Forensic and Anthropological Expertise and Verification of the Bulgarian Formulas for Stature Prediction by the Long Bones (A Case Report)

D. Radoinova

Department of Forensic Medicine, Varna University of Medicine,
Varna, Bulgaria

We present forensic-anthropological expert case by bone remains with complete and final identification
of 21-year-old girl as well as Bulgarian formulae verification for stature assessment by long bones. The
comparison to the Troter-Gleser and Ninnis formulae proves the Bulgarian formulae accuracy.
  Key words: forensic-antropological expertise, bulgarian stature formulae by long bones.

At the Department of Forensic Medicine, Varna University of Medicine, annually a total of 30-35 expertises of bones and bone remains are performed, comprising about 9.8% of all autopsies. Person identification is different in forensic medicine as compared to other sciences for its importance as evidence in court. For this, very strict rules of performing this type of investigation should be followed, including methodological excellence and repeatability of results.

The following order of steps in performing bone expertise is typical: determination of species (i.e. human) nature of the remains, gender, age, height, and race. Then, the cause of death is determined. The answers to these questions are important as they will direct the future actions of the investigating officials.

The **aim** of the present paper is to demonstrate a forensic case in which a precise identification of personality was achieved. This allows a complete forensic analysis of the bones and verification of the Bulgarian formulas for height determination by the long bones, as their precision is compared to other formulas.

The case:

On 28 July 2005, in a deep gully in the region of the village of Oreshak (Varna district), bone remains were discovered, nearby a small river. The spot was indicated by a witness who claimed he had seen a girl (to whom the bones supposedly belonged) being thrown in the river, in February 2005. The skull was partially sunk in water, and along the shore most of the skeleton bones were dispersed.
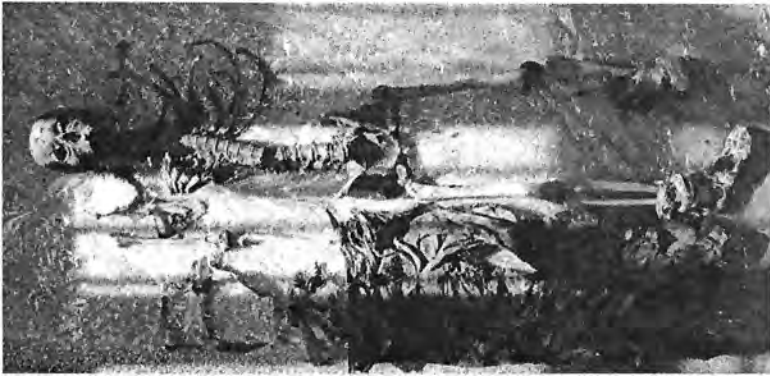
Fig. 1. Discovered bones

Fig. 2. Skull with lower jaw

At the inspection, the following bones were collected (Fig. 1.): skull (including part of the vertebral column attached to it), and the lower jaw. The skull was intact, without mechanical injuries. Only the stylloid processes were broken. Remains of soft tissues and a lot of dirt under the temporal arches as well as in the orbitas were found. The skull was heavy, the first 4 vertebrae attached to it. The lower jaw was completely separated from the skull (Fig. 2.). It was intact, the lower incisors had fallen off post mortem, but their alveolar cavities were intact, deep and with sharp contours. The right humerus was with a missing head and unevenly broken proximal end. Among the vertebral column bones, partially separated were L_1 to L_4 vertebrae, while L_5 was attached to the sacrum. The two ilial bones were completely separated. The upper part of the wing of the right ilial bone was unevenly gnawed. The ribs were intact; their cartilage segments connecting them to the sternum were missing as well as the sternum itself.

Fig. 3. Right foot

Near the lower pat of the sacrum, bikini were found which aided the identification. The left scapula had a broken distal part of the acromion. The right radius was intact without changes. The left femur was with partially gnaws joint surfaces at the knee side. The right tibia and fibula were with unevenly gnawed proximal edges. Distal from the ankle, the right foot had preserved soft tissues, upon which stockings and socks were found. This foot had on it a sport shoe, its soft tissues were partially mummified and partially macerated (Fig. 3.). The length of the right foot was 22 cm. The left shoe was discovered separately, removed from the foot.

The left tibia and fibula were discovered, their proximal edges being gnawed. The bones of the left foot were all missing.

Dry leaves and soil were sealed to most of the discovered bones. No signs of lifetime disease or traumatic processes were identified.

The bones were arranged in an anatomical order. By their morphological appearance (structures, joint surface, etc.) was established that they were human, belonging to a single individual.

The skull with the vertebra attached to it was placed in water for maceration, and subsequently opened. The brain was well preserved, showing grayish or sometimes reddish spots. However, the identification of particular disease or traumatic processes was not possible. Along the inner surface of the top part of the skull, the two anterior cranial fosse and the anterior part of the skull base was observed a black-colored contamination, which was removed in water.

Subsequent histological analyses and a reaction for iron were not sufficiently informative.

The following parameters were defined:

I. Identification signs of gender.

Descriptive or metric parametes of the skull and the seat. The skull was relatively small, gracile, with weakly developed occipital relief. The sinusoid processes were visibly small, the end of the cheekbone did not continue beyond the external auditory orifice. The forehead was convexed outward, the relief over the eyebrows was well-developed. The chin was oval, the lower jaw was thin, gracile, and the man-

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dibular angle was over 90 degrees. The orbitas were round. These are features are typical for the female gender.

The metric features were processed with the Russian anthropological program "Anthropolog" with the following results: for female gender — reliably female (2 features), probably female (10 features); for male gender: reliably male (1 feature), probably male (1 feature), undefined gender (11 features).

Based on the descriptive and metric parameters the skull was concluded to be female, Caucasian. The seat was also with female features.

II. Identification signs of age.

The skull was heavy also after maceration. The teeth formula was defined as follows: the nuclei of the wisdom-teeth were not seen, upper right 6th tooth has a small stopping of amalgama, the lower central incisor teeth have fallen off post mortem, the rest of the teeth were without changes. During lifetime, the teeth had been in a very good condition, with wearing out of enamel 1st degree. The cranial sutures along the internal surface of the skull roof were almost accrete, while along the external surface — not accrete.

III. Determination of stature.

We measured the left tibia (32.8 cm; within physiological limits), the left femur (40.8 cm), the right ulna — 22.8 cm (maximal lengths).

The height was determined by the following formulas: (i) according to the **Trotter—Gleser** formula, the height was determined to be 154.2 cm (by the femur length), 155.1 cm (by the ulnar length) or 154.9 cm (by the tibial length); (ii) according to the **Nainis** formula, the height was determined to be 154 cm (by the tibial length); (iii) according to the formulas for the Bulgarian population of **Radoinova** — regression equations, nomograms and computer programming - the height was determined to be 158,6 cm (by the tibial length). **With a reliability of 99.9% the true height of the dead girl is in the range of 152.5-163.5 cm.**

According to the data acquired by her personal identification card and school datasheet, the girl's height had been **160 cm**. Thus, the difference between the projected difference in height from the Bulgarian formulas to those of Trotter—Gleser formula is over 3 cm, while to those of Nainis — 4,6 cm.

The precise identification of the girl was made by constant (general) signs — gender, age, etc. as well as by concomitant signs — clothes, underwear, shoes. No special signs were found. The definitive determination of the identity was done by DNA analysis, which resulted in 0.99986 identities as compared to tissues from her parents.

The cause of death could not be determined.

Summary of the expertise: • All investigated bones are of human origin and belong to a single individual. • The descriptive and metrical parameters of the skull and seat demonstrate that the remains belong to a woman. • According to the teeth, cranial sutures and the rest of the bones, the bone age was defined to be in the range of 18-25 years. • The height as determined by the tibial length with the Bulgarian formulas was found to be 158,6 cm. With a reliability of 99.9% the true height of the dead girl is in the range of 152.5-163.5 cm. According to the data acquired by her personal identification card and school datasheet, the girl's height had been **160 cm**. • No special identification signs were found on the investigated bones. • No lifetime traumatic or disease changes of the bones were identified. • The edges of some of the bones were missing, gnawed post mortem by animals. • The appearance of the bones (heavy, with low amounts of preserved tissues, parts of cartilage and wizened ligaments), including the presence of dry leaves on them, suggested that death had

occurred more than an year ago. ● The cause of death was not possible to be determined because of the lack of traumatic or disease changes of the bones. ● Probable identification was done based on general and concomitant signs. ● The definitive identification was done by DNA analysis.

Conclusions

1. Investigating bones in forensic medicine is always advisable, even if only general signs are being determined.
2. At the lack of traumatic or disease changes of the bones the cause of death is usually impossible to be determined.
3. The general (constant) and specific (not constant) signs as well as the concomitant signs have differential informative value in each particular case.
4. Their integration directs the individual identification. DNA analysis should also be performed if possible.
5. The Bulgarian formulas and nomograms of stature are considerably more precise as compared to other available formulas: these of Trotter—Gleser and Nainis.
6. The time of death is usually defined by approximation in broad boundaries.

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