

Macro-Anatomical Investigation of the Skull of Golden Jackal (*Canis aureus*) and its Clinical Application during Regional Anesthesia

Ali Louei Monfared

Department of Anatomy, Faculty of Para-Veterinary Medicine, University of Ilam, Ilam, Iran

Abstract: The golden jackal has is widespread in Iran as well as in Asia, Europe and Africa. This specie has a first order ranking from the point of view of road accident statistics for wild mammals. It has a high capacity to adapt to different environments as well as to variety of diets, so it has a wide trophic niche. Since, there is a lack of information on anatomical measurements of the skulls of golden jackals and its clinical value during regional anesthesia; the present work was taken. The investigation was carried out on ten mandibles and upper jaws from adult golden jackal aged between 3-7-year-old. Then, a total of seventeen skull measurements and indices were recorded. The skull length, cranial length, nasal length and cranial width of the adult golden jackals were 16.9 cm, 10.1 cm, 6.7 cm and 7.2 cm respectively. Also, the cranial index was 71.28. In addition, the distances from the root of premolar tooth to infra-orbital canal and from the latter to the root of the canine tooth were 1.5 cm and 3.2 cm, respectively. The length and height of the mandibles of the adult golden jackals were 11.2 cm and 6.0 cm, respectively. Furthermore, the distances from the lateral alveolar root to mental foramen and from the mental foramen to caudal mandibular border were 2.5 cm and 8.7 cm, respectively. In the current work, the distances from mandibular foramen to the base of mandible as well as from caudal border of mandible to below of the mandibular foramen were 1.2 cm and 1.1 cm, respectively. Also, the distances from the base of mandible to condyloid fossa and from the latter to the maximum height of mandible were 4.0 cm and 2.0 cm, respectively. Finally, the distance from caudal border of mandible to mandibular foramen and from the latter to mandibular angle were 1.05 cm and 2.37 cm, respectively. These data as important landmarks are discussed with regard to their application to clinical maneuvers around the head of the injured golden jackals for instance in the zoological gardens' surgical practices.

Key words: Macro-Anatomy • Skull • Golden Jackal • Regional Anesthesia

INTRODUCTION

The golden jackal has is widespread in Iran as well as in Asia, Europe and Africa. The jackal is of medium size and is one of the six native species of the Canidae family in Iran. This specie has a first order ranking from the point of view of road accident statistics for wild mammals. It has a high capacity to adapt to different environments as well as to variety of diets, so it has a wide trophic niche [1,2].

Clinical anatomy is one of the principles of the clinical and surgical practice; because it enables the clinician to visualize details of structures relevant to the case at hand [3,4]. On the other hand, the morphologic and morphometric studies of the skull are not only reflect

contributions of genetic and environmental components to individual development and describe genetic and ecophenotypic variation, but also are foundations of the clinical and surgical practices [5,6]. Similarly, the directions of the cranial nerves and their passages from different foramina in the skull are of clinical importance in regional anesthesia around the head [4,7].

Several authors have previously studied the skull's anatomy of the domestic mammals [5,8-10]. However, there are no records available on the anatomical measurements of the skull of golden jackal and its clinical value during regional anesthesia. Therefore, the present study was taken to provide anatomic reference for golden jackal's skull and its applications for head regional anesthesia.

Corresponding Author: Ali Louei Monfared, Department of Basic Sciences, Division of Anatomy and Histology, Faculty of Para-Veterinary Medicine, University of Ilam, Ilam, Iran, Pajoohesh Street, Bangonjab, University of Ilam, Ilam, Iran.
Tel: +98-8412222015 & +989183419098, Fax: +98-8412222015.

MATERIALS AND METHODS

The investigation was carried out on ten mandibles and upper jaws from adult golden jackal aged between 3-7-year-old. The specimens were brought for dissection purposes in the gross anatomy laboratories of the University of Guilan (Guilan, Iran), University of Shahid Chamran (Ahwaz, Iran) and University of Ilam (Ilam, Iran). The heads were severed at the occipito-atlantal joint and processed in the veterinary anatomy laboratory using the boiling maceration techniques for skeleton preparation that have been reported by Simoens *et al.* [11]. The main steps in skull skeleton preparing briefly are following:

- On the working day, frozen jackal head were allowed to thaw.
- Skin and most of the muscles were separated and eyes were enucleated.
- Heads were heated to over 80 °C for at least 1 hour in solution of surfactant (detergent) and soap chips.
- Muscles of boiled heads were separated with the aid of forceps and scalpel in running water.
- Further separation of muscles and ligaments from the skulls was done after left in detergent water at least 20-30 minutes.
- Separation of remaining muscles and ligaments from the skull was done after left in 1% sodium hypochlorite solution for at least 24 hours.
- After that, the skulls were left in the above solution, for 48-72 hours with solution, being changed at least twice and clean in running tap water.
- The skulls were then left to dry.

Table 1: Mean ± SD of the anatomical measurements of the mandibles and upper jaws of adult golden jackal (cm)

Morphometric parameter	Mean ± SD
A	16.9 ± 3.19
B	10.1 ± 2.37
C	6.7 ± 1.66
D	7.2 ± 0.44
E	71.28 ± 3.67
F	1.5 ± 0.03
G	3.2 ± 0.12
H	11.2 ± 3.46
I	2.5 ± 0.17
J	8.7 ± 0.38
K	1.2 ± 0.04
L	1.1 ± 0.08
M	2.0 ± 0.06
N	4.0 ± 0.49
O	6.0 ± 0.58
P	1.05 ± 0.02
Q	2.37 ± 0.28

A total of 17 gross anatomical measurements were done in the upper jaw and mandibles using scale, thread and digital calipers and the results were presented as means ± SD in Table 1. These anatomical parameters of the upper and lower jawbones of the adult jackal's skulls are defined below and shown in Figs.1-5.

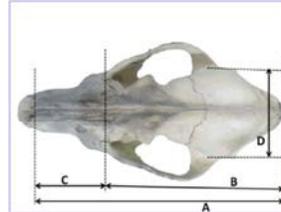


Fig. 1: Skull of the adult golden jackal; dorsal view. A: Skull length, B: Cranial length, C: Nasal length, D: Cranial width.



Fig. 2: Skull of the adult golden jackal; lateral view. F: The root of premolar tooth to infra-orbital canal, G: Infra-orbital canal to root of canine tooth.

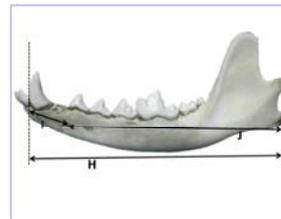


Fig. 3: Mandible of the adult golden jackal; lateral view. H: Mandibular length, I: Lateral alveolar root to mental foramen, J: Mental foramen to caudal mandibular border.

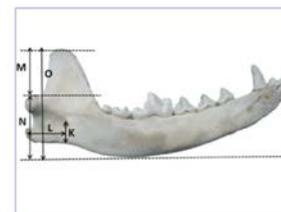


Fig. 4: Mandible of the adult golden jackal; medial view. K: Mandibular foramen to base of mandible, L: Caudal border of mandible to below of the mandibular foramen, M: Condylod fossa to height of mandible, N: Condylod fossa to the base of the mandible, O: Maximum mandibular height.



Fig. 5: Mandible of the adult golden jackal; medial view. P: Caudal border of mandible to the level of mandibular foramen, Q: Mandibular foramen to mandibular angle.

- Skull Length: From the dorsal lateral nasal cartilages to the external occipital protuberance; sub-divided into cranial length and nasal length.
- Cranial Length
- Nasal length.
- Cranial width.
- Cranial index: Cranial width \times 100/cranial length.
- The root of premolar tooth to infra-orbital canal: From the root of the first premolar tooth to the mid level of the infra-orbital canal.
- Infra-orbital canal to root of canine tooth: Measurement is taken vertically from the mid-level of the in infra-orbital canal to the root of the canine tooth.
- Mandibular length: From the level of the cranial extremity of the alveolar root of the incisor to the level of the caudal border of the mandible.
- Lateral alveolar root to mental foramen: Shortest distance from the mental foramen to the lateral extent of the alveolar root of lower incisor.
- Mental foramen to caudal mandibular border: From the level of the mental foramen to the extreme caudal border of the mandible.
- Mandibular foramen to base of mandible: Vertical line from the ventral limit of the mandibular foramen to the base of the mandible.
- Caudal border of mandible to below of the mandibular foramen: Length from the caudal most border of the mandible to the vertical line produced by description of measurement of mandibular foramen to base of the mandible.
- Condylod fossa to height of mandible: From the maximum height of mandible to the condylod fossa.
- Condylod fossa to the base of the mandible.
- Maximum mandibular height: From the basal level of the mandible to the highest level of the coronoid process.
- Caudal border of mandible to the level of mandibular foramen.

- Mandibular foramen to mandibular angle: Shortest distance from the mandibular foramen to the extreme caudal border of the angle of the mandible.

RESULTS

In the present work, the skull length, cranial length, nasal length and cranial width of the adult golden jackals were 16.9 cm, 10.1 cm, 6.7 cm and 7.2 cm respectively. Also, the cranial index was 71.28 (Figure 1, Table 1). In addition, the distances from the root of premolar tooth to infra-orbital canal and from the latter to the root of the canine tooth were 1.5 cm and 3.2 cm, respectively (Figure 2, Table 1).

The length and height of the mandibles of the adult golden jackals were 11.2 cm and 6.0 cm, respectively. Furthermore, the distances from the lateral alveolar root to mental foramen and from the mental foramen to caudal mandibular border were 2.5 cm and 8.7 cm, respectively (Figure 3, Table 1). In the current work, the distances from mandibular foramen to the base of mandible as well as from caudal border of mandible to below of the mandibular foramen were 1.2 cm and 1.1 cm, respectively. Also, the distances from the base of mandible to condylod fossa and from the latter to the maximum height of mandible were 4.0 cm and 2.0 cm, respectively (Figure 4, Table 1). Finally, the distance from caudal border of mandible to mandibular foramen and from the latter to mandibular angle were 1.05 cm and 2.37 cm, respectively (Figure 5, Table 1).

DISCUSSION

Although there was not literature data on the macro-anatomical measurements of the jackal's skull with which comparison could be made but these data have clinical value in the nerve block purposes and also regional anesthesia during treating head injury and dental extraction. In the golden jackals, the distances from the root of premolar tooth to infra-orbital canal and from the latter to the root of the canine tooth were 1.5 cm and 3.2 cm, respectively. It had been demonstrated that the infra-orbital foramen in the skull of Canidae family is over the alveolus for the third premolar tooth and infra-orbital nerve emerges through this foramen [3]. Therefore, these data can be useful for tracking the infra-orbital nerve and necessary for the desensitization of the skin of the upper lip, nostril and face on that side of the level of the foramen [3]. The injection of local anesthetic agents within the canal via the infra-orbital foramen will also lead to analgesia of the incisor, canine and first three premolars.

In the present study, the distance from the lateral alveolar root to mental foramen was 2.5 cm. This parameter is a vital guide that will detect the location of the mental nerve for this regional nerve block in the golden jackals; especially for lower lip anesthesia. The injection of the local anesthetic agents can be made in the rostral aspect of the mandibular canal through the mental foramen to mandibular nerve block in the mental zone. This will ensure the loss of sensation of the lower incisors, premolar and lower lip on the same side [7] during lower lip trauma, dental extraction and treatment of the tooth injuries.

The caudal border of the mandible to below of the mandibular foramen was 1.1 cm in the golden jackals. In addition, the distance from the caudal border of mandible to the level of mandibular foramen and from the latter to the border of mandibular angle was 1.05 cm and 2.37 cm, respectively. The anesthetic agents must be injecting on the medial side of the mandible, thereby; a successful nerve block produces anesthesia of the lower jaw with its teeth and the lower lip. These data are necessary for achieving the regional anesthesia of the mandibular nerve and also have clinical importance for desensitization of all the teeth in lower jaw [7].

To best knowledge of the author, there is no literature data on the macro-anatomical measurements of the jackal's skull with which comparisons could be made. In conclusion, the morphometric values of the skull and clinical anatomy of the head region of the golden jackals provide an important baseline for further research in this field. Furthermore, these results can also be useful tool for wildlife managers that will aid the regional anesthesia of the cranial nerves around the head especially during treating head injury and dental extraction.

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