important contribution of osteologists in forensic research is the explanation of all potential solutions and opportunities for better collaboration with the research team (Ubelaker, 1989).

Figure 2. *1- Peri-mortem (left) and post-mortem (right) fractures of human femoral shafts; 2- Burned human bone; 3- Burning and weathering of bone; 4- Highly patterned rodent gnawing*

marks on human skeletal elements. The cranium shows heavy gnawing, with broader gouges left by the animal's incisors; 5- Root marking on a human cranium from; 6- Hop marks made by tools on the posterior surface of a proximal tibia fragment (White, Black, & Folkens, 2012).

Peri-mortem traces can indicate the intent of the perpetrator to hide or remove the body, which means that death is not accidental. Saws and similar tools are often used for such purposes after the killing. These tools leave different traces on the bones, and sometimes leave traces of metal fragments embedded in the bones. Experts can identify the types of knives used and can indicate whether they are of the same type of tool as the ones owned by the suspect. If an attempt to remove the skin of the victim can be identified in such methods of removal of the body, an important evidence for a court procedure is secured, which explains the gravity of the crime itself (Burns, 2012).

Post-mortem

After death, further changes in bones may occur, by biological (animal, botanical and human activities), chemical and physical agents (weather, soil, temperature, humidity, micro-organisms, etc). The post-mortem modification changes the state of the individual bones as well as the completeness of the skeleton (Skinner & Lazenby, 1983; Schmidt & Symes, 2008). Post-mortem analysis from the crime scene can be important to determine how the bones have reached a certain place (e.g. whether they were deliberately placed in the grave or whether the individual fell or was thrown from a height) (Wolf, 1986; Steadman, 2009; Dupras, Schultz, Wheeler, & Williams, 2006).

Human bone modification

Burial can have profound effects on the skeleton's disposition. Forcing the body into a small space can cause certain anatomical substances and even fractures. In secondary burials, there are often traces of human activity on bones; removing the skin can leave cuts on the bones, cremation usually causes a colour change (resulting in white, grey, black and blue shades) and bone cracking (Correia & Beattie, 2002).

In contemporary forensic contexts, projectiles are most common metal findings, in the form of bullets of different calibres or shrapnel. Analyses of the entry and exit of projectiles on osteological remains are necessary in forensic research. In addition to such evidence of bone modification, the radiographic detection of a foreign body, metal or other objects in skeletal remains is an additional dimension for forensic analysis (Rouge, Telmon, Arrue, Larrouy, & Arbus, 1993).

IMPORTANCE OF SKELETAL REMAINS – POSITIVE IDENTIFICATION AND DNA ANALYSIS

The anthropologist's most valued skill is knowledge of subtle human skeleton variations. Even though most adult skeletons have the same number of bones (206), no two skeletons are identical. Therefore, unique skeletal traits or observations of patterns lead to positive identifications (Dupras, Schultz, Wheeler, & Williams, 2006; Stanford, Allen, & Anton, 2013).

In order to establish the identity of the victim, as mentioned before, it is necessary to develop a biological profile in order to reduce the number of potential identities and define the timing of events. Then we compile a series of different ante-mortem records in order to try to establish the identity of a person. Positive identification of human skeletal remains - an undisputable match of the findings of teeth, skulls or postcranial remains with distinctive, named individual - is often the essential step in the analysis. The most commonly used means include dental records, health history documents and comparative ante-mortem and post-mortem X-rays. The DNA analysis gives forensic scientists a powerful tool for identifying victims and determining the presence of the alleged perpetrator at the crime scene (Steadman, 2009).

The DNA analysis, in particular, allows a forensic osteologist to deal with issues that are beyond the scope of morphological methods. There are four main questions about the deceased individual to which the DNA analysis of skeletal remains can potentially respond: sex, pathology, origin, and individual's identity (Stojković, 2008).

Forensic scientists use different tests, including DNA profiling (examination of gene sequences that only families would be expected to share), DNA typing (isolation of certain segments of the genetic sequences for analysis) and original DNA test (the same DNA segments were set to examine the degree of similarity between the two sample persons). The DNA analysis identifies the remains of victims and perpetrators of crime with much greater accuracy - connecting people with places and objects of crime. The chance of sampling the same profile with another person is about 1: 10 billion, which is more than the number of people on planet Earth (Stojković, 2008; Stanford, Allen, & Anton, 2013).

The DNA profile is useless for identifying an individual, without comparison samples. It is ideal to have ante-mortem records of the victim in the form of medical, dental records and images. Determining the identity of the victim requires that a person's information is known to some extent in order to obtain related or ante-mortem findings (Weedn, 1997).

When the skeletal material is extremely fragmented, the identification process can be extremely difficult; a biological profile may be impossible; and in such cases, forensic scientists can rely on comparison with reference to DNA samples, which are usually obtained from relatives of victims, in order to obtain positive identification (Stojković, 2008; Stanford, Allen, & Anton, 2013).

Ante-mortem data

Teeth, by skeletal structure, are the most resistant to destruction, and often serve to identify people. Dentists have records with all the information and X-rays related to the dental history of each patient, to what kind of modifications occurred over time (extraction, sealing, and other interventions on teeth). These data are priceless in positive identification, since they are at the same level as the fingerprint (White, Black, & Folkens, 2012).

Medical X-ray images before death can be used for identification as well. An X-ray image of a person's head after an accident can reveal a frontal sinus, a space filled with air inside the frontal bone behind the eyebrow area. The sinus is uniquely developed in each individual, so a comparison of the X-ray of the skull of a known individual can lead to positive identification. Wounds and infections that are visible on ante-mortem X-rays can be compared with post-mortem recordings (Owsley, 2001). Orthopaedic implants and needles with their unique serial number often help to solve the issue of identity (Dupras, Schultz, Wheeler, & Williams, 2006).

Reconstruction of the face

Digital technologies have been developed to provide a three-dimensional virtual reconstruction. The size of the nose is based on the height and width of the nasal orifices and bone marrow. After making the visual, forensic reconstructions of the face can be photographed and shown to the general public in the hope that someone will recognize the individual. If potential identification occurs, ante-mortem records can be checked and thus provide positive identification (Ubelaker, 1989; Iscan & Helmer, 1993).

DOCUMENTATION AND COURT TESTIMONY

Forensic specialists and other forensic scientists are required to document all procedures with the greatest precision. Anthropologists must include a full series of anthropological measurements and estimates, taphonomic assessments, biological profiles, individualization of characteristics, and evidence of peri-mortem traumas. It is essential that the specialists testify about skeletal remains scientifically and neutrally during the hearing (White, Black, & Folkens, 2012). This is primarily due to the fact that they bear a considerable amount of responsibility, not only to the legal community, but also to the victim and the injured party within the crime in question (James & Nordby, 2009). Documentation and court testimony is essential, as it helps the overall outcome of a death investigation by providing the legal system with a scientific explanation of evidence (Steadman, 2009; Dupras, Schultz, Wheeler, & Williams, 2006).

The law requires from forensic osteologists to identify an individual and submit a report. Osteologists as expert witnesses are indispensable due to their expertise and the assistance they provide to both parties, prosecution and defence. A forensic osteologist testifies within the limits of bone evidence and in accordance with the principles of scientific discipline he or she represents (Komar & Buikstra, 2007).

When presenting a human skeleton in reports, a forensic anthropologist needs to describe the skeleton and its components in relation to the standard anatomical position. In this position almost all bones are visible and there is no overlapping. Most bone reports include a skeleton drawing in a standard anatomical position, which is part of court expert or forensic anthropologists' reports. These drawings can be used to indicate the presence or absence of skeletal elements or they can be used to illustrate illness or injury (Stanford, Allen, & Anton, 2013). Skeletons and skeletal elements can be expressed in relation to the anatomical plane (White, Black, & Folkens, 2012). These terms are also used in field reports to describe the position of skeletons or certain bone elements, or to describe the relationship between objects and skeletons (e.g., a bullet found next to the tip of the humerus can be described as being located next to the proximal or superior end of the humerus) (Dupras, Schultz, Wheeler, & Williams, 2006). Clarity and thoroughness are of primary importance for the final reports of forensic anthropologists (Komar & Buikstra, 2007).

There is no uniform format for a forensic report, but specialists usually follow the standards from Buikstra and Ubelaker (1994), written in narrative style. In the analysis of a unique set of skeletal remains, a forensic anthropologist can design 10-20 pages of inventory, observational, osteometric and diagnostic data. These data sheets together with a narrative summary of 3-5 pages make the forensic anthropologists' final report (Stanford, Allen, & Anton, 2013).

Most osteological reports, especially in forensic settings, cover the following points (Buikstra, 1994; White, Black, & Folkens, 2012):

• Introduction. The osteologist should indicate when and how first contact was made regarding the case, characteristics of the received or disclosed material. It is fundamental to indicate each step in which the original condition of the bone material is potentially changed.

• The list of analysed bones, with the potential determination of MNI and a detailed explanation.

• Context and condition of the bones. All skeletal remains sent for analysis are considered as key evidence that is irreplaceable. It is necessary to mention any cultural or biological finding associated with bones. Also, traces of soft tissue, if present, should be recorded in the report.

• Records of all potential evidence of bone pathology. It is also important to document all healed fractures and other osteological manifestations of the disease.

• Anomalies. An osteologist needs to write down all unusual bone appearances, which very often help in the individualization of the victim. In radiographic recording, all features need to be recognised, so that they can be compared to the ante-mortem image and thus determine the individual's identity.

• Marking all signs of osteological injuries, from healed fractures to fractures associated with excavations. Determination of age of fractures based on healing, colour differences or the impact of nature on broken surfaces. It is very important to differentiate between injuries that occurred before, during and after death.

• Determination of age, gender, ancestry, height and weight. It is important to indicate which methods are used for evaluation and why exactly these methods were used.

• Establishing the time and cause of death, with taphonomic effect in mind.

• Determining the identity of a person on the basis of skeletal remains. Dental records, ante-mortem data and radiographs are ideal for individualization and for comparison with post-mortem bone status.

• Metric and non-metric measurements. A record of standard measurements of teeth, skulls and postcranial remains, as well as observations of non-metric properties.

• Summary. A simple overview of the most important bone observations and analyses.

CASE STUDY

Child abuse, unfortunately, is widespread in contemporary society. Approximately 18% of cases of deliberately inflicted injuries have led to more than 2,400 unexpected deaths in infants and children. When the child dies in this way, abusers can try to conceal the body and claim that there has been a kidnapping. In such circumstances, time can pass before the body is discovered and fragmented, and partial skeletal parts are the only evidence. Evidence of scars, bruising and soft tissue injuries is no longer present under these conditions (Walker, Cook, & Lambert, 1997).

Police investigating the case of a boy who disappeared, revealed the partially skeletonised remains of a three-year-old child in the trunk of a family car. His parents first told police officers that the boy died after he slipped and hit his head while bathing. Although initially they said that he had been buried, the discovery of his skeleton made it clear: the dead child was laid in the trunk of their car five years prior to discovery. Parents were accused of illegally disposing of the body and the skeletal remains were sent to the forensic osteologist.

During the dental and metric analysis of the long bones, an age range of 3 to 4 years was determined at the time of death. More thorough histological work on the teeth was in accordance with the age of 3 years and 7 months at the time of death. Moreover, they pointed out

that the child suffered a dental development disorder, the last about two months before his death.

A linear fracture along the left occipital bone was discovered. Growth and histological analysis have shown that the bone formation region records at least two healing phases. The forensic osteologist found that it was a month or more between the injuries that led to the fracture and death of the child. However, along the fracture boundary, the well-healed bone was covered with traces of other later bone formation episodes. Some of the ends of the fractures started to heal, and new traces of the fractures took more than a week to form a new bone. Repetitive healing process is indicative of cases of child abuse. More episodes of injuries have led to these osteological patterns. Parents who participate in the chronic abuse of their children usually avoid bringing the child to the doctor for fear of revealing their behaviour.

Ante-mortem fractures of the upper and lower incisors were observed. Such fractures are common among abused children, reinforcing the idea that the child suffered repeated injuries. The clavicle showed traces of fracture as well. Areas of subperiosteal bone formation were present on the left radius and ulna. These lesions are thin layers of the new bone formed under the periosteum due to injury and subperiosteal bleeding. Healing on the bones of the arm indicated an injury that occurred one month before the child's death. None of these subperiosteal lesions are visible on high resolution radiography. In fact, they are usually less than half a millimetre thick, but they are clearly visible to the osteologist.

The frequency of fractures caused by serious physical abuse has been reduced with the growing up of the child, probably because it is easier to control and forcefully hold younger children with intent to beat them. In this case, with osteological evidence of severe physical abuse over a prolonged period, the prosecutors accused the parents of negligent homicide, of which they ultimately pleaded guilty (White, Black, & Folkens, 2012).

CONCLUSION

Forensic specialists draw conclusions from evidence, mainly by applying their understanding of the human skeleton to a case or subject. Forensic anthropologists' work starts by establishing on-site identification of skeletal remains, and whether they are human. This detection allows the anthropologist to proceed with the plan of their search strategy in response to emerging anatomical scatter patterns and preservation of the crime scene and skeletal remains. For skeletal material, techniques may vary based on the condition of the remains: fresh, decomposed, mummified, or skeletalised.

Specialist continue with taphonomic analysis which involves events from time of death until the bone discovery, which is determined by estimating the post-mortem period, environmental reconstruction, as well as reconstruction of post-mortem events, and differentiating traces of criminal action from alterations caused by taphonomic elements. Proceeding to the laboratory, forensic anthropologists determine deceased individuals' identity by developing biological profiles to depict their physical characteristics. There are various contributing factors that help these professionals establish an individual's age, sex, stature, ancestry, stature, weight and traumas. Forensic anthropologists' analyses of trauma left on bones can assist the medical pathologists in estimating the cause and manner of death. They classify traumatic events as resulting from sharp force, gunshot or blunt force before death (ante-mortem), near the time of death (peri-mortem), or after death (post-mortem). These types of fractures and wounds generate unique skeletal parts that are typically identifiable in unmodified state.

After developing a biological profile and defining the time of events, forensic anthropologists can continue with establishing the individual's identity. Positive identification of human

skeletal remains - an undisputable match of the findings of teeth, skulls or postcranial remains with distinctive, named individual - is often the essential step in the analysis. The most commonly used means include dental records, health history documents and comparative ante-mortem and post-mortem X-rays. Also, the DNA analysis gives forensic scientists a powerful tool for identifying victims and determining the presence of the alleged perpetrator at the crime scene. Forensic specialists and other forensic scientists are required to document all procedures with the greatest precision and form a report. Lastly, the specialists testify about skeletal remains scientifically and neutrally during the court hearing.

To sum up, the main responsibility of a forensic anthropologist is to process the crime scene, examine and process skeletal remains, create an individual's biological profile, establish appropriate documentation of their findings, and testify in the court of law. Their professional understanding of the human skeleton contributes to the outcome of a crime investigation by providing law enforcement with expert answers and conclusions, which ultimately benefit the outcome of any given case.

BIBLIOGRAPHY

1. Adebisi, S. (2008). Forensic Anthropology in Perspective: The Current Trend. *The Internet Journal of Forensic Science vol. 4*, 1-6.
2. Behrensmeyer, A. (1978). Taphonomic and ecologic information from bone weathering. *Paleobiology 4*, 150-162.
3. Buikstra, J. E. (1994). *Standards for data collection from human skeletal remains. (Report Number 44).* Fayetteville, AR: Arkansas Archaeological Survey.
4. Burns, K. (2012). *Forensic Anthropology Training Manual (3rd Ed.).* Upper Saddle River, NJ: Prentice-Hall.
5. Correia, P. M., & Beattie, O. (2002). A critical look at methods for recovering, evaluating, and interpreting cremated human remains. U H. W. D, & S. M. H., *In Advances in Forensic Taphonomy: Method, Theory, and Archaeological Perspectives* (str. 435-450). Boca Raton, FL: CRC Press.
6. Dirkmaat, D. (2002). Recovery and interpretation of the fatal fire victim: the role of forensic anthropology. U W. D. Haglund, & M. H. Sorg, *Advances in Forensic Taphonomy: Method, Theory, and Archaeological Perspectives* (str. 451-472). Boca Raton, FL: CRC Press.
7. Dupras, T. L., Schultz, J. J., Wheeler, S. M., & Williams, L. J. (2006). *Forensic Recovery of Human Remains – Archaeological Approaches.* Boca Raton, FL: Taylor & Francis.
8. Haglund, W. D., & Sorg, M. H. (2001). *Advances in forensic taphonomy: Method, theory, and archaeological perspectives.* Boca Raton, FL: CRC Press.
9. Iscan, M. Y. (2001). Global forensic anthropology in the 21st century. *Forensic Science International, 117*, 1-6.
10. Iscan, M. Y., & Helmer, R. P. (1993). *Forensic analysis of the skull.* New York, NY: Wiley-Liss.
11. James, S. H., & Nordby, J. J. (2009). *Forensic Science: An Introduction to Scientific and Investigative Techniques (3rd Ed.).* Boca Raton, FL: CRC Press.
12. Komar, D. A., & Buikstra, J. E. (2007). *Forensic anthropology: Contemporary theory and practice.* New York, NY: Oxford University Press.

13. Lovejoy, C. O., Meindl, R. S., Mensforth, R. P., & Barton, T. J. (1985). Multifactorial determination of skeletal age at death: A method and blind tests of its accuracy. *American Journal of Physical Anthropology 68*, 1-14.
14. Mays, S., & Cox, M. (2000). *Human osteology in archaeology and forensic science.* London, UK: Greenwich Medical Media, Ltd.
15. Owsley, D. W. (2001). Why the forensic anthropologist needs the archaeologist. *Historical Archaeology 35*, 35-38.
16. Rouge, D., Telmon, N., Arrue, P., Larrouy, G., & Arbus, L. (1993). Radiographic identification of human remains through deformities and anomalies of post-cranial bones: A report of two cases. *Journal of Forensic Sciences 38*, 997-1007.
17. Schmidt, C. W., & Symes, S. A. (2008). *The analysis of burned human remains.* Burlington, VT: Academic Press.
18. Sherwood, R. J., Meindl, R. S., Robinson, H. B., & Mayo, R. L. (2000). Fetal age: Methods of estimation and effects of pathology. *American Journal of Physical Anthropology 113*, 305-315.
19. Skinner, M. F., Alempijević, D., & Đurić-Srejić, M. (2003). Guidelines for international forensic bio-archaeology monitors of mass grave exhumations. *Forensic Science International, 134*, 81-92.
20. Skinner, M., & Lazenby, R. A. (1983). *Found! Human Remains: A Field Manual for the Recovery of the Recent Human Skeleton.* Simon Fraser University, Burnaby, B.C.: Archaeology Press.
21. Snow, C. C. (1982). Forensic anthropology. *Annual Review of Anthropology 11* , 97-131.
22. Stanford, C., Allen, J. S., & Anton, S. C. (2013). *Exploring Biological Anthropology – The Essentials (3rd Ed.).* Upper Saddle River, NJ: Pearson Education Inc.
23. Stanojevich, V. (2012). The Role of a Forensic Anthropologist in a Death Investigation. *J Forensic Res 3*, 154-155.
24. Steadman, D. W. (2009). *Hard evidence: Case studies in forensic anthropology (2nd Ed.).* Upper Saddle River, NJ: Prentice Hall.
25. Stojković, O. (2008). Forenzička genetika. U D. J. Dunjić, *Ekspertizna medicina* (str. 293-348). Beograd: Evropski centar za mir i razvoj.
26. Stone, A. C. (2000). Ancient DNA from skeletal remains. U M. A. Katzenberg, & S. R. Saunders, *Biological anthropology of the human skeleton (1st Ed.).* (str. 351-371). New York, NY: Wiley-Liss.
27. Trotter, M. (1970). Estimation of stature from intact long bones. U T. D. Stewart, *Personal identification in mass disasters* (str. 71-83). Washington, DC: Smithsonian Institution Press.
28. Ubelaker, D. (1989). *Human Skeletal Remains: Excavation, Analysis, Interpretation.* Washington, DC: Taraxcum.
29. Walker, P. L. (2005). Greater sciatic notch morphology: Sex, age, and population differences. *American Journal of Physical Anthropology 127*, 385-391.
30. Walker, P. L., Cook, D. C., & Lambert, P. M. (1997). Skeletal evidence for child abuse: A physical anthropological perspective. *Journal of Forensic Sciences 42* , 196-207.
31. Walker, R. A., & Lovejoy, C. O. (1985). Radiographic changes in the clavicle and proximal femur and their use in the determination of skeletal age at death. *American Journal of Physical Anthropology 68*, 67-78.

32. Weedn, V. W. (1997). DNA identification. *Forensic Dentistry*, 37–46.
33. White, T. D., Black, M. T., & Folkens, P. A. (2012). *Human Osteology (3rd Ed.).* Oxford, UK: Elsevier.
34. Wolf, D. (1986). Forensic anthropology scene investigations. U K. J. Reichs, *Forensic Osteology: Advances in the Identification of Human Remains* (str. 3-23). Springfield, IL: Charles C. Thomas.
35. Zpanič-Pajnič, I., Petaros, A., Balažić, J., & Geršak, K. (2016). Searching fot the mother missed since the Second World War. *Journal of Forensic and Legal Medicine*, 138-142.

CIP – Каталогизација у публикацији
Народна библиотека Србије, Београд

343.85:343.9.02(082)(0.034.2)

INTERNATIONAL scientific conference "Archibald Reiss days" (2018 ; Belgrade)
Thematic conference proceedings of international significance [Elektronski izvor]. Vol. 2 / International scientific conference "Archibald Reiss Days", Belgrade, 2-3 October 2018 ; [editor-in-chief Darko Simović]. - Belgrade : Academy of Criminalistic and Police Studies, 2018 (Belgrade : Službeni glasnik). - 1 elektronski optički disk (CD-ROM) : ilustr. ; 12 cm

Sistemski zahtevi: Nisu navedeni. - Nasl. sa naslovne strane dokumenta. - Tiraž 200. - Bibliografija uz svaki rad. - Abstracts.

ISBN 978-86-7020-405-8
ISBN 978-86-7020-190-3 (niz)

a) Криминалитет - Зборници - Сузбијање
COBISS.SR-ID 268233740