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Research Article

Morphometric Measurements of Mandibular and Mental Foramina of Barbados Blackbelly Sheep

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Abstract

The aim of this study was to determine the morphometric values of the mandibular and mental foramina of the Barbados Blackbelly sheep from the Caribbean island of Trinidad and Tobago. Mandibles were obtained from abattoirs in Trinidad and were prepared and cleaned using standard method. Some anatomical landmarks of the mandibles were identified and measured. The site of the mandibular and mental foramina was detected anatomically and radiographically. The most common injection technique for dental extraction is the insertion of a needle with local anesthetic agent close to the mandibular foramen, just before the nerve enters. The measurements showed that the application of local anesthesia through the mental foramen could be easier to block the inferior alveolar nerve as it is easy to locate this foramen using the recorded anatomical parameters.

Keywords: *Morphometric; Mandible; Nerve Block; Sheep*

Introduction

The Barbados Blackbelly is a breed of domestic sheep found in the Caribbean island of Trinidad and is raised for meat production. The cranial nerves and their passages from different foramina in the skull have clinical importance in applying regional anesthesia around the head [1]. Morphology and morphometry of the bones are used for specie identification, age and forensic investigation [2]. The mandible is the largest bone of the head in animals and many affections of the mandible have been studied [3,4]. The fracture of the mandible is uncommon in animals [5]. The radiography plays a role in actinomycosis diagnosis [6]. Studies of the clinical anatomy of the mandible has been done in the Mehraban sheep [7], in the Iranian Native sheep [8], in the West African Dwarf goat [9], in the Black Bengal goat [10], in the Iranian Native goat [11], in the Makhoz goat [12], in the Rasquera goat [13], in the Gwembe Valley Dwarf goat [14] and in the common opossum [15]. The radiography of the mandible was described in buffalos and camels [16]. The study of normal radiography of the mandible is important to detect its disorders [17]. The description of the site of the mandibular and mental foramina will facilitate the inferior alveolar and mental nerve blocks [18]. This study was done to describe the anatomical and radiographic appearance of the mandible to identify the species as well as to detect the morphometric parameters of the mandible. The latter will provide information regarding the clinically important landmarks for the inferior alveolar and mental nerve blocks in Barbados Blackbelly sheep which can be used by the Trinidadian veterinary surgeons since there is no documented information.

Materials and Methods

Six heads from adult Barbados Blackbelly sheep were collected from abattoirs in Trinidad. The heads were free from skeletal abnormalities and were cut at the occipitoatlantal joint. The mandibles were disarticulated from the skulls at the temporomandibular and boiled to remove skin and muscles then left to dry for two weeks then bleached by soaking in 3% hydrogen peroxide for four days and then left to dry for two weeks [15,18,19]. Gross and radiography photos of the mandible were taken in lateral and caudal views for documentation using a digital camera and Siemens mobile full wave X-ray machine (Siemens Medical Solutions, Erlangen, Germany). The following anatomical landmarks parameters were measured using measuring tape [8,14,15,21] and were expressed as mean measurements with the standard deviation (Mean ± SD).

a) Mandibular length.
b) Lateral alveolar border of the first lower premolar tooth to the mental foramen.
c) Caudal order of the mandible to the mental foramen.
d) Lateral alveolar border to the mental foramen.
e) Ventral border of the mandible to the mental foramen.
f) Maximum mandibular height.
g) Condyloid fossa to the base of the mandible.
h) Caudal border of mandible to the mandibular foramen.
i) Base of mandible to the mandibular foramen.
j) Mandibular angle to the mandibular foramen.

Results

The mandible of the Barbados Blackbelly sheep was the largest bone of the skull. The left and right mandibles were united rostrally at the mandibular symphysis. The mandible length was 18.17 ± 1.53 cm and the mandible height was 15.25 ± 1.44 cm. Furthermore, the distance between the lateral alveolar border of the first lower premolar to the mental foramen was 2.33 ± 0.26 cm. The distance between the caudal mandibular border to the mental foramen was 3.42 ± 0.26 cm. The distance between the lateral alveolar to the mental foramen was 3.75 ± 0.22 cm. the distance between the ventral border of the mandible to the mental foramen was 2.25 ± 0.32. The distance between the condyloid fossa to base of the mandible was 2.25 ± 0.39 cm. The distance between the caudal border of the mandible to the mandibular foramen was 0.71 ± 0.19 cm. While, the distance between the base of the mandible to the mandibular foramen was 10.88 ± 0.74 cm and the distance between the mandibular angle to the mandibular foramen was 7.25 ± 0.42 cm (Table 1 and Figures 1, 2).

P	M1	M2	M3	M4	M5	M6	Mean	± SD
a	17.5	17.75	18.75	17	17.00	21.00	18.17	1.53
b	2.5	2.50	2.50	2.5	2.00	2.00	2.33	.26
c	3.75	3.50	3.50	3.5	3.00	3.25	3.42	.26
d	4.00	4.00	3.75	3.75	3.50	3.50	3.75	.22
e	2.75	2.00	2.50	2	2.25	2.00	2.25	.32
f	14.75	16.00	15.50	14.5	13.25	17.50	15.25	1.45
g	1.75	2.50	2.50	2.00	2.00	2.75	2.25	.39
h	1.00	0.75	0.50	0.75	0.50	0.75	0.71	0.19
i	11.00	11.00	11.75	11	11.00	9.50	10.88	.74
j	7.25	7.50	7.75	7.5	6.75	6.75	7.25	.42

Table 1: *Morphometric measurements of the mandible of the Barbados Blackbelly sheep (Figures 1 and 2).*

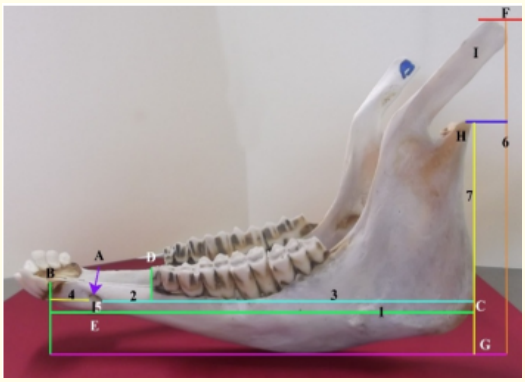


Figure 1: *Lateral view of the mandible of the Barbados Blackbelly sheep showing: A. Mental foramen; B. Lateral alveolar border; C. Caudal mandibular border; D. Lateral alveolar border of the first premolar tooth; E. Ventral border of the mandible; F. Highest point of the coronoid process; G. Base of the mandible; H. Condylar process; 1. Mandibular length; 2. Mental foramen to the lateral alveolar border of the first premolar tooth; 3. Mental foramen to the caudal mandibular border; 4. Lateral alveolar border to mental foramen; 5. Mental foramen the ventral border of the mandible; 6. Maximum mandibular height; 7. Condyloid fossa to base of the mandible.*

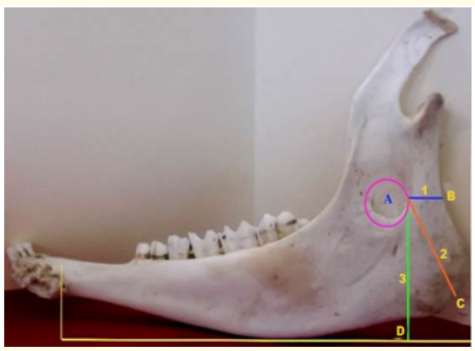


Figure 2: *Medial view of the mandible of the Barbados Blackbelly sheep showing: A. Mandibular foramen; B. Caudal border of the mandible; C. Mandibular angle; D. Base of the mandible; 1. Mandibular foramen to the caudal border of the mandible; 2.Mandibular foramen to the mandibular angle; 3. Mandibular foramen to the base of the mandible.*

The mandibular foramen

The mandibular foramen was a single foramen located grossly and radiography on the medial aspect of each mandibular ramus. The mandibular foramen was detected by using the measured distance between the mandibular foramen and either the caudal border of the mandible; the mandibular angle or the base of the mandible. The mandible had a mandibular canal which was a duct stated at the mandibular foramen, traversing ventrally then curved rostrally through the body of the mandible and ended at the mental foramen. The mandibular canal has the inferior alveolar nerve which was a branch of the mandibular branch of the trigeminal nerve. The inferior alveolar nerve passed through the mandibular foramen supplying the mandibular teeth via its alveolar branches. The blocking of the inferior alveolar nerve by entering a needle at the ventral border the mandibular ramus and advanced dorsally towards the mandibular foramen to desensitize the lower teeth, however, this application could be difficulty due to the potential complication of hemorrhage from injured arteries and veins in this area (Figures 2-6).

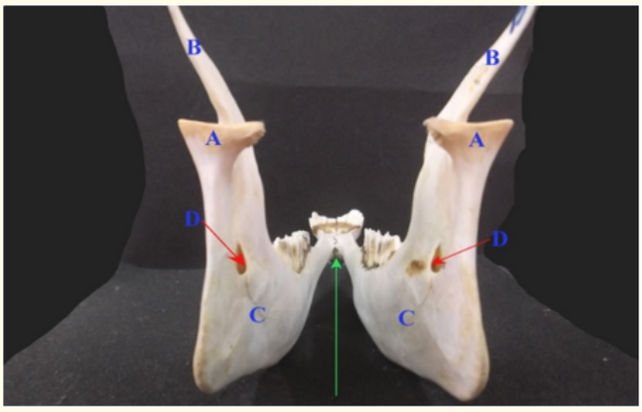


Figure 3: *Caudal view of the mandible of the Barbados Blackbelly sheep showing the mandibular foramen: A. Condylar process; B. Coronoid process; C. Ramus of the mandible; D. Mandibular foramen.*

Figure 4: *A gross photograph of the lateral view of the mandible of the Barbados Blackbelly sheep showing the needle placement in the mandibular foremen (A) and mental foramen (B) of the mandible (1).*

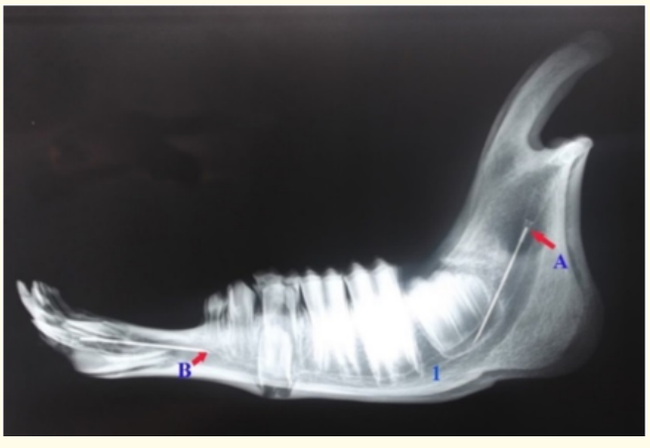


Figure 5: *Radiograph photograph of the lateral view of the mandible of the Barbados Blackbelly sheep showing the needle placement in the mandibular foremen (A) and mental foramen (B) of the mandible (1).*

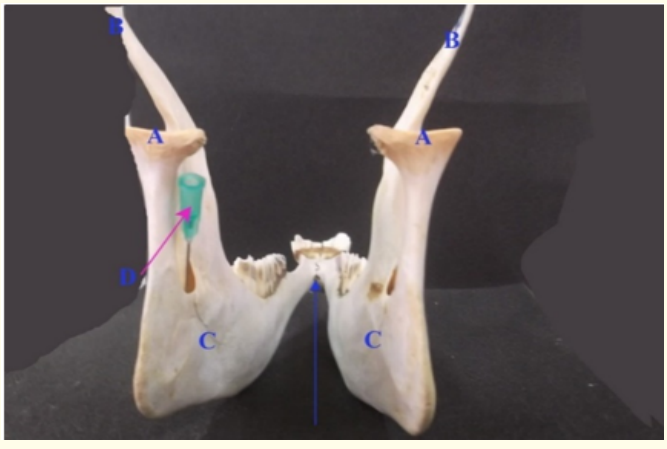


Figure 6: *Caudal view of the mandible of the Barbados Blackbelly sheep showing the site of the needle in the mandibular foramen (D). A. Condylar process; B. Coronoid process; C. Ramus of the mandible.*

The mental foramen

In the gross and radiography study, the mental foramen was a single foramen present in the rostral part of the lateral aspect of the two sides of the body of the mandible. The site of the mental foramen was detected by using the measured distance between the mental foramen and either the lateral alveolar border of the first lower premolar tooth; the caudal mandibular border; the lateral alveolar border of the mandible or the ventral border of the mandible. The mental foramen was under the tendon of the depressor labii mandibulais muscle. The tendon was displaced dorsally to feel the mental foramen. The blocking of the inferior alveolar nerve could be done by entering the needle with large volumes of local anesthetic in a rostro-caudal direction towards the mental foramen and is likely to desensitize the same structures as in performing inferior nerve block via the mandibular foramen. The mental nerve was the rostral continuation of the inferior alveolar nerve after its exit from the mental foramen supplying the chin and lower lip. This nerve can be blocked close to its exit from the mental foramen on the lateral side of the mandible rostral to the first lower premolar tooth (Figures 1, 3, 5, 6, 7).

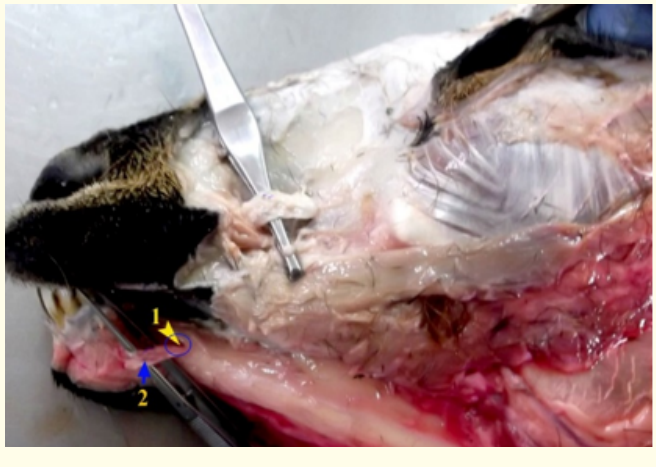
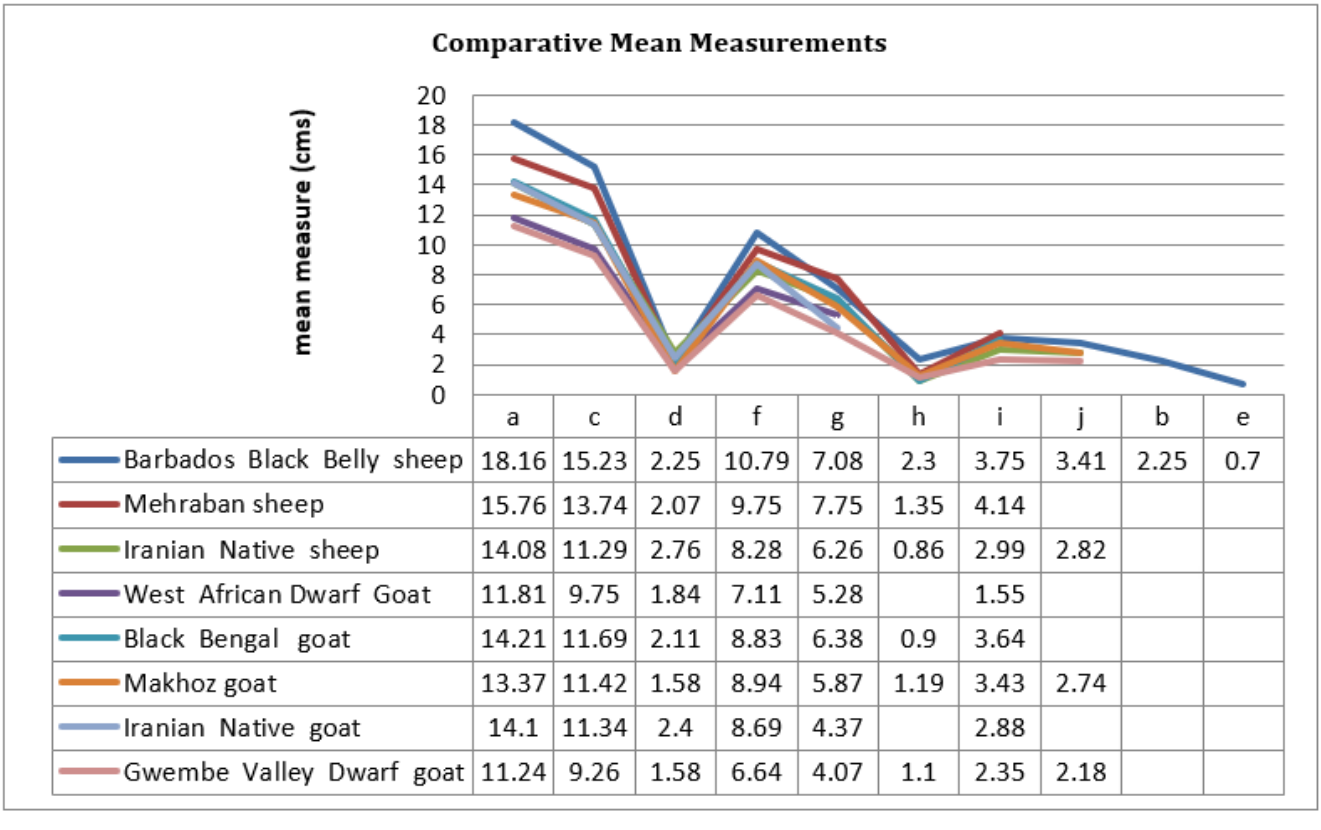


Figure 7: *Photomicrograph of the head region of the Blackbelly sheep showing the mental foramen (1) and mental nerve (2).*

Discussion

Comparison of the landmark measurements of the mandible of the Barbados Blackbelly sheep with other sheep and goat breeds is given in table 2. In the present study, the mean mandibular length and the maximum mandibular height were higher than the values obtained in the Mehraban sheep [7], the Iranian Native sheep [8], the West African Dwarf goat [9], the Black Bengal goat [10], the Makhoz goat [12], the Iranian Native goat [11] and the Gwembe Valley Dwarf goat [14]. The obtained results showed that the mean distance from the condyloid fossa to the base of the mandible was comparable to that reported in the Mehraban sheep [7] and was higher than in the Iranian Native sheep [8], the West African Dwarf Goat [9], the Black Bengal goat [10], the Makhoz goat [12], the Iranian Native goat [11] and the Gwembe Valley Dwarf goat [14]. Further, the results showed that the mean distance from the caudal border of the mandible to the level of the mandibular foramen was higher than the values reported for the Mehraban sheep [7], the Iranian Native sheep [8], the Black Bengal goat [10], the Makhoz goat [12] and the Gwembe Valley Dwarf goat [14]. Moreover, the mean distance of the mandibular foramen to the base of the mandible in the Barbados Blackbelly sheep was nearly equal to what was observed in the Black Bengal goat [10] and in the Makhoz goat [12] but higher than that was recorded in the Iranian Native sheep [8], the West African Dwarf goat [9], the Iranian Native goat [11] and the Gwembe Valley Dwarf goat [14]. However, this parameter was higher in the Mehraban sheep than that reported in the present study [7]. For the parameter "j" the results showed that the distance from the mandibular angle to the mandibular foramen was higher than the value reported in Iranian Native sheep [8], in the Makhoz goat [12] and in the Gwembe Valley Dwarf goat [14]. There were no values for this parameter in the other species mentioned. Observations of the present study confirmed that the parameters of the mandibular foramen are of clinical importance for attaining the regional anesthesia of the mandibular foramen for desensitization of the lower jaw with its teeth and the lower lip on the same side of the block [1].



	a	c	d	f	g	h	i	j	b	e
Barbados Black Belly sheep	18.16	15.23	2.25	10.79	7.08	2.3	3.75	3.41	2.25	0.7
Mehraban sheep	15.76	13.74	2.07	9.75	7.75	1.35	4.14			
Iranian Native sheep	14.08	11.29	2.76	8.28	6.26	0.86	2.99	2.82		
West African Dwarf Goat	11.81	9.75	1.84	7.11	5.28		1.55			
Black Bengal goat	14.21	11.69	2.11	8.83	6.38	0.9	3.64			
Makhoz goat	13.37	11.42	1.58	8.94	5.87	1.19	3.43	2.74		
Iranian Native goat	14.1	11.34	2.4	8.69	4.37		2.88			
Gwembe Valley Dwarf goat	11.24	9.26	1.58	6.64	4.07	1.1	2.35	2.18		

Table 2: *Comparison of mean measurements.*

The results showed that the distance between the lateral alveolar root and the mental foramen was comparable to the reported value in the Mehraban sheep [7], the Iranian Native sheep [8], the Black Bengal goat [10] and the Iranian Native goat [11]. It was higher than in the West African Dwarf Goat [9], the Makhoz goat [12], the West African Dwarf Goat [9], and the Gwembe Valley Dwarf goat [14]. Further, this study showed that the mean distance between the mental foramen to the caudal mandibular border was higher than the values obtained in the Mehraban sheep [7], the Iranian Native sheep [8], the West African Dwarf goat [9], the Black Bengal goat [10], the Iranian Native goat [11], the Makhoz goat [12] and the Gwembe Valley Dwarf goat [14]. Moreover, the mean distances between the mental foramen to the lateral alveolar border of the first upper premolar tooth and to the ventral border of the mandible were 2.25 cm and 0.70 cm respectively. No values were recorded for the other species mentioned above. Finally, observations in this study confirmed that the parameters of the mental foramen are vital because injection of local anesthetic drugs can be made in the rostral aspect of the mandibular canal via the mental foramen for blocking the inferior alveolar nerve, so that desensitization of lower jaw with its teeth and the lower lip will occur. Moreover, this method is easier and avoids all risks of blood vessel injuries as in the case of the infra-alveolar nerve block via the mandibular foramen [15,21].

Conclusion

The results of this study were important for identifying the Barbados Blackbelly sheep from other ovine and caprine species using the anatomical parameters Furthermore, the results were vital in understanding the clinical anatomy of the mandible of the Barbados Blackbelly sheep which will help the veterinarian surgeons in the administration of regional nerve blocks. Blocking of the inferior alveolar nerve by injecting a large volume of anesthetic agent through the mental foramen could be the shorter, easier and safer technique to perform prior to surgical operations in the mandible or extraction of the lower teeth hence; avoiding the risks associated with either mandibular foramen technique or the use of general anaesthesia.

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