Global Veterinaria 10 (4): 459-463, 2013
ISSN 1992-6197

DOI: 10.5829/idosi.gv.2013.10.4.7295

Anatomical Study of the Skull of the Adult Dogs and its Clinical Value During Regional Anesthesia

Ali Louei Monfared

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

Abstract: It had been reported that the domestication of dogs began in the late Paleolithic and Mesolithic period. Since, there is a lack of information on anatomical measurements of the skulls of dogs and its clinical value during regional anesthesia; the present work was taken. The investigation was carried out on nineteen mandibles and upper jaws from adult dogs aged between 4-8-year-old without any apparent skeletal disorders. Then, a total of seventeen skull measurements and indices were recorded. The skull length, cranial length, nasal length and cranial width were 17.6 cm, 11.2 cm, 6.38 cm and 7.5 cm respectively. Also, the cranial index was 66.37. 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 1.07 cm and 3.4 cm, respectively. The length and height of the mandibles were 12.7 cm and 6.5 cm, respectively. Furthermore, the distances from the lateral alveolar root to mental foramen and from the mental foramen to caudal mandibular border were 2.3 cm and 10.3 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 1.1 cm and 1.3 cm, respectively. Also, the distances from the base of mandible to condyloid fossa and from the latter to the maximum height of mandible were 4.5 cm and 2.1 cm, respectively. Finally, the distance from caudal border of mandible to mandibular foramen and from the latter to mandibular angle were 0.97 cm and 0.93 cm, respectively. These data as important landmarks are discussed with regard to their application to clinical maneuvers around the head of the adult dogs such as regional anesthesia during treating head injury and dental extraction.

Key words: Anatomy · Skull · Adult dog · Regional anesthesia

INTRODUCTION

It had been reported that the domestication of dogs began in the late Paleolithic and Mesolithic period [1, 2]. Human selection generated a lot of canine breeds with a wide range of phenotypic variation, except for changes in character, which is a typical domestication sign for all dogs [3]. Furthermore, the archaeological and archaeozoological sources clearly indicate the great phenotypic variation in the early period of dog breeding [1, 3, 4].

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 [5, 6]. 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 ecophenotyipic variation, but also are foundations of the clinical and surgical practices [7, 8]. 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 [6, 9].

As a whole, the form and size of the skull in dogs shows considerable breed and individual variation [10]. In addition, the shape of the skull is the most important criterion in determining the standard breeds of dog. For this reason, the canine skull form has been studied by previous researchers [11, 12]. However, there is a lack of information on anatomical measurements of the skulls of dogs and its clinical value during 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.

While there are a few studies on measurements of the skulls of dogs in the literature, there are no records available on applied clinical anatomy and its value during regional anesthesia. Therefore, the present work was taken to provide anatomic reference for dog's skull and its applications for head regional anesthesia.

MATERIALS AND METHODS

The investigation was carried out on nineteen mandibles and upper jaws from Iranian mixed-breed dogs aged between 4-8-year-old without any apparent skeletal disorders. The specimens were brought for dissection purposes in the gross anatomy laboratories of the University of Tehran (Tehran, 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.* [13]. The main steps in skull skeleton preparing briefly are following:

- On the working day, frozen dog 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.

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 dog´s skulls are defined below and shown in Figs. 1-5.

Skull Length: From the dorsal lateral nasal cartilages to the external occipital protuberance; sub-divided into cranial length and nasal length.

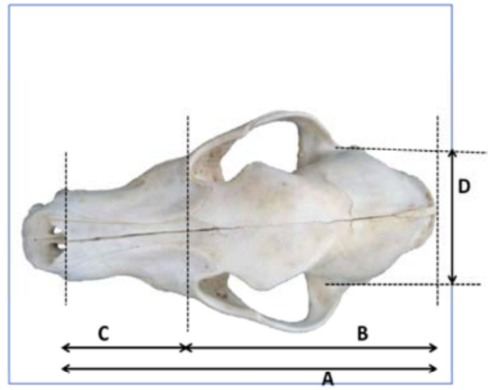

Fig. 1: Skull of the adult dog; dorsal view. A: Skull length, B: Cranial length, C: Nasal length, D: Cranial width.

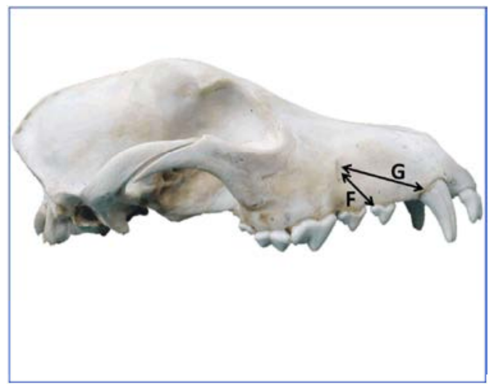

Fig. 2: Skull of the adult dog; lateral view. F: The root of premolar tooth to infra-orbital canal, G: Infra-orbital canal to root of canine tooth.

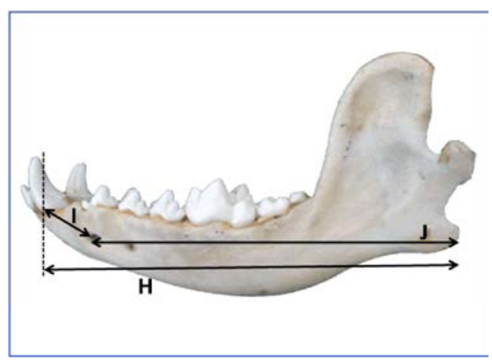

Fig. 3: Mandible of the adult dog; lateral view. H: Mandibular length, I: Lateral alveolar root to mental foramen, J: Mental foramen to caudal mandibular border.

Cranial Length

Nasal Length

Cranial Width

Cranial Index: Cranial width × 100/cranial length.

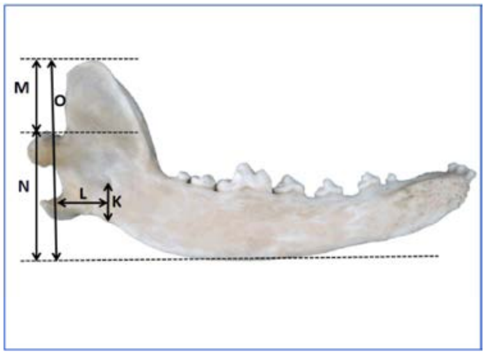

Fig 4: Mandible of the adult dog; medial view. K: Mandibular foramen to base of mandible, L: Caudal border of mandible to below of the mandibular foramen, M: Condyloid fossa to height of mandible, N: Condyloid fossa to the base of the mandible, O: Maximum mandibular height.

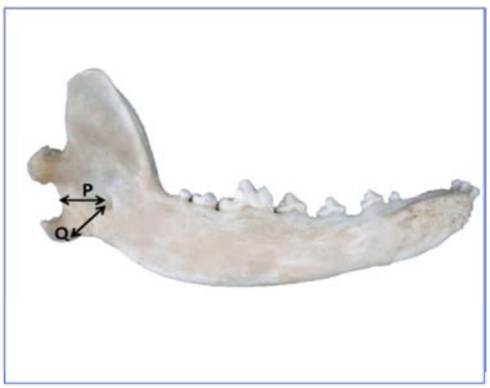

Fig. 5: Mandible of the adult dog; medial view. P: Caudal border of mandible to the level of mandibular foramen, Q: Mandibular foramen to mandibular angle.

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.

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

Morphometric parameter	Mean±SD
A	17.6±2.47
B	11.2±0.85
C	6.38±1.03
D	7.5±2.16
E	66.37±6.28
F	1.07±0.05
G	3.4±0.66
H	12.7±2.48
I	2.3±0.02
J	10.3±1.22
K	1.1±0.09
L	1.3± 0.01
M	2.1±0.42
N	4.5±0.19
O	6.5±0.33
P	0.96±0.57
Q	0.92±0.28

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.

Condyloid Fossa to Height of Mandible: From the maximum height of mandible to the condyloid fossa.

Condyloid 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 dogs were 17.6 cm, 11.2 cm, 6.38 cm and 7.5 cm respectively. Also, the cranial index was 66.37 (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 1.07 cm and 3.4 cm, respectively (Figure 2, Table 1). The length and height of the mandibles of the adult dogs were 12.7 cm and 6.5 cm, respectively. Furthermore, the distances from the lateral alveolar root to mental foramen and from the mental foramen to caudal mandibular border were 2.3 cm and 10.3 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 1.1 cm and 1.3 cm, respectively. Also, the distances from the base of mandible to condyloid fossa and from the latter to the maximum height of mandible were 4.5 cm and 2.1 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 0.97 cm and 0.93 cm, respectively (Figure 5, Table 1).

DISCUSSION

Comparatively, the values of skull length, cranial length, nasal length and cranial width of the adult dogs were similar to the results on the adult Kangal dogs [14], but were relatively different from the findings on the German shepherd (Alsatian) puppies [15]. It is may be due to the existence of significant differences in the skull's shape and size between various breeds and individuals [10].

In the adult dogs, the distances from the root of premolar tooth to infra-orbital canal and from the latter to the root of the canine tooth were 1.07 cm and 3.4 cm, respectively. It had been demonstrated that the infra-orbital foramen in the skull of dog is over the alveolus for the third premolar tooth and infra-orbital nerve emerges through this foramen [5]. 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 [5]. 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 2.3 cm. This parameter is a vital guide that will detect the location of the mental nerve for this regional nerve block in the adult dogs; 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 [9] during lower lip trauma, dental extraction and treatment of the tooth injuries.

The mandibular length and height in the adult dogs (Table 1) were greater than the data obtained for German shepherd (Alsatian) puppies [15]. Similar results had been reported in the values of the distances between the mandibular foramen to base of mandible, the condyloid fossa to height of mandible and condyloid fossa to the base of the mandible [15].

The caudal border of the mandible to bellow of the mandibular foramen was 1.3 cm in the adult dogs. 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 0.97 cm and 0.93 cm, respectively. The anesthetic agents must to 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 [9].

In conclusion, the morphometric values of the skull and clinical anatomy of the head region of the adult dogs provide an important baseline for further research in this field. Furthermore, these results can also be useful tool that will aid the regional anesthesia of the cranial nerves around the head especially during treating head injury and dental extraction.

ACKNOWLEDGEMENTS

The author wish to acknowledge Mr. Ali Akbar Hosseinizadeh for his assistance with photographing the skulls.

REFERENCES

1. Bokonyi, S., 1974. History of Domestic Mammals in Central and Eastern Europe. Budpest: Akademiai Kiado, pp: 313-333.
2. Davis, S.J.M. and F.R. Valla, 1978. Evidence for domestication of the dog 12,000 years ago in the Natufian Israel. Nature, 276: 608-610.
3. Janeczek, M., A. Chrószcz, V. Onar, G. Pazvant and N. Pospieszny, 2008. Morphological analysis of the foramen magnum of dogs from the Iron Age. Anatomia, Histologia, Embryologia, 37(5): 359-361.

4. Onar, V. and O. Belli, 2005. Estimation of shoulder height from long bone measurments on unearthed from the Van-Yoncatepe early Iron Age necropolis in Easteren Anatolia. Revue de Médecine Vétérinaire, 156: 53-60.
5. Ommer, P.A. and K.R. Harshan, 1995. Applied anatomy of domestic' animals, 1st Edition. Jaypee brother's medical publisher, India.
6. Dyce, K.M., W.O. Sack and C.J.G. Wensing, 2002. Textbook of Veterinary Anatomy, ed 3. Philadelphia,WB Saunders.
7. Karimi, I., V. Onar, G. Pazvant, M. Hadipour and Y. Mazaheri, 2011. The cranial morphometric and morphologic characteristics of Mehraban sheep in western Iran. Global Veterinaria, 6(2): 111-117.
8. Wehausen, J.D. and R.R. Ramey, 2000. Cranial morphometric and evolutionary relationships in the northern range of *Ovis Canadensis*. Journal of Mammalogy, 81: 145-161.
9. Hall, L.W., K.W. Clarke and C.M. Trim, 2000. Wright's Veterinary Anesthesia and Analgesia. 10. ed. London, ELBS and Baillierre Tindall.
10. Sisson, S., 1975. Carnivore Osteology. Skull. In: The Anatomy of Domestic Animals, ed. R. Getty, W. B. Saunders Company, Philadelphia, pp: 1467-1482.
11. Brehm, H.K., H. Loeffler and H. Komeyli, 1985. Skull shape in the dog. Anatomia, Histologia, Embryologia, 14: 324-331.
12. Regodon, S., A. Robina, A. Franco, J.M. Vivo and Y. Lignereux, 1991. Radiological and statistical determination of the morphological type of the canine skull: dolichocephaly, mesocephaly and brachycephaly. Anatomia, Histologia, Embryologia, 20(2): 129-138.
13. Simoens, R., P. R.oles and H. Lauwers, 1994. Morphometric analysis of foramen magnum in pekingese dogs. American Journal of Veterinary Research, 55: 33-39.
14. Onar, V., S. Ozcan and G. Pazvant, 2001. Skull typology of adult male Kangal dogs. Anatomia, Histologia, Embryologia, 30(1): 41-48.
15. Onar, V., 1999. A Morphometric Study on the Skull of the German Shepherd Dog (Alsatian). Anatomia, Histologia, Embryologia, 28: 253-256.