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Anthropometric aspects of the human skeleton

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Abstract

The anatomy deals with learning about the shape and structure of the human body, and at the same time it is the basis for all sciences whose scope of interest relates to the human body. Anthropometric studies are aimed at translating the size and shapes of the human body into specific numbers and quantitative ratios, thus they constitute a set of measurement techniques and methods, through which it is possible to closely examine the diversity of human measurable features as well as variability in individual and evolutionary development. The scope of measurements in anthropometry applies mainly to sections, circumferences, angles between planes or body lines. The aim of the work is to present selected anatomical features of the human skeleton in the aspect of sexual dimorphism and individual human variability.

Keywords: skeleton, biometry, sexual dimorphism

1. Introduction

Elements of the human body are given specific and precise names, based mainly on their position, e.g. in relation to the above axes and planes. This creates the possibility of systematising the anatomical terminology used in various fields of science [1]. Knowledge of the anatomy of the human body is necessary in the case of issues in the field of anthropometry, which is based on comparative measurements of parts of the human body, e.g., bone length, volume and proportions of the skull, head, body proportions, body weight, eye spacing, etc. Measurement range in anthropometry it applies mainly to sections, circumferences, angles between planes or body lines [2].

Research on the variability and simultaneously regularity of human morphology is based on the collection and analysis of information such as:

• external features of individual body parts;

• spatial arrangement of organs and systems in relation to each other;

• record data of individual dimensions.

The important thing is that without knowing one variation, you cannot correctly determine the next [3].

2. Purpose of work

The aim of the work is to present selected anatomical features of the human skeleton in the aspect of sexual dimorphism and individual human variability

3. Description of knowledge

The measurement of features is carried out in a fixed position, in accordance with the measurement technique adopted by the International Organization for Standardization. During the measurements, the patient is in a standing position, upright and with loosely lowered hands, in the case of infants and the disabled, the measurement is performed in a lying

position. The correct body posture is defined when the individual sections of the body are harmoniously arranged in relation to each other, as well as in relation to the main axis of the body, while the tension of the muscular and nervous systems occurs to a minimal extent [4].

Performing static anthropometric measurements is possible with respect to fixed points. The breakdown looks like this:

• height measurements (body height, limb height, etc.);

• length measurements (torso, upper limb, etc.);

• measurements of width and depth (shoulders, hips, etc.);

• measurements of circuits (head, neck, waist, etc.);

• others (diameter of the hand grip, etc.).

In this case, measurements referring to the angles between different sections of the human body or bones [5]. The following division can be distinguished:

• static goniometry (measuring the size of angles between planes and sections of the body or bones, e.g. facial angles, spinal angles, angles of the anterior torso wall);

• dynamic goniometry (measurement of motion ranges in individual joints of the organism: trunk, upper and lower limbs, eg chest movement volume, head inclination, spine movement, the size of limb joint movements).

The results of goniometric measurements determine the possibilities of ranges and spans of movements of the human body. For example, the range of motion in the radial-wrist joint in the dorsal flexion is 70-80º, palmar folding 80-90º, radial deflection15-20º, abduction40-50º [6].

A special contribution to the development of anthropometry was made by French police officer Alphons Bertillon (1853 - 1914), who assumed that the physical development of man is subject to strict laws, i.e. some human bones do not undergo any changes after reaching a certain age (Figure 1), and in addition that there are no two identical people in the world with the same body dimensions, his conclusions, he brought to methods and techniques of measuring individual parts of the human body, creating their identification system based on the following theses [7]:

• process-development, in the case of the human skeleton, ends around the age of 21, so the dimensions of the skeleton after this period do not change (for example, he observed that the chest ceases to grow after 20 years of age);

• the identity of the skeleton dimensions and the measurement relations between the various parts is practically impossible in the case of the general population;

• some measurements of the human body can be carried out with simple techniques, using

simple tools, thus maintaining accuracy.

Figure 1. The sacrum bone (os sacrum) is formed from the combination of five crucifers around 20-25 years old. On the left side, the view of the sacrum bone, and on the right side the sacral vertebrae [own elaboration].

Variability of morphology in the skeletal area of women and men is clear. Male bones are characterized by durability and size, eg the sternum of the sternum is twice as long in the handpiece and the collarbone is more bent than in women. The most important elements of the skeleton's sexual dimorphism are the pelvis and skull [8]. Numerous studies prove that the accuracy of determining gender in the pelvic area is as much as 90%, while in the case of the skull it is 80% [9]. Anthropometric differences indicate that the shape of the male pelvis is tall, narrow and strongly sculptured, in combination with the pelvis of women, which is wide and low with a delicate structure. In the men's pelvis, the pubic angle is acute (Fig. 2), deep and narrow sciatic sciatica, high hip plates, vertically aligned, long, narrow and not bent sacrum. In the pelvis of women, the iliac plates are deflected and the pubic angle obtuse (Fig. 3), the sciatic incision is shallow and wide, the sacrum is broad, short and flat, bent [8].

The skull examination is one of the most important measurements of the human skeletal system, because it has the most diagnostic features. In the sexual dimorphism, the skull of a man (Fig. 4) is on average wider, larger and more massive, and the occipital bone with the system of bone boundaries is a clear muscle trailer. The mastoid process is larger and more massive, the bony incision present on it is deep, the supraorbital bony thickings, that is the eyebrow arches, are clearly marked. Eye sockets have rounded edges, are smaller and wider apart than in women. The frontal bone is inclined towards the back, there are no bone tumors on it. In the skull structure of a female (Fig. 5), the osteotile has an almost smooth outer

surface, the eyebrow arches are smooth, straight and thin, the frontal bone goes vertically into the nasal bone, which is caused by pronounced frontal tumors, and similar bone tumors are found within the bone parietal [10].

Figure 2. Pelvis of an adult male, dashed pelvic angle [own elaboration]

Figure 3. Pelvis of an adult woman, dashed pelvic angle, drafted [own elaboration].

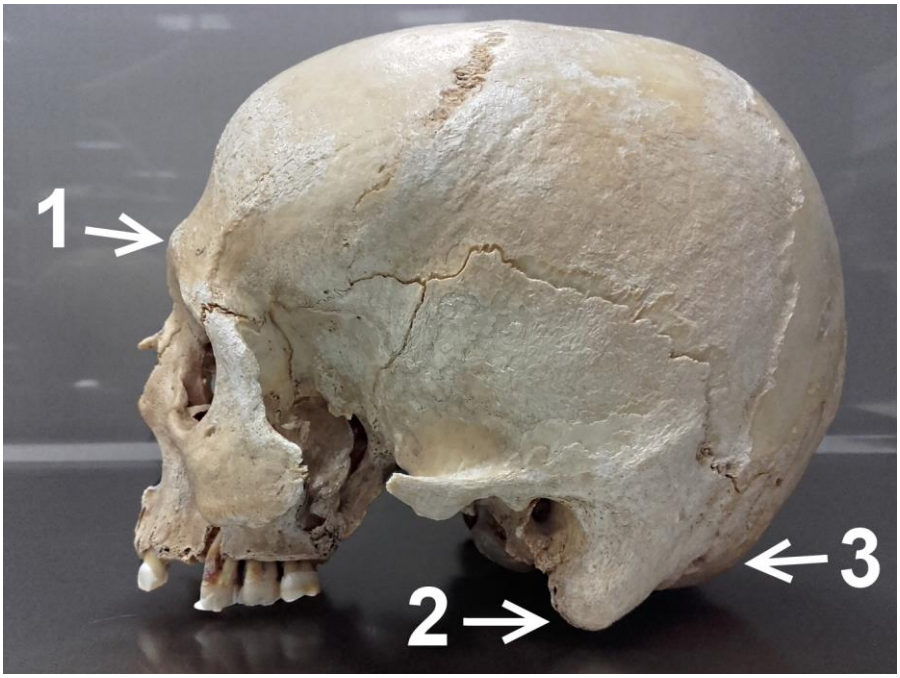

Figure 4. Skull of an adult male, eyebrow ridge (1), mastoid process (2), occipital protuberance (3) [own elaboration]

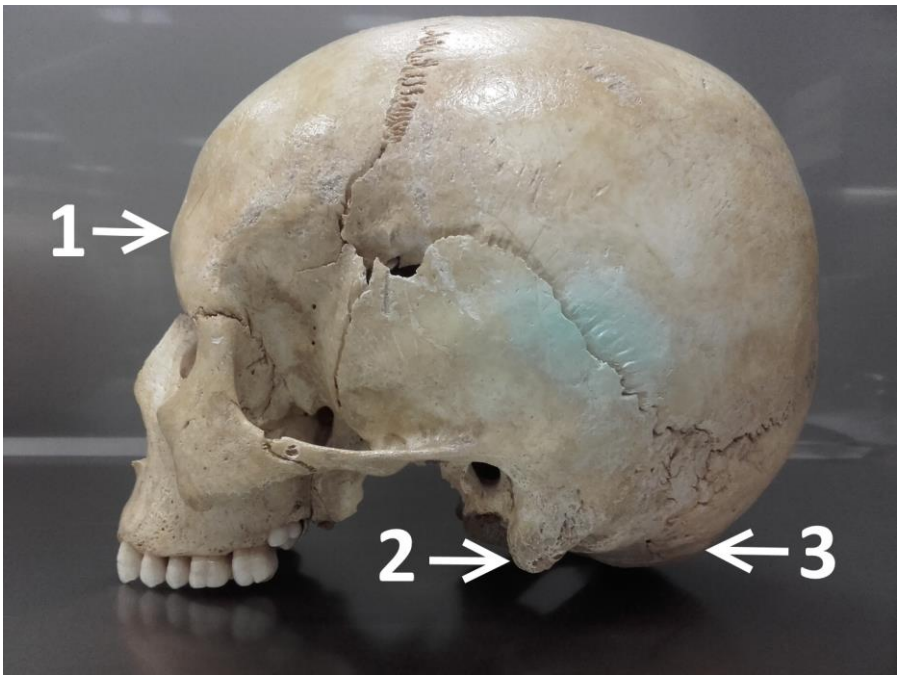

Figure 5. Skull of an adult woman, eyebrow ridge (1), mastoid process (2), occipital protuberance (3) [own elaboration]

Methods of age estimation are associated with developmental changes such as: bone length, teeth changes, eruption of teeth, and the appearance and connection of secondary

centers of bone development. Aging of adults, most visible through changes in the state of the cranial sutures and morphological changes in the pubic symphysis (determination of the age up to 50 years), as well as changes in the sacroiliac joint (range allows estimates over 50 years), as well as changes in the morphology of the sternal ends of the ribs [11].

The development of teeth begins in the period of 14-16 weeks after fertilization, in its course there are four periods. The first period concerns the appearance of most milk teeth in the 2nd year of life. Permanent teeth, usually the first permanent molar, appear in the 6-8 year old. Most often, permanent canines, premolars and molars appear between 10 and 12 years old. The last period concerns the third molar appearing around 18 years of age [10, 12]. Man's age can be determined based on the development of teeth in several ways, including comparing the teeth of an unknown person with a graph or atlas showing the average stage of development of the entire human teeth (Fig. 6-7).

Figure 6. Child's mandible, about 5 years old (± 1.5 years) [own elaboration]

Estimation of the human age on the basis of bone material is also possible by making an arrowhead of the upper root of the humerus, which is further information about the state of the intermediate cartilage and medullary cavity, this method is called the Wachholz method developed at the end of the 19th century. It should be noted that the upper root of the humeral shaft separates the intermediate cartilage, which ossifies between 17 and 18 years of age, and in men between 19 and 21 years of age. In human development, the medullary canal becomes longer, at the age of 28 years women are already reaching the surgical neck, while in men over 30 years of age. The medullary canal reaches the anatomical neck in women between 35 and 40 years of age, in men a bit later [8].

Figure 7. Youth's mandible about age 15 (± 3 years) [own elaboration]

4. Conclusions

Conducting research on morphological features of the human skeleton aims to improve the procedures for determining the individual variability of the human population, it is also worth remembering various factors (external and internal) affecting human development, e.g. population differences resulting from different living conditions. Each human body is different, and each reacts differently to genetic and environmental factors while maintaining at the same rate of development.

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