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Forensic Identification of Personality: Skull as a Key Element of Person Identification (a Case Report)

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ABSTRACT

One of the most sophisticated types of examinations conducted in forensic practice is person identification. If genetic data are available for comparison, the identification of an unidentified cadaver is currently not challenging. The methods given in the report have shown their reliability and effectiveness for the identification of unidentified cadavers.

This case report describes a case of an extremely problematic identification of a deceased person. The medical and forensic department received fragments of an unknown cadaver found on the lake shore (skull with lower jaw, symphysis and proximal ends of the humerus and femur). Sex, age, and race were established during the examination, and the specific dental features promoted the reliable identification of the deceased person. The law enforcement investigation gave grounds to assume that the cadaver was the missing male K., a native of Kazakhstan, whose data coincided with the results of forensic medical examination. This was confirmed by the correlation analysis of craniometric landmarks at the lifetime picture and the skull picture by combining the images of the K.'s head and the skull of an unknown man.

Anatomical features of skull and teeth are significant in forensic identification; its scrupulous analysis contributes to the accuracy of the identification of missing persons. It is crucial to continue the development of technologies and methods of identification, which is especially relevant in the light of a special military operation, with a high demand for identification of deceased persons, including among civilians, yet the availability of genetic research is absent.

Keywords: unidentified corpse; person identification; skull; dental features; photographic matching; case report.

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Судебно-медицинская идентификация личности: череп как основной элемент опознания человека (случай из практики)

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АННОТАЦИЯ

Одним из сложнейших видов исследований, проводимых в медико-криминалистическом отделении бюро судебно-медицинской экспертизы, является идентификация личности. При наличии сравнительного генетического материала вопрос идентификации личности неопознанных трупов в настоящее время не вызывает больших трудностей. Методики, приведённые в статье, показали свою надёжность и эффективность для идентификации личности неопознанных трупов. В статье представлен случай крайне сложной идентификации личности погибшего. В медико-криминалистическое отделение поступили фрагменты трупа неизвестного человека, обнаруженного на берегу озера (череп с нижней челюстью, симфиз и проксимальные концы плечевой и бедренной костей). В ходе исследования установлены пол, возраст и расовая принадлежность, а выявленные характерные особенности зубов позволили достоверно установить личность погибшего. Проведённые оперативно-розыскные мероприятия дали основание предположить, что труп неизвестного человека принадлежит пропавшему гражданину К., уроженцу Казахстана,чьи данные совпадают с результатами судебно-медицинского исследования, что подтвердилось в ходе отождествления личности методом корреляционного анализа опознавательных точек на прижизненной фотографии и фотографии черепа путём совмещения изображений головы гражданина К. и черепа неизвестного мужчины.

Анатомические характеристики черепа и зубов являются значимым элементом в судебно-медицинской идентификации, и их тщательный анализ способствует повышению точности установления личностей людей, пропавших без вести. Важно продолжать развитие технологий и методов идентификации, что особенно актуально в свете текущих событий, связанных со специальной военной операцией, когда возникает необходимость в идентификации личности погибших людей, в том числе среди мирного населения, но отсутствует возможность проведения генетического исследования.

Ключевые слова: труп неизвестного человека; идентификация личности; череп; особенности зубов; фотосовмещение; случай из практики.

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法医身份鉴定：头骨是人体鉴定的基本要素（实践案例）

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简介

司法鉴定机构法医部门进行的最复杂的研究之一是身份鉴定。目前，在具备可比较的遗传物质的情况下，无名尸体的身份鉴定工作没有太大的困难，文中给出的方法在无名尸体的身份鉴定中已显示出其可靠性和有效性。

文章介绍了极其复杂的死者身份鉴定案例。法医部门收到一份在湖边发现的一具无名尸体碎片（有下颌的颅骨、联合，以及股骨和股骨近端骨）。研究确定了性别、年龄和种族，确定的牙齿特征可以可靠地确定死者的身份。所采取的搜查行动措施有理由认为，无名尸体属于失踪的哈萨克斯坦公民K. 某，通过身份识别证实，其信息与法医研究的结果一致。期间，采用的方法是将公民K. 某的头部图像和身份不明男子的颅骨图像结合起来，对生前照片和颅骨照片上的识别点进行相关性分析。

颅骨和牙齿的解剖特征是法医鉴定中的一个重要因素，对它们进行彻底分析有助于提高失踪人员身份鉴定的准确性。不断发展识别技术和方法具有重要意义，鉴于当前的特别军事行动，在需要识别死者身份，包括平民身份识别，但无法进行基因检验时，这一点尤其重要。

关键词：无名尸体；身份识别；颅骨；牙齿特征；照片组合；实践案例；病例报告。

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INTRODUCTION

Unidentified corpses (or their parts and bone fragments) person identification is one of the main activities of forensic medical institutions. When identifying a person, bone remains, dismembered and charred corpses or their parts, as well as putrefied and mummified bodies of people are often the object of research [1].

If comparable genetic material is available, the issue of person identification is currently not very challenging. It is otherwise when the material is not available. Then the identification method and its reliability depend entirely on the available lifetime objective data concerning the presumed dead or missing person [2]. In particular, lifetime images of internal structures, for example, any parts of the head or other parts of the body, are used for comparative study with obtained radiographs of the same parts of the skull or skeleton bones in the same scale and angles. In most cases, the comparison provides a basis for a strong positive or strong negative conclusion, as the images show individual features of the bone structure. The dental history, especially individual dental scans, provide valuable information for identification [3].

Photos of the presumed person in two or three angles are mostly used as a comparative material; in rare cases, there is no comparable resource. A similar case occurred in our practice, when we had only a small full-face image of the presumed deceased.

CASE DESCRIPTION

Incident Circumstances

In one of the districts of Republic of Karelia, an almost skeletonized corpse was found on the shore of a lake. A small amount of black hair, up to 15–20 cm long, was preserved on the mummified skin fragment in the occipital area of the head. No visible injuries were detected when the corpse was examined at the scene. According to the forensic medical expert, the corpse belonged to a man aged 30–40 years old, about 160 cm tall. The victim was identified by his clothes as K., a native of Kazakhstan.

Forensic Results

In order to identify the person, the medical and forensic department received parts of the corpse: the skull with the lower jaw, symphysis and proximal ends of the humerus and femur.

The study revealed the following: the skull was of medium size (Fig. 1) and brachycranial shape (cranial index 87.5%); morphological and metric parameters indicated the male sex; morphological features of the studied bones indicated the age of 30–39 years. The age was established using the methods of Zvyagin (1975) [4] and Acsady Nemeskeri in the edition of Sjøvol (1975) [5]; when determining the race of the skull, the method of Zvyagin (1981) was used [6]. The studied skull belonged to the mixed racial group (among the identifying features of the skull there were eight presumably Caucasian indicators, 12 presumably Asian indicators, the rest of the indicators are undetermined). Examination of the teeth revealed shovel-shaped incisors on the upper jaw, torsion and inward displacement of the second upper incisor (Fig. 2). In addition, enamel leaks were found on the first and second large molars of the lower jaw (Fig. 3).

Fig. 1. Skull submitted for examination.

Fig. 2. Spatulate shape of the upper incisors and inward twisting of the upper second incisor.

Fig. 3. Enamel leaks on the first and second molars of the lower jaw (indicated by arrows).

Further examination of the skull revealed a number of features that formed the appearance of the unidentified person. In particular, the shape and the size of the skull indicated a relatively wide and high form of the face due to moderately prominent zygomatic bones and expanded angles of the lower jaw. The forehead is high, hollowly sloping. The superciliary arches are short, most prominent in the glabella (the area of the frontal bone between the eyebrows). This arch structure requires the eyebrows to be short and can make the impression of raised eyebrows. The orbits are rounded; the upper and lower edges are thin, slightly blunted. The eye chambers are roughly closed in shape. The lacrimal fossae of the orbits are brought forward, which leads to some lowering of the inner corner of the eye and, possibly, to a slight dilatation of the upper eyelid with the formation of a fold (Mongolian). The left orbit is longer, and its lacrimal fossa and orbital tubercle are slightly higher than of the right one, indicating a horizontal eye shape, with the left eye being slightly higher than the right. The zygomatic bones are flat and relatively wide, leading to some flattening of the face. The nasal bones are long, flattened, the nasal root is slightly prominent, indicating a long, flattened dorsum of the nose. The piriform aperture is small, its left half is slightly larger than the right, which indicates the small size and low wings of the nose. The left wing of the unidentified person's nose may have been slightly larger during his lifetime. The alveolar process of the upper jaw is orthognathic, with the incisors standing vertically, slightly overlapping the incisors of the lower jaw, which also stand vertically and form, together with the upper ones, a scissor bite. Teeth of both jaws are white and relatively large with wedge-shaped crowns of incisors. The chin is wide and slightly extends beyond the upper jaw. The corners of the upper jaw are turned outward, which together with the zygomatic bones brings the lower part of the face closer to an oval shape. The bite, vertical position of the incisors, and height of enamel on the upper jaw incisors indicate a small size of the mouth. The elongated nose indicates that the unidentified person also had elongated auricles. Judging from the location of the mastoid processes, the auricles were uniformly protruded.

Investigative Activities

The investigation established that the corpse found on the lake shore could belong to K., 38 years old, 160 cm tall, a native of Kazakhstan, who went missing in the Republic of Karelia in 1992.

The experts were presented with only one en face picture of K. available to the investigative authorities, which showed a young man with an Asian type of face. The face shape was rounded. The hair was thick, black, long, covering the forehead and auricles. The eyebrows were short, medium thick, raised. The eyes shape was horizontal. The left eye was slightly higher than the right. The cheekbones were wide; there was a small tumor-like growth on the skin of the left face in the zygomatic area. The dorsum of the nose was flattened. The nasal wings were small; the left wing was slightly larger than the right wing. The mouth line was straight; the mouth was small. The nasolabial fold was barely visible. The chin was broad, rounded.

The forensic data matched the picture of K. The matching of sex, race, age, height, appearance on the verbal portrait of the skull indicated that the investigated skull could belong to K. To confirm this, the identification of the person was carried out by correlation analysis of skull landmarks on the lifetime picture and skull picture by combining the images of the head of K. and the unidentified person's skull.

Person Identification by Correlation Analysis of Landmarks

The lifetime picture of the person to be identified and pictures of the skull on single-scale images in the same perspective were marked by landmarks (Fig. 4, 5). The coordinates of these marks were established by measuring the distance from them to the left (Y-axis) and bottom (X-axis) edges of both images. The obtained coordinates were mathematically and statistically processed using Statistica 8.0 (StatSoft, USA). The result of correlation analysis was found to be positive.

Person identification by skull was performed using TADD SM, v. 5.0, developed by the Russian Center of Forensic Medical Expertise of the Ministry of Health of Russia. The image of K's head was viewed on Mustek Bear Paw 2448TA Plus scanner (Mustek System Inc., Taiwan). After cropping in Photoshop CS2 (Adobe Systems Inc., USA), the image was displayed on the monitor screen in the window of TADD SM with subsequent marking by topographical landmarks that are important for identification: contours of the head arch, nose wings, points of eye corners, etc. Relevant constant points significant for identification were marked on the skull.

The skull was put on a rotating tripod, which allowed smoothly changing the angle of rotation and tilting of the skull against the video camera and fixing it in a given position. The image of the skull was entered into the program using

a Panasonic NV-GS60 video camera (Panasonic Corporation, Japan) in the perspective closest to the perspective of the head image in the picture. The skull on a tripod was put in the position with maximum correspondence to the size and perspective of the head image in the picture. The study of the images of K's head and the unidentified person's skull (Fig. 6) combined on the screen revealed coincidences in the following parameters: location of the homonymous constant points of the head and skull images; congruence (correspondence) of the shape of the contours of the head and skull images, taking into account the throw ratios; correspondence of the thickness (distance) between the contours of the head and skull to the average data on the thickness of soft tissues.

Expert Opinion

Thus, despite the potential expert error in the photo-alignment of the skull with only one en face picture, on the basis of the coincidence of sex, race, age, height, hair color and length, the features of the verbal portraits of the skull of the unidentified person and K., the positive results of person identification by correlation analysis and photo-alignment, as well as taking into account the case materials (the coincidence of items of clothing on the corpse with those worn by K. when he went missing), we considered it possible in this particular case to conclude that the unidentified person's skull found in the lake belonged to K.

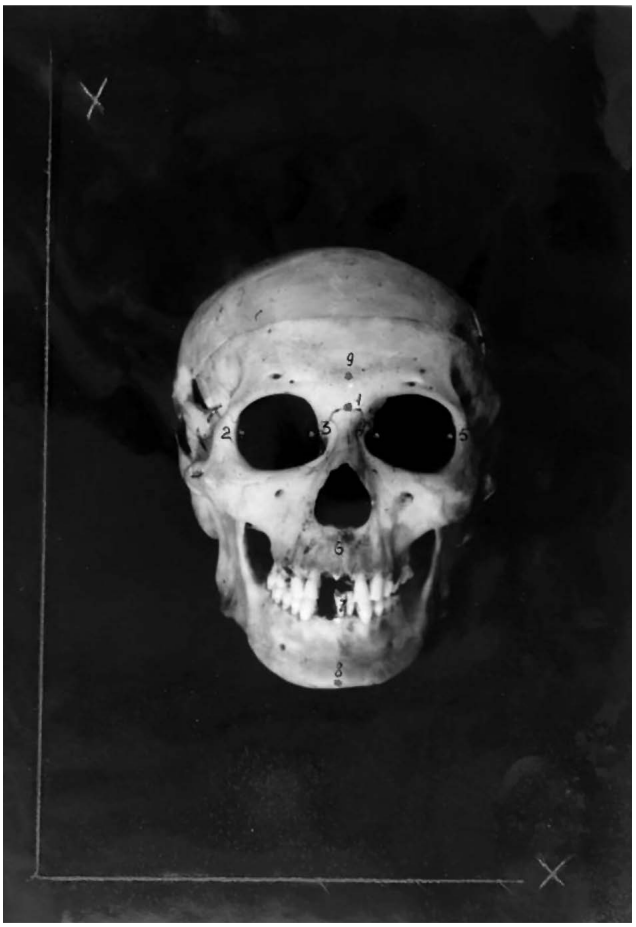

Fig. 5. Marking of identification points on a photograph of an unknown person's skull.

Fig. 4. Marking of identification points on the photograph of citizen K.

Fig. 6. Combined images of the head of citizen K. and the skull of an unknown man.

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DISCUSSION

Anatomical characteristics, including skull structure and dental features, play a key role in the forensic person identification process. Examination of the skull can provide valuable information about a person's age, gender and race, which is crucial for proper identification of an unidentified person [7].

The skull, as a basic element for person identification, is a complex anatomical structure where its shape and size can indicate sex and race. In the case we described, the skull had a brachycranial shape, which is one of the most important features in determining race. Approaches developed, for example, by Zvyagin [6, 8], classify skulls by race and sex, which helps experts in establishing correspondences between the identified skull and the missing person. Teeth also serve as a reliable source of information for personal identification [9]: their shape, location, features and the presence of pathologies provide additional information about a person's life (e.g., heredity and lifestyle) [10–14]. Teeth can be cross-referenced with medical history and other information about the presumed individual, which also contributes to the identification.

It is important to note that the analysis of anatomical features should be comprehensive [15]: for example, matches on the size and shape of the skull, features of teeth and dental rows can significantly increase the reliability of the identification of a person [16]. Modern technologies, such as correlation analysis of landmarks, provide for more accurate and reliable comparisons.

The general morphological state of cranial and dental structures is an indicator of individual genetic, ecological and biological factors that are formed throughout lifetime [17, 18]. In this regard, studies based on these anatomical features not only help to identify individuals, but also give new opportunities in study of population dynamics and migration processes.

CONCLUSION

Anatomical features of skull and teeth are a significant element in forensic identification, and their scrupulous analysis contributes to the accuracy of the identification of missing persons. It is important to continue the development of technologies and methods of identification, especially relevant in the context of current events related to a special military operation, when, in the absence of conditions for genetic testing, there is a need to identify dead people, including among civilians.

ADDITIONAL INFORMATION

Authors' contributions: V.M. Antipov: correlation analysis for identification of the individual, writing—original draft; writing—review & editing; O.S. Lavrukova: collection and analysis of published data, writing—original draft; writing—review & editing. Thereby, all authors provided approval of the version to be published and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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