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Applying Anthropological Methods for Establishing the Sex, Age and Stature in a Case of Dismembered Corpse

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One of the basic steps in resolving a criminal case is the identification of the victim. This part of the investigation might be difficult in cases with an advanced stage of decomposition or when there are missing parts of the body. Establishing sex, age and stature can provide important information to start the criminal investigation. This forensic case is used to show the accuracy and the informational value of the anthropological methods used in the clinic of forensic medicine at the University Hospital St. Marina - Varna. In the following case study, a number of methods were applied for estimating sex, age and stature to determine their accuracy. The anthropological methods described in this work show good precision: using them, a correct determination of the person's sex, age range and stature was achieved. All these biological characteristics were used in the later stages of the criminal investigation and the person's identification.

Key words: identification, anthropological methods, dismembered corpse

Introduction

One of the basic steps in resolving a criminal case is the identification of the victim. This part of the investigation might be difficult in cases with an advanced stage of decomposition/skeletonization or when there are missing parts of the body (in case of dismemberment). Establishing sex, age and stature can provide information, invaluable for the criminal investigation.

The following forensic case is used to show the accuracy and the informational value of the anthropological methods used in the clinic of forensic medicine at the University Hospital St. Marina - Varna.

A dismembered corpse in advanced stage of decomposition was found in a forested area near an intercity road. The main methods for establishing the time of death were applied, and it was determined that it occurred between the last ten to fourteen days [14].There were seven body parts (belonging to a single person) which were found in plastic bags:

Part 1 – thorax – from the seventh cervical vertebra to the fifth lumbar vertebra, including all of the ribs, sternum, left and right clavicle and left and right scapula.
Part 2 – pelvis and the hips to the knees, including all pelvic bones and left and right femur.
Part 3 – right upper limb from the shoulder to the elbow, including only the right humerus.
Part 4 – right upper limb from the elbow to the hand, including radius, ulna and all of the hand bones.
Part 5 – left upper limb from the shoulder to the wrist, including the left humerus, radius and ulna.
Part 6 – right lower limb from the knee to the foot, including the right tibia, fibula and all of the foot bones.
Part 7 – left lower limb from the knee to the foot, including the left tibia, fibula and all of the foot bones.

Missing were, the head with the neck and the left hand. A month later, the police found a skull and three cervical vertebrae with some preserved soft tissue on them, belonging to the same person. The left hand and a part of the neck were never found. The identity of this corpse was later confirmed by DNA analysis.

In a case like this, one of the questions that we have to answer what is the identity of the person. DNA analysis is the most well-known and precise method for confirming identity, but its downside is that it is necessary to have comparative material from a supposed person of interest or his/hers blood relative. Acquiring such material can be a time-consuming process, and the police need information about the body, from the initial examination, to narrow the circle of potential subjects and continue the investigation. Forensic medicine experts focus on establishing the biological profile (sex, age and stature) and, if it is possible, some individual features of the person. Determining these characteristics is rarely problematic when the body is whole and well preserved. However, in the cases when the body is severely decomposed or dismembered or when only partial remains are found, the anthropological methods become invaluable for establishing the sex, age, and stature of the person.

Materials and Methods

In this specific forensic case, during the autopsy, an external and internal examination of the body was performed. A detailed description of the traumatic injuries was made and the time of death was determined. The identification features were examined by applying a set of anthropological methods for estimation of sex, age and stature, also blood and tissue samples were set aside for subsequent DNA analysis. These methods are the standard techniques used at the clinic of forensic medicine at the University Hospital St. Marina – Varna, when determining identity and also examining skeletal remains.

1. Sex – When performing a forensic anthropological analysis, sex estimation is one of the first and most important steps [18]. We usually use metric and non-metric methods to determine sex. The non-metric method is based on the presence or degree

of expression of sexually dimorphic traits. Nonmetric techniques for estimating sex are largely focused on the pelvis and cranium as bone conglomerates with well-defined signs of sexual dimorphism [7]. In our practice, we apply Walker`s logistics regression equations for sex estimation of the skull and Khaled's method for estimating the sex from the pelvis based on Phenice`s nonmetric traits and statistical methods [6, 21, 22]. The metric analysis is based on accurate measurements between specific landmarks of the bones. In our practice, we use a software called "Anthropolog" based on the anthropometric research of V. I. Pashkova and B. D. Reznikov [13,16]. This program analyzes 25 dimensions of the skull and classifies each of them as "definitely male/female", "probably male/female" and "unidentified". At the end, the software classifies the sex of the examined skull as "male", "female" or "unidentified". The software "Anthropolog" contains other options not only for estimation of sex but for determining age and stature. The program can be accessed openly on the Internet [13, 16].

2. Age – In the case study of the dismembered corpse, age-at-death was identified based on cranial sutures closure, changes of the pubic symphyseal surface and the degenerative processes of the bones [4, 11, 13, 16, 17]. The cranial suture assessment requires an observation of the stage of adhesion between the bones on the ectocranial and endocranial surface of the skull. The sutures on the ectocranial surface are rated on a scale between 0 and 4 and those on the endocranial surface between 0 and 3. Those findings were applied into the software "Anthropolog", which then yields separate results for the ectocranial and endocranial condition of the sutures [3, 4, 11, 13, 15, 16, 23]. The pubic symphyseal ageing is analysed using the Suchey-Brooks method with six stages of changes [2, 4, 17]. We always thoroughly check the condition of the bone tissue to search for degenerative processes, like osteoarthritis [4, 15].

3. Stature – We usually apply the method of Trotter and Gleser to estimate stature from long bones, but the software "Anthropolog" has an option to combine different methods for estimation the stature from the same bones.The program's output shows a mean value of stature from every examined long bone [1, 5, 8, 9, 12, 19, 20, 23].

Results

The identity of the person was confirmed using comparative DNA analysis, consequently the actual biological characteristics were compared to the results gained using the above mentioned anthropological methods. The body belonged to a 66 years old, 178 cm tall male. The results are presented in **Table 1**.

The sex estimation methods show a perfect match. All methods, used separately and together, identify the person as male.

The suture adhesion on the ectocranial surface is indicative of a 59 years old person and the same suture on the endocranial surface shows full obliteration, which indicates a person over 65 years. The endocranial condition of the sutures is the only characteristic that roughly matches the person's actual age. The ectocranial condition is 6 years lower than the actual age. However, the adhesion on both surfaces shows a range between 59 and over 65 years, which roughly matches the actual age. The Suchey-Brooks method

shows the 6th phase of symphyseal surface change, which corresponds to a mean age of 61.2 years and a range of 34-86 years old. The mean value is nearly 5 years lower than the actual age. Despite being very wide, the 34-86 years range does include the person's actual age.

Table 1. Comparison between the true biological characteristics, and the ones estimated using anthropological methods.

Body parts	Used Anthropological method	Result gained using the anthropological method	Actual biological characteristics
Skull	Non-metric method for sex estimation – 3 to 5 score for the different features	**male**	**male**
	Metric method for sex estimation – definitely male – 3; probably male – 15; definitely female – 0; probably female – 3; unidentified - 4	**male**	
Pelvis	Non-metric method for sex estimation – 2 to 5 score for the different features	**male**	
Skull	Suture closure – score for ectocranial surface – 3 and 4; score for endocranial surface – 3;	**59 years** based on ectocranial adhesion; **>65 years** based on endocranial adhesion;	**66 years**
Pelvis	Pubic symphyseal surface changing – phase 6	**Range 34-86,** **mean 61.2years**	
Long bones	Stature from long bones – combined method: Humerus – 359mm Ulna – 281mm Radius – 265mm Femur – 475mm Tibia – 393mm Fibula – 386mm	Average value between **173.83 cm. and 179.04 cm.** Humerus – 178.75cm Ulna – 178.22cm Radius – 179.04cm Femur – 173.83cm Tibia – 175.45cm Fibula – 174.6cm	**178cm**

The combined method for stature estimation returns an average value between 173.83 cm and 179.04 cm, which includes the person's actual stature (178cm.). In our practice we have noticed that the stature, determined based on the dimensions of the lower limb bones, is more accurate than the one determined based on the upper limb. In the present case however, the values from the humerus, ulna and radius are closer to the actual stature than the others long bones.

Conclusion

In this case study a set of anthropological methods for estimating sex, age and stature was applied with the aim to show their accuracy and informational value. Although this was a case of dismemberment, almost all bones of the human body were found, yet our focus was only on those parts, which showed a high degree of expression of the traits for sex, age and stature. In our practice we also use these anthropological methods in cases where only skeletal remains are found. These types of analyses are usually limited to the few available bones, such as the skull, some of the long bones, and parts of the pelvis, among others.

The methods for sex estimation yield accurate results, individually and when combined. In our usual practice, we always combine the results from the different methods for sex determination. Age estimation is the most challenging task when examining remains. The results of this study are indicative of the difficulty because neither method used here established the exact age. However, both methods helped determine the person's age range.

All long bones of the skeleton were used to determine the person's stature and compare the accuracy of each estimation. The results show that the estimations based of the upper limb are closest to the actual stature.

Overall, the anthropological methods described in this work show good precision: they correctly determined the person's sex, age range and stature. All these biological characteristics were used in the criminal investigation and the person's identification.

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