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MORPHOLOGICAL VARIABILITIES OF THE SKULL

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Summary

The article describes different aspects of variability of the human skull: gender, age and ethnic. An attempt of systematization of the structural features of the skulls is undertaken .

Rezumat

Variantele morfologice ale craniului

În articol se descriu diferite aspecte referitoare la variabilitatea craniului uman: de sex, de vârstă și apartenența etnică. Este întreprinsă încercarea sistematizării particularităților structurale ale craniilor.

News Theme

One of the most important aspects of behavior management in pediatric dentistry is pain control. Basically, in order to have a rapid, deep and safe local anesthesia, location of MF in relation to the occlusal plane should be acquired. As the child grows up, the position of MF changes. Hence, for a successful mandibular local anesthesia, consideration to such changes is imperative. Differences between male and female skull and between individuals of different races are very important in forensics to determine the sex of the skull which has been recovered and in the establishment of a victim's ethnic origin.

Aim

The aim of this study is to investigate the influence of age and gender on the structure of the human skull. The purpose of this investigation was to establish how the mandibular angle changes with age and loss of teeth among the sexes.

Materials and methods

A wide range of literature on the subject was studied, and made an observations were made on 30 human skulls which were selected from the skeletal collection of the Department of Anatomy of our university, College of Medicine and 20 radiographs taken from the Department of Stomatology. Ten of them were child and twenty adult skulls. Images of the skulls were obtained using a digital camera.

Discussions and results

The skull is the bony section of the head. The skull encases and protects the brain, houses the brain senses, provides attachments for muscles of the head and neck, and helps to form the first

portions of the respiratory and digestive tracts. At birth, the skull is large in comparison to the rest of the body, and a baby's skull is compressible. A human skull is almost full sized at birth. However the 8 bones that make up the cranium are not yet fused together. This means that the skull can flex and deform during birth, making it easier to deliver a baby through the narrow birth canal. The "soft spots" in a baby's head harden and grow together until the bones meet and mesh like a jigsaw puzzle. The largest of the six main soft spots is a diamond-shaped area near the middle of the top of the skull. This is the last area to harden and close, usually at about the age of eighteen months.

The skull of the infant is markedly different from that of the adult. At birth the face is quite small and undeveloped, while the cranium is relatively large. The frontal and parietal eminences are very marked. The vault of the skull is not entirely ossified and the sutures are not completed. The bones of the base of the skull originate in cartilage, while those of the vault originate in membrane. This membrane has one or more centres of ossification appearing in it for each bone. These centres increase in size and finally meet at the edges of the bone, thus forming the sutures. At the time of birth the sutures are represented by membrane, which joins the adjacent bony edges. The frontal bone has two centres of ossification; one for each side. These form a suture in the median line of the forehead which becomes obliterated in the course of the first or second year. Traces of it in the shape of a groove or ridge can sometimes be seen or felt in the adult skull.

The frontal eminences are far more marked in childhood than later in life and give to children the prominent forehead. A similar peculiarity is seen in the parietal bones, the parietal eminences being quite prominent. On this account, they are often injured in childbirth, sometimes being compressed by the obstetrical forceps, and are frequently the seat of haematoma neonatorum. The cranial bones not being firmly united allow of a certain amount of play or even overlapping, thus facilitating the delivery of the head at birth.

At the juncture of the various bones there are six spaces called fontanelles. Two, the anterior and posterior, are in the median line of the cranium, and four, the two anterolateral and two posterolateral, are at the sides. The fontanelles are situated at the four corners of the parietal bones.

The anterior fontanelle is the largest. It is diamond-shaped and formed by the frontal suture in front, the interparietal behind, and the coronal at each side. It is usually closed by the end of the second year, but may be delayed until the fourth. In rickets and malnutrition the fontanelles remain open longer than would otherwise be the case.

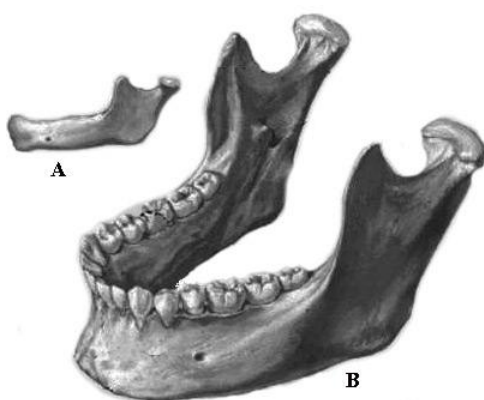


Fig. 2. Mandible of the infant (A) and adult (B).



Fig. 1. The body of the mandible with completely resorbed alveolar process.

The posterior fontanelle is formed by the juncture of the parietal (sagittal) suture with the lambdoidal suture. It is triangular in shape with the apex forward between the two parietal bones, the sides passing down, one to the right and the other to the left of the top of the occipital bone.

The pliable head which allowed the child to safely pass through the birth canal is also responsible for enabling normal human development during the first 18 months of a child's life. During this period the brain grows rapidly and the skull has to be flexible enough to adapt to its growth. The natural development of the cranial and facial bones involves changes in skull shape, which is also accommodated by the lack of a

permanently fused skull. The permanent skull is fused between the ages of 20 months and two years.

During an individual's life, the morphological changes undergone by the mandible are thought to be influenced by the dental states and age of patient.

The mandible and also the associated maxillary alveolar process may be almost completely resorbed in elderly edentulous patients (Fig.1).

Tab.1. How to know roughly the age of the mandible?

<i>Age</i>	<i>Angle</i>	<i>Mental foramen</i>	<i>Alveolar border</i>
<i>At birth</i>	About 170° (very obtuse)	Near the lower border	No eruption of the teeth
<i>At 4 years</i>	About 145° (25° less)	Slightly higher in position	Eruption of the 10 milk teeth
<i>Adult</i>	About 120° (25° less)	Midway between the upper and lower borders	Eruption of the 16 permanent teeth
<i>Old age</i>	About 145° like young age again	Near the upper border (due to absorption of the alveolar margin)	Shows loss of teeth and absorption of the alveolar margin

The funnel-shaped lip of the mandible in old age causes the prominent chin and leads to a reduced height of the lower face. In old age, the mandible is shaped like a clasp and flattened so that it looks similar to the mandible of a newborn.

Severe atrophy results in the mental foramen becoming relatively more superior and closer to the upper edge of this clasp and no longer visible from the vestibule. Atrophy of the alveolar process significantly reduces the distance from the mandibular canal to the upper edge of the mandible so that in rare cases the inferior alveolar nerve is located directly underneath the mucosa.

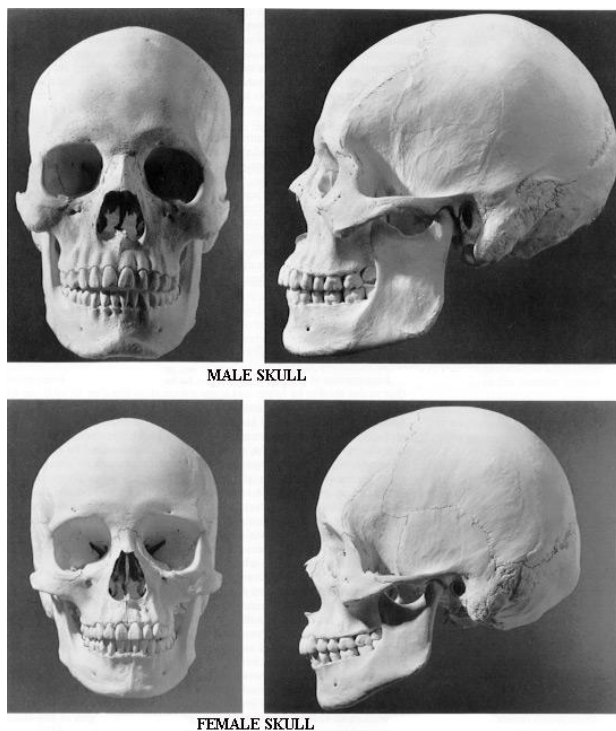


Fig. 3. Sex differences of the skull.

Male and female skulls also show significant differences in structure (Fig.3). The small bulge at the back of the head known as the external occipital protuberance is usually more pronounced in men. The male jawbone or mandible is typically angular and square-shaped at the chin area, while the female jawbone tends to be more rounded and pointed. The brow ridges of men are often more prominent than those of women. These distinctions in cranial and facial features underlie the basic difference between men's and women's faces.

All dimensions of the female skull and face are smaller compared to the male features. The facial width is relatively larger in women than in men. Resulting contours are therefore more rounded in females, especially in the orbital area, with more prominent malar (cheek) bones and less prominent mandibular (chin/jaw) angles.

In the upper part of the face, the forehead is

quite different, most noticeably women have less sloping mid-foreheads and the position of their eyebrows is higher and has a stronger curvature.

In the middle part of the face, the angles of the nose differ substantially, especially at the tip portion. Females generally have a more pointed, narrow, and vertically shortened less nasal prominence than males.

Tab.2. Sex and gender differences of the skull

<i>Cranium Feature</i>	<i>Male</i>	<i>Female</i>
<i>General size</i>	Large	Small
<i>Architecture</i>	Rugged	Smooth and gracile
<i>Supraorbital torus</i>	Medium to large	Small to medium
<i>Mastoid process</i>	Medium to large	Small to medium
<i>Occipital bone</i>	Muscle lines and protuberance marked	Muscle lines are not marked
<i>Frontal eminence</i>	Small	Large
<i>Parietal eminence</i>	Small	Large
<i>Orbit</i>	Squared, lower, relatively smaller with rounded superior margins	Rounded, higher, larger with very sharp superior margins
<i>Forehead</i>	Steeper, less rounded	Rounded and full, sometimes infantile
<i>Cheek bones</i>	Heavier, more laterally arched	Lighter, more compressed
<i>Mandible</i>	Larger and more robust, higher symphysis, gonial angle less than 125°, gonial angle flares and is sharply angled	Smaller and lighter, gonial angle more than 125°, gonial angle does not flare as much outward and sharply angled
<i>Ramus of mandible</i>	Straight	Slanting
<i>Symphysis and mental eminence of mandible</i>	Square	Rounded (generally) or pointed
<i>Palate</i>	Larger, broader, tends to the U-shaped	Small, tends to be a parabola
<i>Occipital condyles</i>	Large	Small
<i>Posterior part</i>	Has a protuberant crest that may continue posteriorly to meet with the most inferior curve on the temporal lines	Crest usually not as pronounced, does not continue across to temporal lines
<i>Frontal Bone</i>	Lower/sloping	More vertical and rounded
<i>Temporal Ridge</i>	Large	Small
<i>Bony superciliary arches</i>	Prominent	Absent/slight
<i>Mastoid process</i>	Large	Small (generally)
<i>Supraorbital margin</i>	Rounded	Sharp
<i>External occipital protuberance</i>	Generally present	Generally absent
<i>Nuchal crest</i>	Rugged, well defined	Smoother, even absent
<i>Nuchal line</i>	Rugged and sharp	Absent
<i>Zygomatic process (cheek bones)</i>	Extends past external auditory meatus	Does not extend past (generally)
<i>Paranasal sinuses</i>	Larger	Smaller
<i>Teeth</i>	Larger	Smaller
<i>Cranium</i>	Deeper and larger by about 10%	Smaller
<i>Total skull</i>	Rougher, heavier	Smoother and more rounded

In the lower part of the face the most dominant differences are found in the chin region, which varies markedly between the male and female. The male chin is larger in every dimension, the mandible symphysis (upper chin) is generally wide and vertically high, while the female is more rounded, and the male mental eminence (point of the chin) tends to be square and the female more pointed. The degree of perceived masculinity/femininity due to the chin can vary tremendously.

Bishara *et al.* (1990) showed that dento-facial parameters are bound to ethnic origins.

Until the age of puberty there is little difference between the skull of the female and that of the male. The skull of an adult female is, as a rule, lighter and smaller, and its cranial capacity about 10 per cent. less than that of the male. Its walls are thinner and its muscular ridges less strongly marked; the glabella, superciliary arches, and mastoid processes are less prominent, and the corresponding air sinuses are small or rudimentary. The upper margin of the orbit is sharp, the forehead vertical, the frontal and parietal eminences prominent, and the vault somewhat flattened. The contour of the face is more rounded, the facial bones are smoother, and the maxillæ and mandible and their contained teeth smaller. From what has been said it will be seen that more of the infantile characteristics are retained in the skull of the adult female than in that of the adult male. A well-marked male or female skull can easily be recognized as such, but in some cases the respective characteristics are so indistinct that the determination of the sex may be difficult or impossible.

We have found that there are the key skull differences between the female skull and the male skull. First of all, the male cranial mass is more blocky and massive compared to the female's one which is more rounder and tapers at the top.

Secondly, the female's brow ridge margin is sharper while the male's one is rather rounded and dull. Thirdly, the zygomatic bone is more pronounced on the male skull than on the female skull.

The Mandible or the lower jaw is more rounded on the female skull while the male skull is squared. Also, the male have a deeper cranial mass than the female dose. And, last but not least- the superciliary arch of the male skull is more pronounced and larger than the female skull.

There is a number of differences in the structure and appearance of bones between individuals of different races that can be observed and used in the establishment of a victim's ethnic origin. The majority of these differences are based in the skull.

Caucasian skull, or white European descended people have relatively no prognathism (or the extension of the lower jaw) and relatively little projection of the alveolar ridge. Faces are typically smaller, with a tear-shaped nasal cavity and tower-shaped nasal bones. The palate is triangular and the skull has a sloping eye orbital formation. The forehead and cranium are prominent.

Mongoloid skull, or Asian people have small to no extension of the lower jaw and the nasal sill or dam, and an oval nasal cavity. The nasal bones are tent-shaped and the palate is horseshoe-shaped. The eye orbital is rounded and non sloping, and the cranium is generally rounded.

Black, or Negroid skulls feature a broad and round nasal cavity and no dam or nasal sill. There is notable facial projection in the jaw and mouth area and a rectangular palate. The eye orbit shape is square or rectangular. The skull is dolichocephalic, which means longer from front to back proportionally.

In general, the racial group to which the person belongs is determined by examining the width and height of the nose. It is important to note that many of these characteristics only have a higher frequency among particular races and the presence or absence of one or more does not automatically classify an individual into a racial group. Different human populations have developed close proximity to one another due to mixed ethnic heritage.

Tab.3. Differences in the structure and appearance of bones between individuals of different races

	<i>Caucasian/European</i>	<i>Negroid</i>	<i>Mongoloid</i>
<i>Nasal Cavity</i>	Steep towering nasals Large nasal spine Narrow nasal aperture Triangular nose holes	Semicircle nasals Small nasal spine Large nasal aperture Square nose holes	Tented nasals but not towering and sharp. Diamond shaped nose holes Small nasal spine Nasal aperture larger than Caucasian
<i>Prognathism</i>	Maxillary prognathism "overbite"	Mandibular prognathism "underbite"	Most often no prognathism, face relatively flat. Chin is more vertical. If prognathism is present it favors a maxillary trend
<i>Eye Orbit</i>	Angular, lower eye border receding	Square or rectangular, lower eye border receding	Round, lower eye border projecting
<i>Mouth and teeth</i>	Parabolic dental arch and spatulate teeth shaped like a spatula; rounded more or less like a spoon.	Hyperbolic rectangular-shaped palate and megadontic teeth, spatulate	Dental arch is rounded, incisors shoveled swollen lateral borders and a hollow in the center of the crown
<i>Zygomatic bones</i>	Curved	Curved	Squared

Conclusions

Knowledge of the large variability of the human skull is needed to dentists, pediatricians, specialists of forensic services for the proper implementation of the anesthesia and plastic surgery, assessment of child development, and for the establishment of a victim's origin.

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