Global Veterinaria 17 (2): 99-104, 2016
ISSN 1992-6197

DOI: 10.5829/idosi.gv.2016.17.02.10330

Morphological Studies of the Facial Tuberoses and Infraorbital, Supraorbital and Mental Foramina in Kuri Cattle

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Abstract: This work was undertaken to study the pattern of opening of the infraorbital, supraorbital and mental foramina and the locations and relationship between the facial tuberoses and infraorbital foramen in Kuri cattle. A total of eleven adult Kuri cattle skulls comprising 6 male and 5 female were utilized for this study, the skulls apparently had no musculoskeletal deformity. In 63.6% of the skulls studied, the facial tuberoses were located above first molar teeth and in 18.2% were located at a junction above first and second molar teeth and in 9.1% each, found to be above second molar teeth and at a junction above third premolar and first molar teeth. The infraorbital foramen in 63.6% skulls was located above first premolar, in 18.2% they appeared at a junction above first and second premolars and in 9.1% seen directly above second premolar and in another 9.1% located at a junction above the first premolar and caudal end of diastemal line. The foramina studied were mostly single; however, double foramina were recorded for all the three foramina studied. Accessory foramina were seen in infraorbital and supraorbital foramina. Supraorbital notch was also recorded along the supraorbital groove. From this study, it was observed that there might be a relationship in the location of facial tuberoses and the infraorbital foramen in the Kuri cattle, as relative position of the facial tuberoses corresponds to the relative position of the infraorbital foramen and vice versa. We therefore conclude that, the information provided can be useful in locating the infraorbital foramen more precisely using the facial tuberoses as a guide in the Kuri cattle.

Key words: Morphology · Facial Tuberoses · Infraorbital · Supraorbital · Mental · Foramina · Kuri Cattle

INTRODUCTION

The Kuri (Buduma) cattle is one of the tallest breed of cattle originating from Africa whose height at withers stands at about 180 cm tall and adults weights ranging from 360-750 kg [1, 2]. They are of the Hamitic longhorn [3] and are predominantly found on the islands and along the shorelines of the Lake Chad as their natural habitat. The Lake is formed by the neighboring countries of Nigeria, Niger, Chad and Cameroon [4]. Many writers reported that this breed is vulnerable because of the, localized special but shrinking habitat [5] and they are unable to thrive outside this environment [1, 6].

Regional anatomy of the head is important due to the fact that it accommodates vital organs such as the brain, eyes, nose, tongue, lips, eye-lids and the horns. It is also one of the foundations for surgical and clinical practices as it will help surgeons to visualize structures relevant to the case at hand [7]. Hence, gross morphological studies of the head are important not only for reflect contributions of environmental and genetic components to development and for describing ecophenotypic and genetic variations, but are also foundations of the surgical and clinical practices [8, 9].

The background knowledge of maxillofacial and mandibular regions are essential in veterinary clinical practice, since the different foramina located in these regions are clinically significant in regional anaesthesia for surgical interventions such as trephination of maxillary and caudal frontal sinuses, dehorning and dental and oral surgery [10].

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Therefore, this study was undertaken to study the locations and pattern of openings of the infraorbital, supraorbital and mental foramina and the relationship between the facial tuberoses and infraorbital foramen.

MATERIALS AND METHODS

A total of eleven adult Kuri cattle skulls and mandibles consisting 6 male and 5 female were utilized for this study. The animals were physically examined at ante mortem examination at Bodija abattoir, Ibadan and Bariga abattoir, Lagos, Nigeria, for their state of general health, particularly absence of musculoskeletal disorders. Age of the animals was estimated based on dental eruption technique [11]. The skulls were prepared according to hot water maceration technique [12], as modified [13]. The steps involved in the preparation of each skull were briefly:

- Skin, excess muscles, fats and other tissues were removed and then eye enucleated (using sharp knives and scalpel blades), a head at a time was then put in a drum containing water, detergent (polycarboxylate and surfactant), soap chips and potassium hydroxide and then heated to over 100°C for at least 1 hour. Boiling of the head was done carefully and gently to prevent damage to the bones by over cooking.
- The head was then removed from the boiling solution and more muscles and ligaments separated. The skull was then returned into the boiling solution and this was repeated three to four times until all soft tissues were removed. Care was taken not to damage the skull and the mandibles. The mandibles were then carefully separated from the skull and cleaned.
- The brain tissues were then removed from the cranium through the foramen magnum by inserting a wire with a loop at its end into the brain cavity and extracting the brain tissues using a mixing action. Brain tissues were washed out by filling the brain cavity with water and flushing the cavity.
- The skull was put under running tap water and remnants of muscle and ligaments including those around the base of the horn and occipital areas were removed using iron sponge and forceps.
- The skull was kept in detergent solution for at least 1- 2 hours.
- Further extraction of muscle and ligaments were done in detergent solution using iron sponge and forceps.
- The skull was then left in 0.3 – 0.5% hydrochloride solution for at least 24 hours to bleach the skull and also remove smaller pieces of tissues and other debris from inside the skull cavities. Care was taken to avoid over bleaching.
- The skull was finally rinsed in running tap water for 10 – 15 minutes.
- The skull was then left to dry under sunlight for 15 days.

The skulls were then carefully studied for locations and pattern of openings of the infraorbital, supraorbital and mental foramina. The locations and relationships between the facial tuberoses and infraorbital foramen were also observed. A 16 megapixel Panasonic digital camera was used to produce figures in this study.

RESULTS

In this study, all the skulls examined were observed to be having facial tuberoses and the foramina (infraorbital, supraorbital and mental). The locations of the facial tuberoses and the foramina maintained bilateral symmetry in all the skulls and mandibles studied.

The facial tuberoses were observed to be located at four different locations on the maxilla. In 63.6% of the skulls, the facial tuberoses were located above the first molar teeth (Figure 1a). Secondly, they were observed to be above the junction between the first and second molar teeth in 18.2% of the skulls (Figure 1b). Thirdly, they were above second molar teeth in 9.1% (Figure 1c) and lastly they were above the junction between third premolar and first molar teeth in also 9.1% of the skulls (Figure 1d). On the skulls studied, the infraorbital foramen in 63.6% were located somewhere above first premolar (Figure 1a), or at a junction above first and second premolars in 18.2% (Figure 1b) and directly above second premolar in 9.1% (Figure 1c), but located somewhere at a junction above the first premolar and caudal end of diastema in 9.1% (Figure 1d).

The infraorbital foramina were observed to be single in number in 54.5% of the skulls (Figure 2a) and double in 9.1% (Figure 2b). While in the remaining 36.4% of the skulls had one or more accessory foramen (foramina) in addition to the main infraorbital foramen. The accessory foramen/foramina is/were located either rostrally (Figure 2c) or scattered around the infraorbital foramen (Figure 2d).

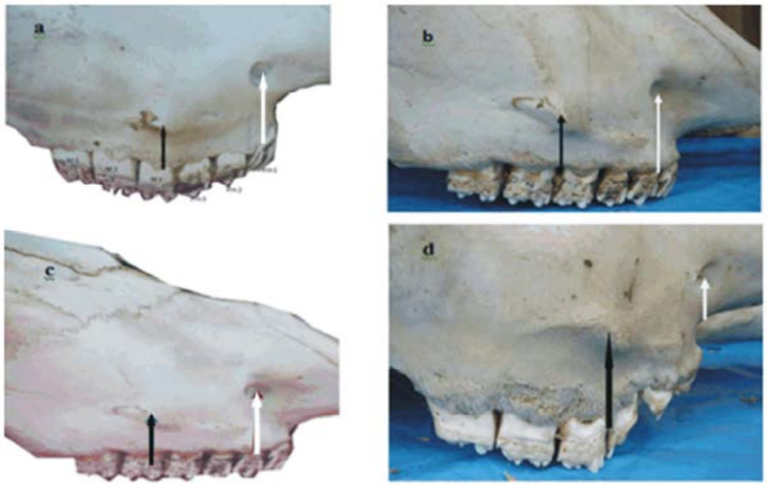

Fig. 1: Right lateral views of the Kuri Cattle Skull: Showing the locations of (a) facial tuberoses located above molar one (arrowed black) and the infraorbital foramen above premolar one (arrowed white), (b) facial tuberoses located above the junction between molar one and two (arrowed black) and the infraorbital foramen above the junction between premolar one and two (arrowed white), (c) facial tuberoses located above molar two (arrowed black) and infraorbital foramen above premolar two (arrowed white) and (d) facial tuberoses located above the junction between premolar three and molar one (arrowed black) and the Infraorbital foramen located above the junction between the premolar one and caudal end of the diastema (arrowed white).

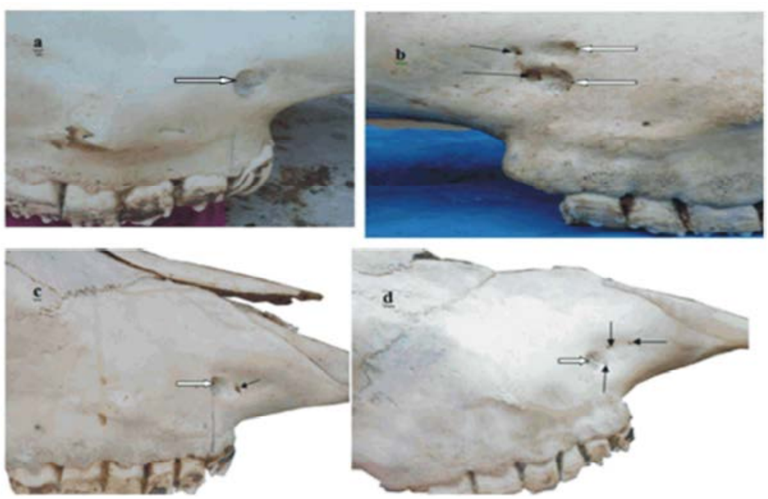

Fig. 2: Lateral views of the Kuri cattle skulls showing Infraorbital foramen (arrowed white) and accessory foramen (arrowed black) (a) Single infraorbital foramen, (b) double infraorbital foramen and accessory foramina, (c) infraorbital foramen and accessory foramen and (d) accessory foramina scattered around the infraorbital foramen.

The supraorbital foramen was large and single bilaterally in 72.7% of the skulls while in the remaining 27.3% they had one or more accessory opening(s) rostral to or rostral and caudal to the main supraorbital foramen were observed in the supraorbital groove (Figure 3a and 3b). The smaller accessory foramen or foramina opened into the larger supraorbital foramen or ended in a dead end and thus a notch. Single mental foramen was observed to be located on both lateral surfaces of the mandibles in 90.9% and double in 9.1% of the mandibles. In the case of double mental foramina, they were placed obliquely dorso-ventrad on both lateral sides of the mandibles (Figure 4a & b).

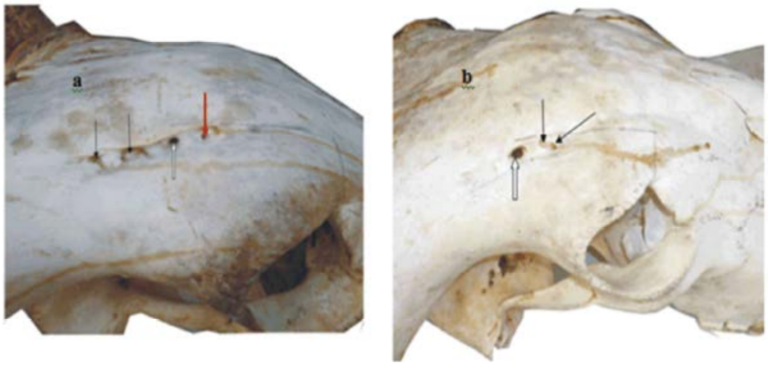

Fig. 3: Dorso-lateral views of the Kuri cattle Skull: Showing (a) accessory foramen (red arrowed) and notches (black arrows) rostral and caudal to the supraorbital foramen (white arrowed) in the supraorbital groove and (b) accessory foramina (black arrows) in the supraorbital groove that led into the main supraorbital foramen (white arrowed)

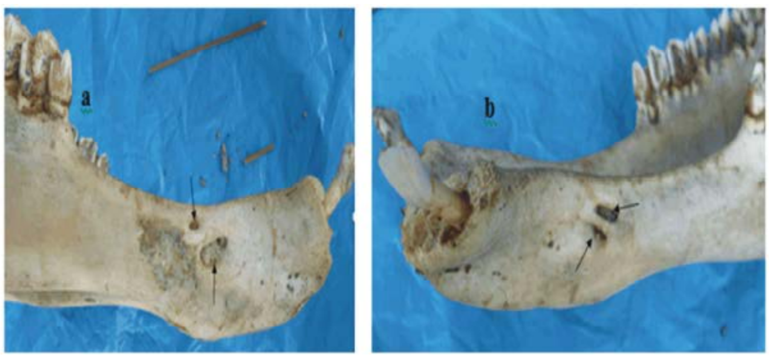

Fig. 4: Lateral views of the Kuri cattle Mandible: Showing obliquely placed double mental foramen opening bilaterally (arrows), (a) Right lateral surface and (b) Left lateral surface.

DISCUSSION

Facial tuberoses is highly prominent even in the live animals; and serve as a guide to locate the infraorbital foramen that is necessary for desensitizing the infraorbital nerve that innervates the nostril, skin of the face and lips around the foramen of the side [14]. In over 60% of the skulls studied, the facial tuberoses were located above molar one and in about 20% it was located above the junction between first and second molar teeth of the specimens and in less than 10% each located either above second molar or above the junction between premolar three and molar one.

In this study, the infraorbital foramen was observed to be located in four different locations (Figures 1a-d) with over 60% located above first premolar. But in the Iranian native cattle [15], Iranian Buffaloes [16] and Pakistan buffaloes [17] it was reported to be only above the first premolar. It was also indicated that the infraorbital foramen in the cattle is located about 3cm above the first premolar [7]. However, this was reported to be located dorsal to the second upper premolar or above the junction between the first and second upper premolar in the West African Dwarf goat [14]. It was also indicated that in the majority of Red Sokoto goat they were located above second premolar, but were more located above the first premolar in the Sahel goat [18]. In the Sheep, it was reported to be located above the junction between first and second premolars [19].

From this study, it was observed that there might be a relationship in the location of facial tuberoses and the infraorbital foramen in the Kuri cattle, as relative position of the facial tuberoses corresponds to the relative position of the infraorbital foramen and vice versa (Figure 1a-d). Since facial tuberoses is prominent even in live animals and can serve as a guide to locate the infraorbital foramen [14] and the location of the infraorbital foramen, relative to premolar tooth is essential to a successful regional anesthesia during tooth extraction [20]. However, occurrences of double and accessory foramen were observed in this work (Figure 2b-d), this might hinder successful regional anaesthesia of the infraorbital nerve. The occurrence of double infraorbital foramen was reported in cattle [21] and accessory infraorbital foramen in Red Sokoto and Sahel goats [18].

It was reported that, in the adult Kuri cattle the distance between the facial tuberoses and infraorbital foramen is 5.3 ± 0.63cm and from the latter to the alveolar root ventral to it is 3.7 ± 0.47cm [10]. This information will serve as a guide to track the infraorbital nerve with more precision because of the relatively constant relationship that exists between the facial tuberoses and the infraorbital foramen in the Kuri breed of cattle.

One or two accessory supraorbital foramen(s) are observed to be located rostral to the main supraorbital foramen. Supraorbital notches were also seen located caudal to the supraorbital foramen. Presence of any of these is clinically important because regional anaesthetic agent might end up deposited in the notch or accessory foramen resulting in escape of nerve from the agent with attendant anaesthetic technique failure. Double supraorbital foramen was reported in cattle [21], it was also noticed in Assam goat [23].

The bilateral double opening of the mental foramen observed in this study may suggest splitting of the mental nerve into two portions by the bony partition, or the presence of accessory mental nerve from the other foramen. In any case, the occurrence is clinically significant because mental nerve is said to transmit branches of nerves that supply the roots of facial nerve. Hence, local anaesthetics nerve block might partially fail if some of the nerves fibers pass through other accessory opening(s) escaping the anaesthetic agent. Occurrence of accessory mental foramen has also been reported in Red Sokoto and Sahel goats [18] and in man [23].

This work reported the occurrences of double mental and infraorbital foramina, accessory infraorbital and supraorbital foramina and supraorbital notches in the Kuri cattle. The information provided on the relationship between facial tuberoses and infraorbital foramen can be useful in locating the infraorbital foramen more precisely using the facial tuberoses as a guide.

Many authors reported on the locations of facial tuberoses and the infraorbital foramen in different species of animals, but to the best of our knowledge, this is the first report on the study of relationship between them. We therefore recommend that more studies be carried out on the relationship between the facial tuberoses and the infraorbital foramen in relation to location in different species and breeds of animals.

ACKNOWLEDGMENTS

We appreciate the contributions of Mr. M. A. Buhari and Drs. I. O. Fatola and K. A. Sanda for the skull preparation and secretariat assistance.

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