Central Asian Journal of Medicine

# DETERMINATION OF HUMAN AGE BY MORPHOLOGICAL CHARACTERISTICS OF THE STERNUM

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## ABSTRACT

During the forensic examination of the corpses of unknown persons for the purpose of identification, as well as in the conditions of strongly developed decay changes in the corpses or during their criminal dissection, the study of the bones of the human skeleton can serve to determine the objective evidence of identification process. Currently, the forensic identification of unknown corpses issues of medicine and expertise remain important, as the number of armed conflicts, terrorist attacks, natural disasters, man-made disasters, and criminal murders remains high. With expertise and investigations carried out in this department, rapid search in the course of conducting criminal and civil cases and solving many issues that arise before the prosecutor's office, the examination of the identity of the person is important for the determination of justice.

**Key words:** sternum, age-related bone elasticity, anatomical analysis, determination of bone age.

## INTRODUCTION

One of the most challenging tasks that forensic experts and law enforcement agencies face is identifying missing citizens, unidentified dead, and dismembered corpses. These examinations are typically complex and require extensive efforts. Unfortunately, not every examination can fully achieve its intended goals (1, 2, 3, 6).

Currently, identifying unknown bodies in forensic and criminalistic examination remains a crucial issue due to the high occurrences of armed conflicts, terrorist attacks, natural disasters, man-made disasters, and murders. Despite almost a century of experience in dating unknown corpses and living people, several important cases still require further exploration (4, 5, 7, 8). The

macroscopic and morphological methods used to evaluate external parameters do not provide sufficient accuracy (9, 10). Some methods have slightly larger or smaller age estimation errors. Therefore, it is imperative to increase the efficiency and parameters of existing methods in forensic medicine and further develop new research methods to more accurately determine a person's biological age (11, 12).

**Objective.** The application of anatomy-morphological characteristics of the sternum for age determination has become an essential tool in the identification of individuals based on forensic materials. This method has gained significant importance in forensic science due to its reliable and accurate results.

**Materials and methods.** 1111 sternum bones taken from unidentified corpses were used as materials for the research in 2015-2021 at the Scientific and Practical Center of Forensic Medical Expertise and the Department of Criminalistics of the Tashkent city branch. Of these, 898 were male and 213 were female sternums. Osteoscopic, osteometric, stereomicroscopic, photographic and statistical analysis methods were used to identify the identity of unknown corpses.

Determining age-related changes in the sternum consists of the following steps:

Preparation stage: Soft tissues are separated from the bones by the following methods: The presented sternum is washed under warm running water. The soft tissue debris is mechanically removed with sharp, non-abrasive blades, and the object is aired and dried after the debris is removed.

Research stage: The sternum is subjected to X-ray examination together with primary soft tissues and secondary X-ray examination after the soft tissues are cleaned.

**Results and Discussion.** Researches were carried out by medical forensic specialists during the years 2015-2021, in order to determine the stages of development of the sternum in relation to age, taking into account the various changes in their formation. During 2015-2021, the number of sternum bones from male and female corpses studied by the experts of the Scientific and Practical Center of Forensic Medical Expertise of the Republic and the Medical Forensics Department of the Tashkent city branch and their ratio in percentage are shown in Tables 1 and 2:

**Table 1**

**Distribution by gender in the examination of the sternum**

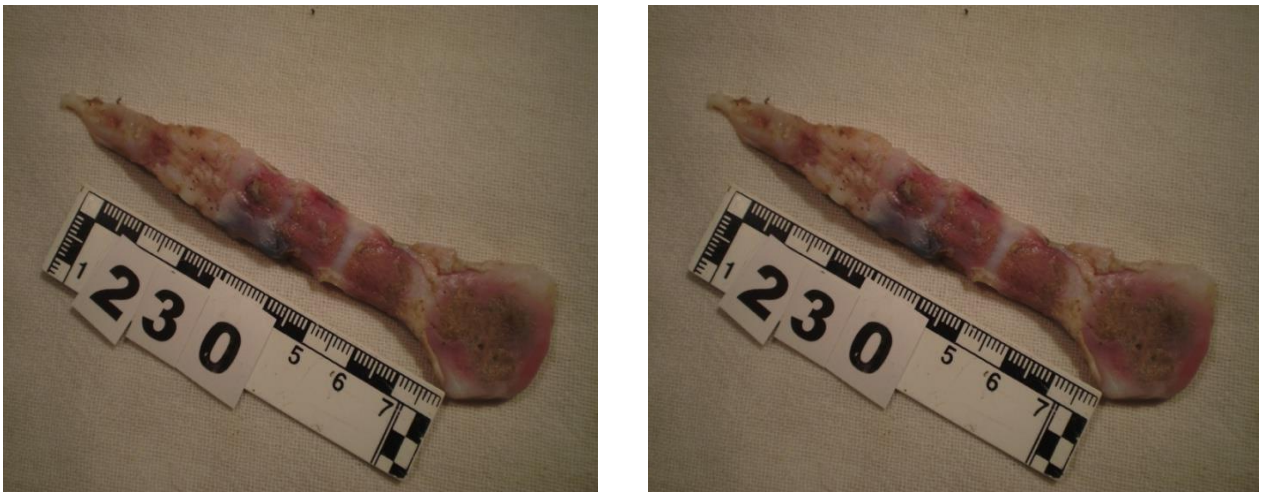
| № | Years | Man | Woman | Total |
|---|---|---|---|---|
| 1 | 2015 | 179 | 46 | 225 |
| 2 | 2016 | 216 | 59 | 275 |
| 3 | 2017 | 210 | 46 | 256 |
| 4 | 2018 | 118 | 25 | 143 |
| 5 | 2019 | 36 | 8 | 44 |
| 6 | 2020 | 55 | 11 | 66 |
| 7 | 2021 | 84 | 18 | 102 |
| | Total | 898 | 213 | 1111 |

**Table 2**

| № | Years | Man - % | Woman - % |
|---|---|---|---|
| 1 | 2015 | 16,1 | 4,1 |
| 2 | 2016 | 19,4 | 5,3 |
| 3 | 2017 | 19,0 | 4,1 |
| 4 | 2018 | 10,62 | 2,2 |
| 5 | 2019 | 3,24 | 0,72 |
| 6 | 2020 | 5,0 | 1,0 |
| 7 | 2021 | 7,6 | 1,62 |
| | Total | 80,96 | 19,04 |

During these investigations, we carefully examined the ossification process of the sternum, including its size, shape, joining surfaces, rib sockets, and any noticeable features. We also studied the development of the sternum at various age stages, keeping in mind that it undergoes changes over time and is a complex structure that requires special attention.

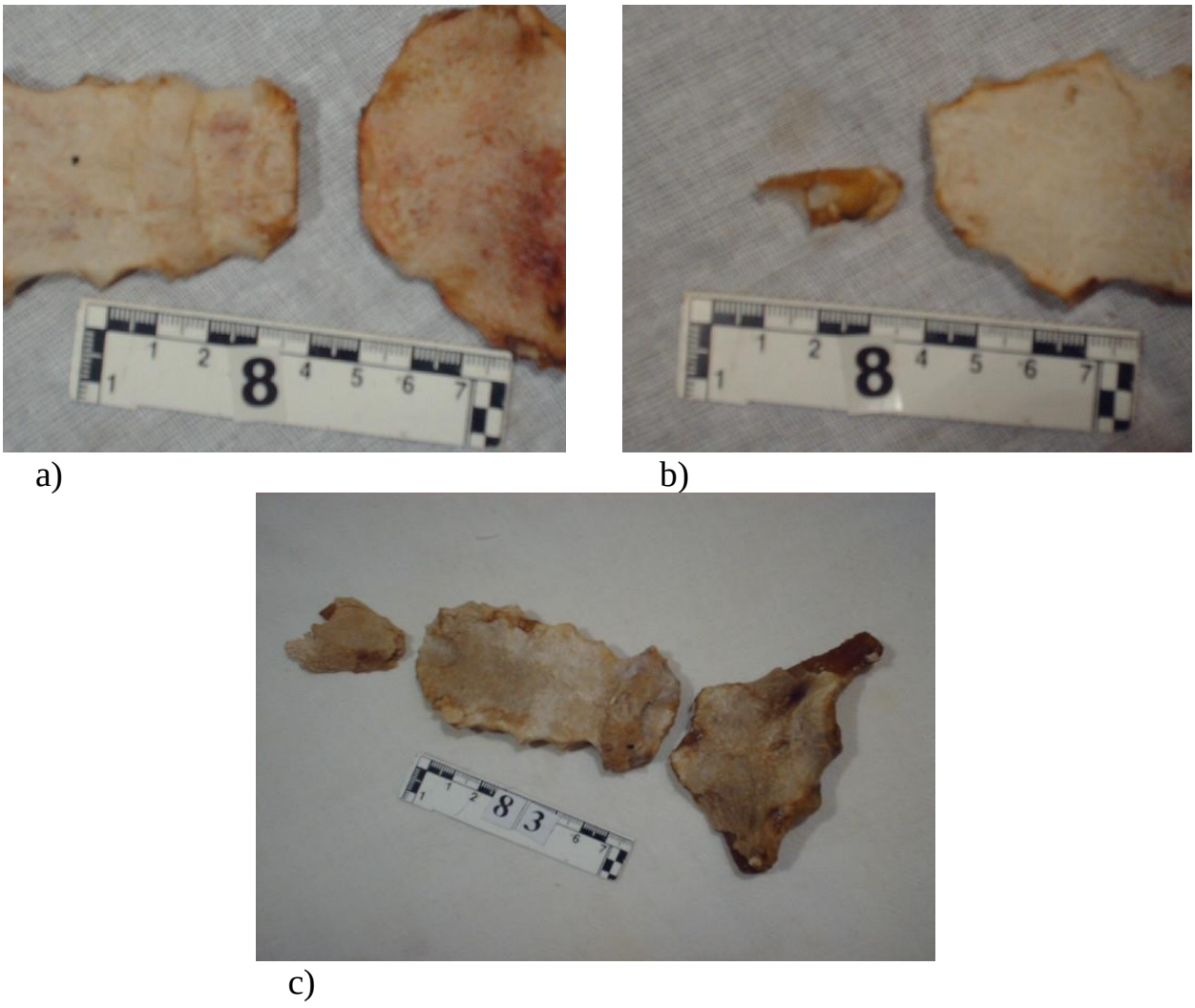
In the section of **10-19 years** of age, the sternum consists of a flat bony tissue, is located on the frontal surface, and consists of a manubrium, a body and a xiphoid proces, and is light brown in color. Between the segments of the body part, a thick floor is visible. The formation of fusion nuclei was observed at the fusion of segments of the body part. In the upper corners of the sternum handle part, the area of the vertebral bone and the 1st rib joint surfaces are different, and also in the 3rd segment of the body, the rib joint areas are also different. The jugular vein bulge is formed from the handle of the sternum, and the 2nd rib fusion surface is formed. It is observed that there are less defined borders between the segments of the body of the sternum (Fig. 1).



a) b)

Fig. 1. a), b). The appearance of the presence of thick cartilage between the segments of the sternum body, as well as the absence of rib sockets Overview of manubrium and body parts.

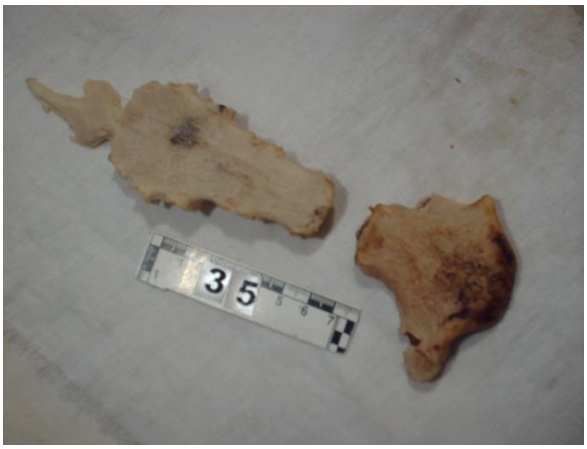
For individuals aged **20-29**, it is not uncommon for the joint between the body of the sternum in the 1st and 2nd segments to go undetected. In some cases, small tooth-like protrusions can be observed in the joint space of the body. Additionally, there may be small dents present on the lower edges of the handle. However, no cuts are typically found on the edges of the 1-2 rib cages. The rib socket of the body part tends to be almost flat, with the depth of the 3rd rib socket ranging from 8 mm to 10 mm. Furthermore, the joint area of the sternum with the handle and the body part may exhibit slight hardening (Fig. 2).



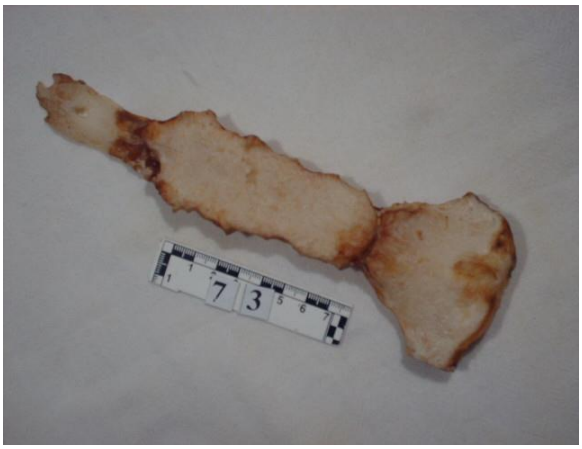
a) b) c)

Fig. 2. a), b), c). General view of the joint area of the sternum body with the handle, the area of the joint of the sternum body with the xiphoid process, and the general view of the sternum body and handle. Also, the appearance of small tooth-like structures on the lower edges of the handle and the edges of the rib cages are shown.

At the **age of 30-39**, small tooth-like bumps appear on the lower edges of the handle part of the sternum. There are no cuts on the edges of the rib cages. The sternum handle and the body part are united or united (intercostal space, notches, depressions) (Fig. 3).




a)




b)


c)

Fig. 3. a), b), c). General view of the area of the junction of the body part of the sternum with the manubrium, the area of the union of the body part of the sternum with the xiphoid process. It is also shown that the lower edges of the manubrium have small dents, and the presence of cuts on the edges of the rib sockets.

In the **40-49 age group**, the interstices of the manubrium, body part and xiphoid process of the sternum are united or merged (synostosis). The sternum is flattened by the disappearance of the marks of fusion between the segments of the body part (Fig. 4).

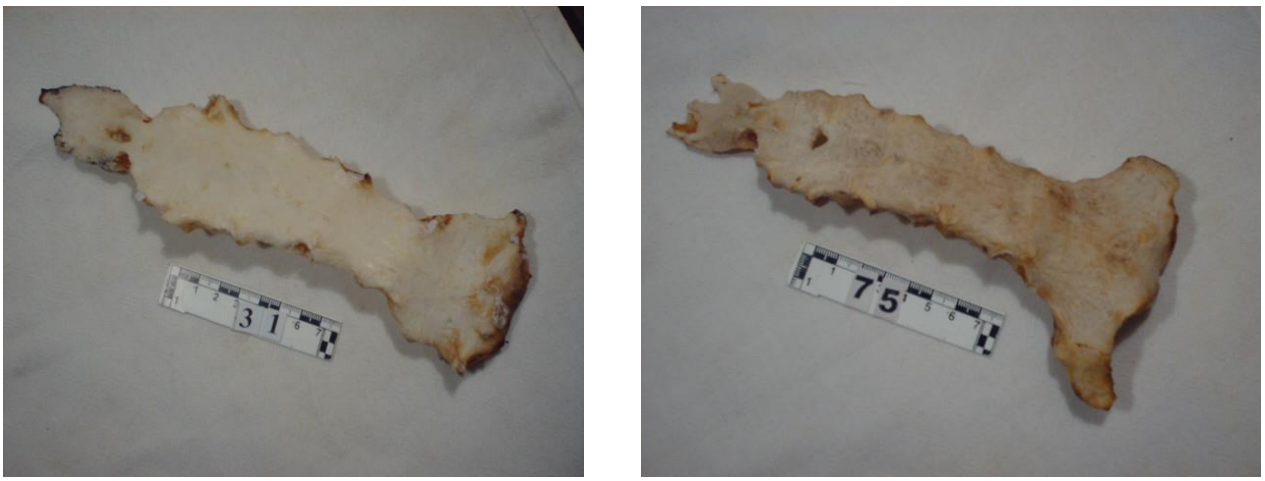

a)


b)

c)

Fig. 4. a), b), c). Area of connection of the body part of the sternum with the manubrium, area of connection of the body part of the sternum with the xiphoid process, general view of the sternum. Also, the surface of the sternum, the bulging bone in some parts, and the presence of bone barriers in the rib sockets were shown.

In the **50-59 age group**, the sternum is often combined with the manubrium, the body and the xiphoid process. The surface of the sternum is uneven, bumpy areas appear, and the presence of bone barriers in the rib grooves is determined (Fig. 5).



a) b)

Fig. 5. a), b). Area of connection of the body part of the sternum with the manubrium, area of connection of the body part of the sternum with the xiphoid process, general view of the sternum. It is also shown that the surface of the sternum, some of its parts have raised ridges, and the presence of bone barriers in the rib sockets.

At the **age of 60** and older, the sternum fuses with the manubrium, body and xiphoid process (synostosis). The surface of the breast is uneven, and there are developed convex areas. Wing-like lesions are observed on the joint edges of the body parts, and in some parts, signs of erosion of the compact plate with a focus are determined (Fig. 6).

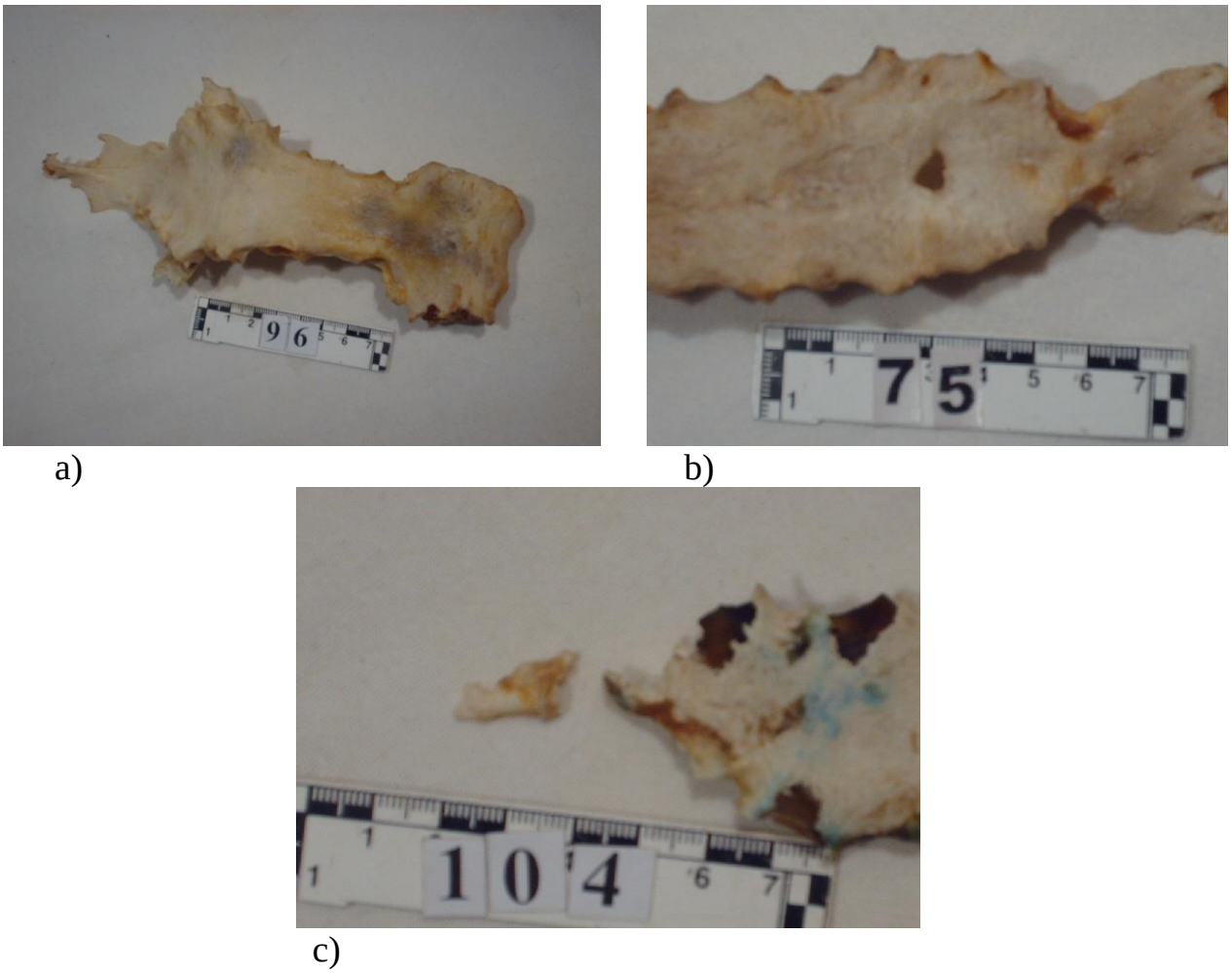


Fig. 6. a), b), c). The general view of the sternum, the area where the sternum body part joins the xiphoid process, the wing-like cuts on the joint edges of the sternum body part, and signs of erosion of the compact plate with the hearth in some parts are shown.

In the field of identifying skeletal remains, it's understood that each bone possesses distinct characteristics. While developmental changes in these bones serve as a dependable means for estimating age, they don't provide a conclusive determination. Instead, we can only provide an estimated age of the bone. The study of skeletal changes over time remains a crucial component of age assessment and has proven to be a reliable and long-standing practice within medico-legal work.

**Conclusion.** The research findings suggest that studying only the sternum and analyzing certain features can enhance the probability of accurately determining skeletal bone age. This approach can help alleviate some of the primary challenges. The study demonstrates that the sternum is a highly practical tool for identification and can effectively assist experts in accomplishing their objectives.

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