

## MORPHOLOGICAL PARTICULARITIES OF THE JACKAL SKULL (*CANIS AUREUS*) - CASE STUDY

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### Abstract

*This study aims to describe the morphological characteristics of the jackal skull. The jackal (Canis aureus) belongs to the Order Carnivora, Family Canidae, and is widespread in northern Africa and southern Europe. In Romania, the number of specimens of this species has dramatically increased in recent years because the jackal has no natural predators, and wolf specimens are rare. The skull features are valuable elements of species identification. Data on skull morphology in jackals in the specialized literature are few and lacking in detail. A skull from an adult specimen from the Anatomy discipline collection was used for the study. The following conclusions emerged: the external sagittal crest is very high; the paracondylar processes are attached to the tympanic bulla; the foramen lacerum is absent; the presence of 2-3 lesser palatine foramina, placed caudal to the greater palatine foramen; the supraorbital foramen is absent; on the medial face of the angular process there is a reduced fossa.*

**Key words:** jackal, lesser palatine foramina, skull.

### INTRODUCTION

The jackal (*Canis aureus*) is part of the *Carnivora* family, presenting phenotypic and genotypic characteristics similar to those of the wolf and coyote.

There are numerous studies in the specialized literature, some on the jackal's dentition, which noted differences compared to wolves; the canines are thinner but more robust, while in the carnivores, they are weaker. All differences are correlated with specific feeding characteristics. Similarities to the domestic dog have been observed; the dentition is diphyodont, heterodont, brachyodont and secodont type, and the upper dental arch is longer than the lower one (Stan, 2016).

Macro-anatomical studies were conducted on the golden jackal skull to achieve clinical applications during anesthesia (Louei Monfared, 2013).

Sexual dimorphism in golden jackals, considering the linear body parameters and weight between males and females, is weaker than in red foxes and wolves (Raichev et al., 2017). There are several studies on head variability and differences in morphometric data of jackal skulls among jackal species found in

Europe, Asia and Africa (Stoyanov, 2020; Markov et al., 2017; Rutkowski et al., 2015).

There are various studies on other carnivores' skull morphology, but mostly on felines such cheetas, and domestic cats and a few on other skull morphology such as brown bears (Roșu et al., 2016; Georgescu et al., 2016; Roșu et al., 2022).

### MATERIALS AND METHODS

A skull from an adult jackal (*Canis aureus*) was used for the study. The skull belongs to the collection of Anatomy discipline of the Faculty of Veterinary Medicine Bucharest. The most relevant morphological aspects were described and photographed. Description and identification follow the *Nomina Anatomica Veterinaria* (N.A.V.), 2017.

### RESULTS AND DISCUSSIONS

The jackal's skull (*Canis aureus*) is of the dolichocephalic type, with an elongated and narrow appearance.

The dorsal side of the skull has an elongated and narrow appearance, with a maximum

neurocranium width in the middle portion of the parietal bones.

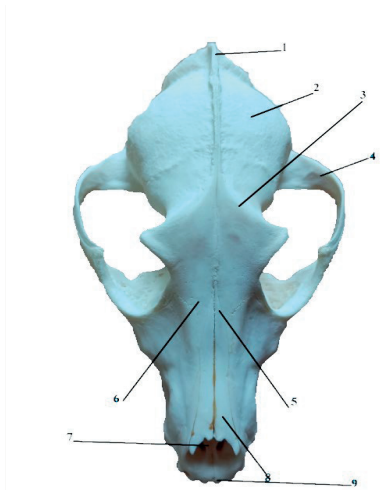


Figure 1. Dorsal face of jackal (*Canis aureus*) skull – original:

1. External sagittal crest; 2. Parietal; 3. Temporal line;
4. Zygomatic process of the temporal; 5. Frontal process of the nasal;
6. Nasal process of the frontal; 7. Nasal notch; 8. Nasal; 9. Interincisive foramen

The external sagittal crest starts from the external occipital protuberance, is very high at the interparietal bone level and in the parietals' aboral extremity, and decreases in a rostral direction. At the frontal level, it divides into two temporal lines (Figure 1).

The frontal bone presents, rostrally, a nasal process between the caudal extremities of the nasal and the maxilla.

The zygomatic processes of the frontals are very short, directed ventro-laterally and lack supra-orbital foramina at the base. The dorsal surface of the frontals is slightly convex, creating a small, narrow and slightly elongated frontal fossa at the level of the interfrontal suture.

The nasals are narrow and elongated, ending in the caudal extremity through very sharp frontal processes. The nasal bone ends bifid at the rostral extremity, creating a wide notch between the short medial and elongated lateral parts (Figure 2).

The nasal process of the incisive bones ends tapered, exceeding the maxilla's upper half edge, and the body of the incisive is convex in the caudo-rostral direction.

The vomer presents a deep septal groove, and in its caudal extremity, it does not articulate with

the aboral portion of the palatine processes, delimiting a vast subvomer space through which the two nasal cavities communicate. The nasal opening is wide, so the single first endoturbinde and the divided maxilloturbinate are visible.

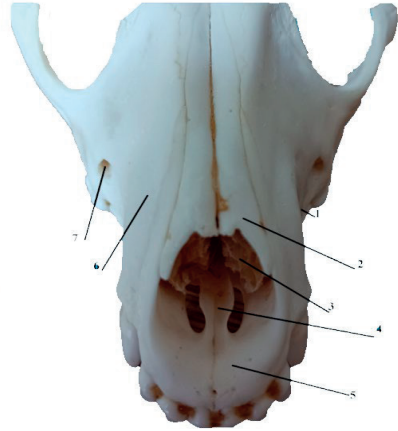


Figure 2. The rostral extremity of the jackal (*Canis aureus*) viscerocranium - original

1. Canine fossa; 2. Nasal; 3. Maxilloturbinate; 4. Vomer;
5. Incisive; 6. Maxilla; 7. Infraorbital foramen

At the rostral extremity of the interincisive suture there is a very narrow interincisive canal visible on both sides.

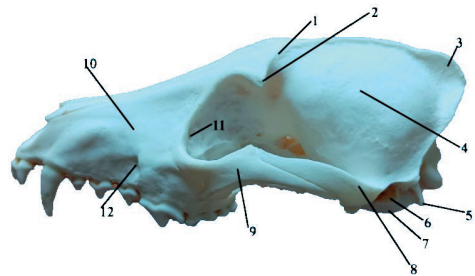


Figure 3. Lateral view of jackal (*Canis aureus*) skull – original:

1. Temporal line; 2. Zygomatic process of the frontal;
3. External sagittal crest; 4. Parietal; 5. Jugular process;
6. External acoustic meatus; 7. Tympanic bulla; 8. The zygomatic process of the temporal;
9. Zygomatic; 10. Maxilla; 11. Lacrimal foramen; 12. Infraorbital foramen

The orbit is incomplete (Figure 3). The convex temporal fossa communicates broadly with the orbit in a rostral direction. The orbito-temporal crest is short but very well-defined in its dorsal

extremity. The temporal line of the zygomatic bone is well-highlighted.

The fossa of the lacrimal sac is narrow and has a single lacrimal foramen. At the level of the maxilla, there is a large, elongated infraorbital foramen located caudal to the reduced canine fossa. The maxillofacial crest is absent.

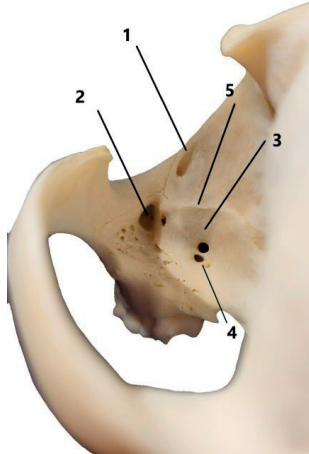


Figure 4. Maxillary hiatus (*Canis aureus*) - original:  
1. Lacrimal foramen; Maxillary hiatus; 2. Maxillary foramen; 3. Sphenopalatine foramen; 4. Caudal palatine foramen. 5. Inferior orbital crest

On the medial wall of the orbit is a reduced inferior orbital crest that descends from the level of the lacrimal foramen. Caudally, above it, is an ethmoid foramen. The supraorbital margin is reduced in length and does not show a supraorbital notch or foramina.

The maxillary tuberosity features a reduced medio-caudal spine toward the pterygopalatine crest. Within the maxillary hiatus there are three foramina: maxillary, sphenopalatine, and caudal palatine. The maxillary foramen is wide and elongated, located ventral to the lacrimal fossa, and connects with the infraorbital foramen via the infraorbital canal. The sphenopalatine and caudal palatine foramen are located medial to it and separated by a reduced transverse bone plate (Figure 4).

The orbital hiatus is wide, shallow, and at its level open: the optic canal, the orbital fissure, and in the same opening round foramen with the rostral alar foramen. The last one communicates with the caudal alar foramen through a short alar canal (Figure 5).

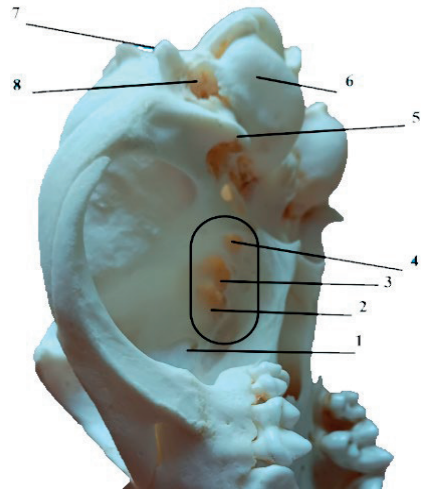


Figure 5. Lateral side of the jackal (*Canis aureus*) skull - original:  
1. Ethmoidal foramen; Orbital hiatus; 2. Optical canal; 3. Orbital fissure; 4. Round/rostral alar foramen; 5. Retroarticular process; 6. Tympanic bulla; 7. Caudal process (occipital); 8. External acoustic meatus

Two highly developed, latero-medially convex, obliquely arranged tympanic bullae are on the ventral face in the aboral extremity. The hypoglossal canal is located between the occipital condyle and the tympanic bulla, slightly above the ventral condylar fossa. The jugular foramen is caudo-medially from the tympanic bulla (Figure 6).

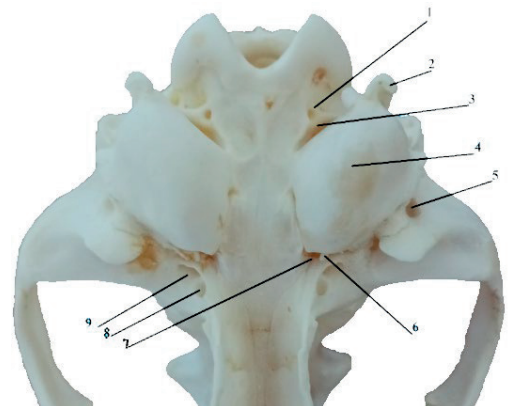


Figure 6. Ventral face of jackal (*Canis aureus*) skull - original:  
1. Hypoglossal canal; 2. Jugular processes; 3. Jugular foramen; 4. Tympanic bulla; 5. Retroarticular foramen; 6. Styloid process; 7. Carotid foramen/Spinous foramen; 8. Caudal alar foramen; 9. Oval foramen

The paracondylar processes are attached to the caudal extremity of the tympanic bulla. They form a narrow and deep ventral condylar fossa with the occipital condyles.

The carotid foramen has a common wall with the spinous foramen at the rostral extremity of the tympanic bulla. Rostro-lateral to the carotid foramen is the oval foramen. The styloid process is significantly reduced (Figure 6).

Near the base of the tympanic bulla on the medial side, there is a small sphenobasioccipital tubercle. At the end of the long and straight pterygopalatine crest, a short pterygoid hamulus projects caudally.

The basioccipital body continues seamlessly with the basisphenoid body and features a medial crest that fades rostrally (Figure 7).

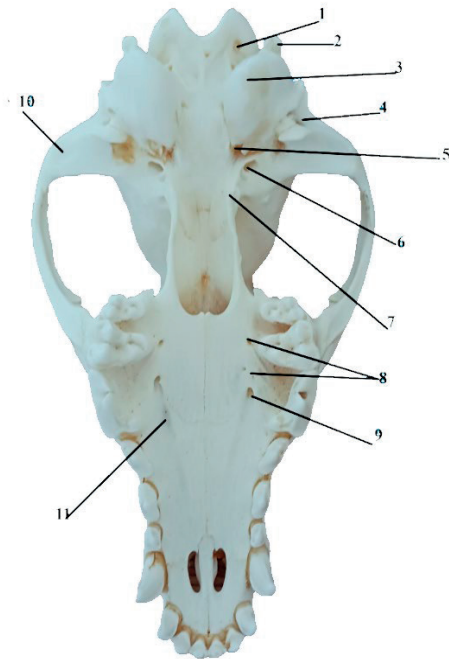


Figure 7. Ventral face of the jackal (*Canis aureus*) skull - original:

1. Ventral condylar fossa; 2. Jugular processes;
3. Tympanic bulla; 4. Retroarticular foramen; 5. Carotid foramen and spinous foramen; 6. Oval foramen;
7. Hamulus of the pterygoid bone; 8. Lesser and accessory palatine foramina; 9. Greater palatine foramen;
10. Zygomatic process of the temporal bone
11. Palatine groove

Located on the ventral side of the zygomatic process of the temporal bone, the mandibular

fossa is a stretched-out glenoid cavity. Just beyond it lies a curved and well-developed retroarticular process that projects rostrally. Caudal from the base of the retroarticular process is an elongated dorso-caudal retroarticular foramen (Figure 7).

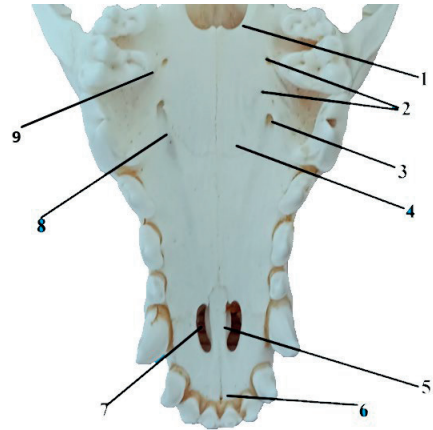


Figure 8. Hard palate in the jackal (*Canis aureus*) - original

1. The horizontal plate of the palatine; 2. Lesser and accessory palatine foramina; 3. Greater palatine foramen;
4. The palatine processes of the maxilla; 5. The palatine processes of the incisive; 6. Interincisive foramen; 7. Palatine fissure; 8. Palatine groove; 9. Lesser palatine foramen

On the hard palate, close to the alveolar process, the greater and the lesser palatine foramen are on each side. On the right side, 2-3 accessory palatine foramina appear caudally from the greater palatine foramen (Figure 8).

The palatine grooves are well highlighted and start from the greater palatine foramina, reaching the level of the palatine fissures, which are wide, oval, and arranged at the canine alveoli level.

The nuchal face has a triangular aspect, with developed nuchal crests on the sides; the maximum height is in the dorsal part. The external occipital protuberance is evident (Figure 9).

The external occipital crest is visible in the median plane, linking the external occipital protuberance and the foramen magnum (Figure 9).

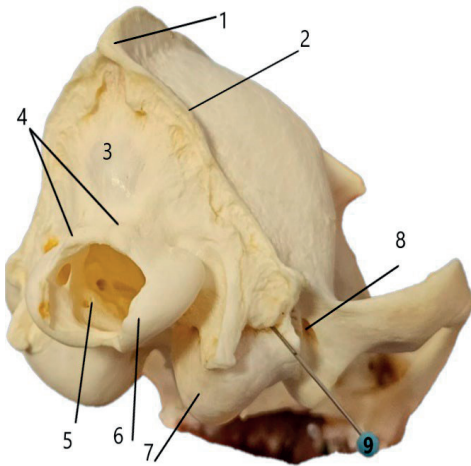


Figure 9. Nuchal face of jackal (*Canis aureus*) skull - original:

1. External occipital protuberance; 2. Nuchal crest;
3. External occipital crest; 4. Nuchal tubercles;
5. Foramen magnum; 6. Occipital condyle; 7. Tympanic bulla; 8. Retroarticular foramen;
9. Stylomastoid foramen

The external acoustic meatus has the appearance of a wide and elliptical opening, and caudal to it, the stylomastoid foramen opens. The mastoid process of the temporal bone is reduced and has a tuberos appearance.

The foramen magnum is relatively oval and, on the dorsal margin, has two reduced nuchal tubercles. It is delimited on the sides by two condyles arranged slightly obliquely dorso-ventrally.

Above each condyle, there is a small dorsal condylar fossa. The paracondylar processes arranged approximately vertically are attached to the tympanic bulla, forming a narrow and deep ventral condylar fossa with the condyles.

The mandible is a paired bone in the jackal (*Canis aureus*). The part incisive of the mandibular body is short.

The diastema is reduced, but the dental alveolus for the canine is developed. The molar part of the mandibular body has a slightly convex ventral edge and ends with an apparent angular process, curved dorsally. There is a small fossa on the medial side of the angular process.

On the lateral face of the mandibular body, caudal to the mental foramen is an accessory mental foramen.

The lateral side of the mandibular ramus is a deep, triangular masseteric fossa that extends

until the base of the coronoid process. On the medial side, the pterygoid fossa is shallow, and the mandibular foramen is arranged ventro-caudally (Figure 10).

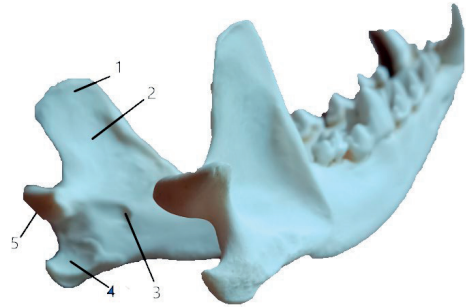


Figure 10. Jackal (*Canis aureus*) mandible - original:

1. Coronoid process; 2. Pterygoid fossa; 3. Mandibular foramen;
4. Angular process; 5. Condylar process

The coronoid process is well-developed and maintains a consistent width on its length; at its proximal end, the edge is rounded. The condylar process is short, with a convex surface, and the corono-condylar notch is reduced (Figure 11).

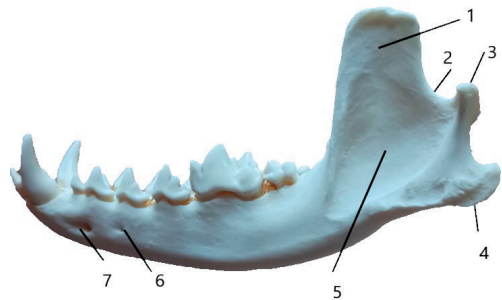


Figure 11. Jackal (*Canis aureus*) mandible - side view - original:

1. Coronoid process; 2. Corono-condylar notch;
3. The condylar process; 4. Angular process;
5. Masseteric fossa; 6. Accessory mental foramen;
7. Mental foramen

## CONCLUSIONS

The jackal (*Canis aureus*) skull is dolichocephalic. The frontal bones show two well-defined nasal processes in the rostral extremity. The nasal bone is narrow and elongated and ends in the caudal extremity

through very sharp frontal processes. The nasal cavities communicate through a wide subvomerian space.

The orbit is incomplete. The supraorbital foramen is absent. There is a single lacrimal foramen and a single ethmoidal foramen.

On the occipital's squamous part, two nuchal tubercles are on the dorsal margin of the foramen magnum.

The tympanic bullae are highly developed, oblique and convex latero-medially. The jugular processes are arranged ventrally and are attached to it. At the rostral extremity of the tympanic bulla, the carotid and the spinous foramina have a single external opening. The styloid process is very reduced. The stylomastoid foramen is caudal to the external acoustic meatus.

The round foramen and the rostral alar foramen have a joint opening in the orbital hiatus. The short alar canal links the rostral and the caudal alar foramen.

Caudal to the retroarticular process is an elongated retroarticular foramen.

The maxillary tuberosity is reduced and has an apparent medio-aboral spine.

The coronoid process of the mandible is very developed, with approximately the same width along its entire length. There is a small fossa on the medial side of the angular process.

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