FORENSIC ANTHROPOLOGY

R. Jankauskas
Department of Anatomy, Histology and Anthropology, Faculty of Medicine, Vilnius University, Lithuania; Institute of Forensic Medicine, Mykolas Romeris University, Lithuania

Keywords: Identification; skeleton; age determination; sex determination; ancestry determination; stature determination; history of forensic anthropology

Contents

Summary

This chapter summarizes current status of forensic anthropology as an application of the

science of biological anthropology to legal processes. Although it routinely deals with skeletonized or otherwise unidentified human remains, it is quite often involved in identification of living persons. Forensic anthropology emerged as a subdiscipline of skeletal research in 19th century, and has a broad spectrum for determination of group identification traits (biological sex, age, stature and ancestry), that narrows the range of search, and identification of deceased and living individual. Forensic anthropologists usually are working in close collaboration with specialists of various medical fields (pathologists, odontologists), as well as archaeologists, criminologists and legal authorities. Forensic anthropological expertise is highly requested in investigation of mass disasters, cases of mass murders and similar crimes against humanity. Forensic anthropology is now an integral part of all the forensic science laboratories of the world and other law enforcement agencies.

1. Introduction

1.1. Definition of Forensic Anthropology

Forensic anthropology is usually defined as the application of the science of physical anthropology to the legal process. The routine scope of the discipline is the identification of skeletonized, badly decomposed, or otherwise unidentified human remains. Quite often, forensic anthropologists are involved in identification of living persons. Recently, the range of interests of forensic anthropology is being expanded, as anthropological expertise is requested in the identification and aging of living individuals: in the past few years specialists applying anthropological knowledge and associated disciplines are involved in aging juvenile perpetrators, identifying individuals taped on video surveillance systems, etc., i.e. it is becoming more interdisciplinary.

Identification of the individual is usually defined as the determination of a unique personality on the basis of entirety of characteristics distinguishing him/her from other persons. Identification problems are important for legal and humanitarian reasons, in solving criminal cases, problems of inheritance, marital status etc. A very important question to answer in any death investigation is the identification of the deceased, as it allows his or her family to grieve and settle the decedent's affairs. Investigation of the death is greatly facilitated when the identity of the decedent is known. Identification is more often problematic in forensic cases because the next of kin may not be available to view the body or if injury, dismemberment, and/or postmortal changes that exacerbate emotional responses or that obscure identifying features may make visual identification or use of other techniques such as fingerprints unreliable or impossible. Positive identification entails scientifically establishing identity through the presence of known unique characteristics. All methods of identification require that a known characteristic of an individual distinguishing him/her from all others (*ante mortem* evidence) be compared with the same characteristic of the unknown decedent (*post mortem* evidence). Forensic anthropology centers on the assessment of every aspect of (usually) human remains in a medicolegal context for the purpose of establishing identity and, where possible, the cause of death and circumstances surrounding this event. Forensic anthropologists frequently work in conjunction with forensic pathologists and forensic odontologists. These specialists are also consulted to investigate and authenticate historic and even prehistoric remains and relics. Forensic anthropology may be

extremely helpful in mass disasters, military casualties with considerable skeletal remains or in cases of mass burials. As it also encompasses facial image analysis, forensic anthropology may also provide support to investigations concerning living individuals such as a mix-up of children in a hospital nursery, identification of persons involved in immigration problems or human trafficking, robbers, burglars or thieves recorded by surveillance cameras or occasional witnesses, etc. In forensic anthropological practice, identification is performed according to certain degrees of certainty: identity impossible (identity excluded due to absolute contradiction between *ante mortem* and *post mortem* evidence); indeterminate (if only general, shared similarities are established, implicating that a definite conclusion cannot be reached, and, if there appears to be a strong probability of a match, without a unique feature to set that individual apart); possible (if there is no major incompatibility that would exclude an individual from consideration, and makes this individual eligible for further, more rigorous and specialized testing); positive identification (can only be declared if there is absolutely no contradiction or doubt, and can only be reached based on the presence of unique factors of individualization).

1.2. History of Forensic Anthropology

The history of forensic anthropology extends back to nineteenth century when anatomists and physical anthropologists were occasionally asked to provide their assistance in human identification. In 1835, M.Orfill, French expert of forensic medicine, published a textbook containing data on measurements of arm bones and their sex differences. First cases of osteological expertise were published in the middle of 19th century (series of articles by J.Kanzler in 1855). Extensive three-volume textbook of forensic medicine edited by J.Maschka (1882) contained a large chapter "On bones in medico-legal aspect", written by German anatomist C.Toldt, where principles of species, age, sex, stature, time of death determination are discussed. French scholar E.Rollet (1889) was the first who had elaborated tables for male and female stature reconstruction from bone lengths. These raw data were subsequently used for new stature determination methods by L.Manouvier (1892) and K.Pearson (1899). In North America, Th.Dwight in 1878 wrote an essay "The Identification of the Human Skeleton: A Medico-Legal Study" and launched the professional interest in this area of physical anthropology. Concerning living persons, A.Bertillon proposed an anthropometric system of adult individuals for personal identification (1885) that relied on the taking of the measurements of bony parts of the body, including measurements of the human ear, that was later abandoned in favor of fingerprinting. First microscopic studies on age-related changes of human bones were published by V.Balthazard (1911). The early leader of anthropology A.Hrdlička also contributed much to skeletal identification, trauma interpretation in twenties and thirties of the 20th century. In the period between the 1st and the 2nd World Wars, numerous works dedicated to particular aspects of forensic osteology were published, some of them still are in use today (T.W.Todd (1920) on pubic symphysis, D.Schranz (1933) on humerus, review monograph by N.Minovici and M.Kernbach (1932), etc.). After the 2nd World War, general public needs of identification of military casualties and rising concerns on human rights triggered further developments. Series of articles and monographs written by T.D.Stewart (1948, 1954) , F.D.L.Steel (1958, 1962), K.Hanihara (1958) on sex and age determination, J.Nemeskeri et al. on age (1959, 1961), M.Trotter and G.Gleser on

stature (1952, 1958), J.V.Nainys on sex and stature (1972), M.Gerasimov on facial reconstruction (1955) are widely used as standard methods in today's practice. These, and numerous other, methods are summarized in handbooks by W.M.Krogman (1962), V.I.Pashkova (1963), H.Hunger and D.Leopold (1978), M.Yasar Iscan and K.A.R.Kennedy (1989), and various textbooks of biological anthropology and osteology. In the last few years, the number of works aimed at standardizing, professionalizing and institutionalizing various aspects of forensic activity, including anthropological expertise, has increased rapidly. An important element of those works is also their practical recommendations, which at the same time help to establish whether issued opinions have been drawn according to the rules rigorous methodology. The rule of thumb is that references should always be made to trusted monographic reviews and, above all, to the original literature, before making final conclusions, including those presented for legal institutions. The role of modern internationally applied forensic anthropology is expanding while at the same time drawing upon its traditional roots and is in the process embracing other concerns involving not only osteology but family rights, human rights, gender discrimination, international law, surveying and remote sensing techniques, exhumation strategies, taphonomy, and so on.

2. Identification of Skeletal Remains

Quite often, skeletons or other parts of the body reach the forensic anthropologist in highly disintegrated and fragmented state (cases of mass disasters or materials from mass burials, when non-qualified personnel performed exhumation). As a rule, identification starts from answering questions are the bones human or not? If they are human, how many individuals do they represent? Answer to these questions sometimes is not an easy task, as some parts of animal bones may look similar to human, especially subadults. Identification of number of individuals sometimes is also approximate in case of fragmentary skeletons. Initially, in assessment of the individuality, i.e. checking if all the skeletal parts belong to the same individual criteria to be used include joint articulation and fit at fracture edges, appearance of muscle attachments and size indicators. Moreover, molecular biological polymorphisms may be used in special cases and for the purpose of cross-checking and confirming results. Besides, skeletal remains should be searched for signs of diseases, which might have affected growth and could thus bias the morphological diagnosis of sex and age.

In forensic anthropological practice, identification is performed in two steps. First, group traits (sex, age, stature and body build, ancestry) are determined, that themselves could serve as clues for legal institutions, limiting the range of searched persons. Identification of individual traits is performed as the second step.

2.1. Human / Non-Human Remains

Fragmentary or otherwise altered materials can cause confusion among forensic anthropologists as well. Detailed knowledge of human skeletal anatomy and supplementary comparative collections often is sufficient to reject non-human remains. When small fragments of bone are found, it is sometimes not evident even to expert anthropologists whether they are human or not, particularly in cases of badly burnt bones, of fragmented diaphyseal shafts and of cranial bones of very small animals. In

these cases more specific tests must be performed. Stereomicroscopic analysis of surface details and even thin sections for more detailed microscopic study could be necessary. The advent of DNA analysis has certainly slowed down other research in this area, however, such a heavy rely on DNA may be dangerous as in many instances DNA cannot be extracted. It is known that proteins are more resistant than DNA to many environmental factors and thus methods for detection of species-specific protein in bone should be encouraged. Thus, morphological evaluation by forensic anthropologist is still important.

-
-
-

Bibliography

Acsádi Gy., Nemeskéri J. (1970). *History of Human Life Span and Mortality*. Budapest: Akadémiai Kiadó. [This is a classical monograph presenting still actual methods of sex and age determination from the skeleton]

Arbeitsgemeinschaft für Forensische Altersdiagnostik der Deutschen Gesellschaft für Rechtsmedizin. Available at: http://www.charite.de/rechtsmedizin/agfad/ [some of the most up-to-date methods for age determination presented]

Bass WM. (1971). *Human Osteology: A Laboratory and Field Manual of the Human Skeleton*. Columbia: Special Publications, Missouri Archaeological Society. [The book is widely used as a manual in field and laboratory skeletal research]

Cattaneo C. (2007). Forensic anthropology: developments of a classical discipline in the new millennium. *Forensic Science International* 165, p. 185–193. [A fresh review of contemporary status of forensic anthropology]

Ferembach D., Schwidetzky I., Stloukal M. (1980). Recommendations for age and sex diagnoses of skeletons. *J. Hum. Evol.* 9:517-549. [An European summary of widely used methods for sex and age determination]

Forensic Anthropology and Human Osteology Resources. Available at: http://www.forensicanthro.com/ [provides information about education, books and professional associations]

Garmus A. (1993). *Pelvic bones in forensic medicine.* [An original methods of sex and age determination]

Gindhart P.S. (1973). Growth standards for the tibia and. radius in children aged one month through eighteen years. *Am. J. Phys. Anthrop*., 39: 41-48. [widely used as a reference for age determination of subadult skeletons]

Gustafson G. (1966). *Forensic Odontology*. London: Staples Press. [A complex method for age determination is presented]

Hunger H., Leopold D. (1978) *Identifikation*. Leipzig. [A comprehensive summary of anthropological methods in German language]

Krogman W.M. (1962) *The Human Skeleton in Forensic Medicine.* Springfield: C.C.Thomas. [One of classic references of forensic anthropology]

Krogman W.M., Yaşar Isçan M. (1986). *The Human Skeleton in Forensic Medicine*. 2nd ed. Springfield: C.C.Thomas. [Updated version of the above listed textbook]

Maresh M.M. (1955) Linear growth of long bones of extremities from infancy through adolescence. *Am J Dis Child*. 89:725–42. [widely used as a reference for age determination of subadult skeletons]

Nainys J.-V. (1972). *Identifikacija ličnosti po proksimal'nym kostiam konečnostei*. Vilnius, 1972. [An original reference for widely used in Eastern Europe method for sex and stature determination]

Pashkova V.I. (1963) *Očerki sudebnomedicinskoj osteologii*. Moskva. [A classic Russian textbook]

Rathbun TA, Buikstra JE (Eds.). (1984). *Human Identification: Case Studies in Forensic Anthropology*. Springfield: C.C.Thomas. [Selected papers dealing with forensic archaeology, sex and age determination, individual identification]

Rösing F.W. (1988). Körperhöhenrekonstruktion aus Skelettmassen. In: Knuβman R. (Hrsg.). *Anthropologie. Handbuch der vergleichenden Biologie des Menschen.* Bd I. Stuttgart: Gustav Fischer, s. 586-600. [A comprehensive summary of stature determination methods]

Rösing F.W., Graw M., Marre B., Ritz-Timme S., Rothschild M.A., Rötzscher K., Schmeling A., Schröder I., Geserick G. (2007). Recommendations for the forensic diagnosis of sex and age from skeletons. *HOMO-Journal of Comparative Human Biology*, 58(1), p. 75-89. [The most recent summary of known forensic anthropological methods]

Rösing F.W., Kvaal S.I. (1998) Dental Age in Adults – A Review of Estimation Methods. In: Alt K.W., Rösing F.W., Teschler-Nicola M. (Eds.). *Dental Anthropology: Fundamentals, Limits, and Prospects*. Wien, New York: Springer, p. 443-468. [A comprehensive summary of all dental age determination methods]

Sjøvold T. (1988). Geschletchsdiagnose am Skelett. In: Knuβman R. (Hrsg.) *Anthropologie. Handbuch der vergleichenden Biologie des Menschen*. Bd I. Stuttgart: Gustav Fischer, s. 444-480. [A comprehensive summary of sex determination methods]

Szilvássy J. (1988). Alterdiagnose am Skelett. In: Knuβman R. (Hrsg.) *Anthropologie. Handbuch der vergleichenden Biologie des Menschen.* Bd I. Stuttgart: Gustav Fischer, s. 421-443. [A summary of skeletal age determination methods]

Ubelaker D.H. (1989). *Human Skeletal Remains: Excavation, Analysis, Interpretation.* 2nd ed. Washington: Taraxacum. [A widely cited book, containing good summary of forensic anthropological methods]

Ubelaker D.H. (2000). Methodological Considerations in the Forensic Applications of Human Skeletal Biology. In: Katzenberg M.A., Saunders S.R. (Eds). *Biological Anthropology of the Human Skeleton.* New York: Wiley-Liss, p. 41-67. [A good reference text concerning modern status of research in forensic anthropology]

White T.D., Folkens P.A. (1991). *Human Osteology*. San Diego: Academic Press. [A well illustrated textbook on skeletal and dental biology]

Yasar Iscan M., Kennedy K.A.R. (Eds) (1989). *Reconstruction of Life from the Skeleton*. New York: Alan R. Liss. [A summarizing monograph embracing almost all fields of forensic anthropology]

Zvjagin V.N. (1982). Individuelle Altersbestimmung des Menschen an Hand des Schädels unter Anwendung von Gleichungen der multiplen Regression. *Kriminalistik und forensische Wissenschaften*. Heft 45, S.33- 44. [An original method of age determination widely used in Eastern Europe]

Biographical Sketch

Rimantas Jankauskas is a medical doctor and biomedical anthropologist. He is currently a Professor of Human Anatomy and Anthropology at Vilnius University and Senior Researcher in the Institute of Forensic Medicine, Mykolas Romeris University, Vilnius, Lithuania. He has PhD in Human Anatomy and habilitation in skeletal biology. His research is in the areas of skeletal biology, especially palaeopathology, and forensic anthropology. He is performing routine forensic anthropological investigations and has conducted several investigations of historic and recent mass graves, as well as identification of historical persons. He has authored or co-authored nearly 150 journal articles. He is a council member of European Anthropological Association. For identification of remains of the President of Estonia, he was awarded the "Terra Marianna" 5th grade order of the Republic of Estonia.