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Anatomy of the Mandibularand Maxillo-Facial Regionsof the Iranian NativeDonkeys and its Clinical ImplicationsduringRegional Anesthesia

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Abstract: The head is a very important region for animals. Also, donkey (*equusasinus*) is a member of the equidae family that is classified in the perissodactyla subgroup of ungulate group.Since there is a lack of comprehensive data on the clinical anatomy of the head region of the Iranian native donkeys and its clinical value during regional anesthesia; therefore, the present work was carried out.This study involved some morphometric parameters of the mandibles and upper jaws of ten Iranian native donkeys aged between 3-8-year-old without any apparent skeletal disorders. Then, a total of 17 head measurements and indices were recorded.The supraorbital foramina distance, infraorbital foramina distance, skull length, cranial length and nasal length of the Iranian native donkeys were 17.7 cm, 9.47 cm, 39.7 cm, 26.3 cm and 13.4 cm, respectively. In addition, the distances from facial crest to the infra-orbital canal and from the latter to the root of the alveolar tooth were 3.4 cm and 6.1 cm, respectively. The length and height of the mandibles of the Iranian native donkeys were 19.5 cm and 10.8 cm, respectively. Furthermore, the distances from the lateral alveolar root to mental foramen and from the mental foramen to caudal mandibular border were 11.15 cm and 8.35 cm, respectively. In the present study, 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 4.7 cm and 4.2 cm, respectively. Also, the distances from the base of mandible to condyloid fossa and from the latter to the maximum height of mandible were 8.5 cm and 2.3 cm, respectively. Finally, the distance from caudal border of mandible to mandibular foramen and from the latter to mandibular angle were 3.5 cm and 4.1 cm, respectively. The craniometrical information provided in this study will be important for clinical maneuvers around the head of the Iranian native donkeys such as regional anesthesia during treating head injury and dental extraction.

Key words: Anatomy · Head · Donkey · Regional Anesthesia

INTRODUCTION

The head is a very important region for animals. It is the location of vital organs as the brain, eyes, nose, tongue ear and mouth. Also, the health of an animal can be deduced from the functional state of any of these organs [1]. Additionally, a unique head aspect of the anatomy of any animal is the skull typology of that animal with usefulness in providing a database on the bone features [1] andalso morphological interpretation of the biomechanics of mastication [2]. The regional anatomy of the head is therefore, very useful tool that will aid the regional anesthesia [1].

It has been demonstrated that the morphologic and morphometric studies of the head region 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 [3,4]. On the other hand, 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]. Furthermore, 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 [6,7].

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Donkey (*equusasinus*) is a member of the equidae family that is classified in the perissodactyla subgroup of ungulate group [8]. To use a horse as a model of odd toed ungulate mammal in veterinary anatomy education is expensive and because of the body size, it's hard to move and preserve. Therefore, generally donkey is used instead of a horse in this field [9].

As a whole, there are a few studies on the gross anatomy of the skull and its clinical value for regional anesthesia in the domestic animals. For instance, LoueiMonfared *et al.* [10] determined theapplied landmarks on the head region of the Iranian native goats and their application to clinical maneuvers around the head. In addition, Radinsky [11] studied the ontogeny and phylogeny in horse's skull evolution and demonstrated that when comparing skull length, it is necessary to consider the skull as being composed of two major components; the neuro-cranium and the splanchno-cranium.

Since there is a lack of comprehensive data on the mandibular and maxillo-facial regions of the Iranian native donkeys and its clinical implications during regional anesthesia; therefore, the present work was carried out.

MATERIALS AND METHODS

This study involved some morphometric parameters of the mandibles and upper jaws of ten Iranian native donkeys aged between 3-8-year-old without any apparent skeletal disorders. The specimens were brought for dissection purposes in the anatomy laboratories, University of Tehran (Tehran, Iran), University of Urmia (Urmia, Iran), University of ShahidChamran (Ahwaz, Iran) and also 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.* [12]. The main steps in skull skeleton preparing briefly are following:

- On the working day, frozen donkey heads 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 anionic 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 morphometric 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 morphometric parameters of the upper and lower jawbones of the Iranian native donkey´s skulls are defined below and shown in Figs.1-5.

Table 1: Mean ± SD of the morphometric measurements of the mandibles and upper jaws of the Iranian native donkey (cm)

Morphometric parameter	Mean ± SD
A	17.7 ± 2.25
B	9.45 ± 1.33
C	39.7 ± 5.37
D	26.3 ± 1.08
E	13.4 ± 5.30
F	3.4 ± 0.02
G	6.11± 0.62
H	19.5 ± 3.18
I	11.15± 0.59
J	8.35± 0.43
K	4.7± 1.22
L	4.2± 0.23
M	2.3± 0.14
N	8.5± 1.12
O	10.8± 3.01
P	3.5± 0.02
Q	4.1± 0.07

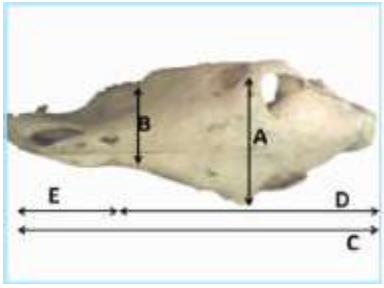

Fig. 1: Skull of the Iranian native donkey; dorsal view. A: Supraorbital foramina distance, B: Infraorbital foramina distance, C: Skull length, D: Cranial length, E: Nasal length.

Fig. 2: Skull of the Iranian native donkey; lateral view. F: Facial crest to infra-orbital canal, G: Infra-orbital canal to root of alveolar tooth.

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

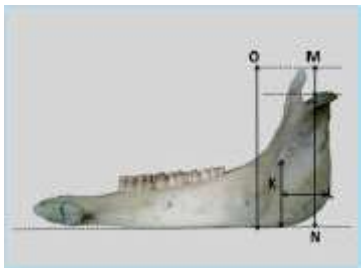

Fig. 4: Mandible of the Iranian native donkey; medial view: Mandibular foramen to base of mandible: Caudal border of mandible to below of the mandibular foramen, M: Condyloid fossa to height of mandible, N: Condyloid fossa to the base of the mandible, O: Maximum mandibular height.

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

Supraorbital Foramina Distance: Greatest width between the supraorbital foramina.

Infraorbital Foramina Distance: Facial width between the supraorbital foramina.

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

Facial Crest to Infra-Orbital Canal: From the level of the most lateral bulging of the facial crest to the mid level of the infra-orbital canal.

Infra-Orbital Canal to Root of Alveolar Tooth: Measurement is taken vertically from the mid-level of the in infra-orbital canal to the root of the alveolar 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 theventral 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 Ofmandible 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

The supraorbital foramina distance, infraorbital foramina distance, skull length, cranial length and nasal length of the Iranian native donkeys were 17.7 cm, 9.47 cm, 39.7 cm, 26.3 cm and 13.4 cm, respectively (Figure 1, Table 1). In addition, the distances from facial crest to the infra-orbital canal and from the latter to the root of the alveolar tooth were 3.4 cm and 6.1 cm, respectively (Figure 2, Table 1).

The length and height of the mandibles of the Iranian native donkeys were 19.5 cm and 10.8 cm, respectively. Furthermore, the distances from the lateral alveolar root to mental foramen and from the mental foramen to caudal mandibular border were 11.15 cm and 8.35 cm, respectively (Figure 3, Table 1). In the present study, 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 4.7 cm and 4.2 cm, respectively.Also, the distances from the base of mandible to condyloid fossa and from the latter to the maximum height of mandible were 8.5 cm and 2.3 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 3.5 cm and 4.1 cm, respectively (Figure 5, Table 1).

DISCUSSION

Although there was not literature data on the anatomical measurements of the donkey'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. The values of supraorbital foramina distance, skull length, cranial length and nasal length of the Iranian native donkey were relatively lower than from the results on the thoroughbreds, standardbreeds and Arabians horse's breeds [13]. It is may be due to the existence of significant differences in the skull's morphometric indices between various breeds [13].

In the Iranian native donkey; the distances from facial crest to the infra-orbital canal and from the latter to the root of the alveolar tooth were 3.4 cm and 6.1 cm, respectively. Since the facial crest is very prominent as a guide 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], therefore; these data are of clinical importance. 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 two premolars. Furthermore, the infra-orbital foramen is located directly dorsal to the second or third upper premolar tooth in Iranian native donkeys. This information would provide a major landmark to regional anesthesia involving the infra-orbital nerve in this specie.

In the present study, the distance from the lateral alveolar root to mental foramen was11.15 cm. This parameter is a vital guide that will detect the location of the mental nerve for this regional nerve block in the Iranian native donkey; especially for lower lip anesthesia. The injection of the local anesthetic drugs 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 mandibular length and height in the Iranian native donkeys (Table 1) were lower than the data obtained for early medieval horses in Poland [14]. 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 [14].

The caudal border of the mandible to bellow of the mandibular foramen was 4.2 cm in the Iranian native donkeys. In addition, the distance from the caudal border of mandible to the level of mandibular foramen and from the latter to the border ofmandibular angle was 3.5 cm and 4.1 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 [7].

To best knowledge of the author, there is no literature data on the morphometric parameters of the head region in the Iranian native donkeys with which comparisons could be made. In conclusion, the morphometric values of the skull and clinical anatomy

of the head region of the Iranian native donkey provide an important baseline for further research in this field. Furthermore, these results are of clinical importance that will aid the regional anesthesia of the various nerves around the head especially during treating head injury and dental extraction.

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