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GROSS ANATOMY OF THE MANDIBLE IN MURRAH BUFFALO (*Bubalus bubalis*)

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ABSTRACT

There is no previously reported information on the anatomy of the mandible in Murrah buffaloes; hence the present investigation is designed to provide the morphological features of the mandible of Murrah buffaloes. In this study, twelve mandibles from both male and female Murrah buffaloes were collected after their natural deaths in the states of Rajasthan and Punjab, India. In the present study, the mandible (mandibula) was a paired bone consisted of a body and a ramus. The mandible was the heaviest bone of the skull and both mandibles were unossified as mandibular synchondrosis rostrally. The body of the mandible was subdivided into a rostral part, that contained the incisor teeth and a caudal part, that contained the cheek teeth. The ramus of the mandible was a vertical bony plate that extended from the mandibular body towards the zygomatic arch. The mandibular ramus presented two surfaces, two borders and two extremities. Two surfaces were medial and lateral. The mandibular borders were alveolar and ventral. The anatomy of the mandible of Murrah buffalo has been described in detail in the manuscript and compared with the other large domestic and wild animals as per literature available. It can be concluded from the present study that the mandible of the Murrah buffalo resembled that of other large domestic and wild ruminant animals with few minor morphological differences.

Keywords: *Bubalus bubalis*, Murrah buffaloes, mandible, body, ramus, anatomy

INTRODUCTION

Murrah buffalo is one of the finest dairy buffalo breeds in India. Buffaloes contribute more than 50% of the total milk production in India (Boro *et al*., 2020). The mandible anatomy is advantageous to understand the structures associated with it and correlate these structures in the clinical anatomy or surgical anatomy. The mental and mandibular foramen can be used as a landmark for perineural anesthesia (König and Liebich, 2014).

Various technological advancements have

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been made in veterinary anatomy in recent years; however, the need for gross anatomical specimens for teaching veterinary anatomy remains unchanged (Choudhary *et al*., 2023; Choudhary *et al*., 2025). The anatomy of the bones is also helpful in identifying the bones of different animals of the same size and group; hence, this study may also help in the many veterolegal cases where zoo officials and veterinarians fail to identify the bones of this animal and confuse them with some other large animals.

The anatomy of the mandible has been discussed in detail in various large domestic and wild animals such as ox (Raghavan, 1964), horse (Getty, 1975), camel (Singh, 1984), mithun (Choudhary *et al*., 2020) and blue bull (Bharti *et al*., 2020). However, there is no previously reported information on the anatomy of the mandible in Murrah buffaloes; hence the present study has been designed to provide the gross morphological features of the mandible in the Murrah breed of buffaloes.

MATERIALS AND METHODS

The present study was carried out from March 2023 to June 2024. The study was conducted on twelve mandibles (n=12) of adult Murrah buffaloes of either sex (n=6 males and n=6 females). The mandibles were collected from the naturally dead Murrah buffaloes in the Jaipur and Tonk districts of Rajasthan. Two female Murrah buffalo mandibles were also collected from Rampura Phul in Punjab. The collected mandibles were macerated as per the standard hot water maceration technique (Keneisenuo *et al*., 2020) immediately after collection. After maceration, the mandibles were soaked in 4% hydrogen peroxide for three days in a sealed container until the bones appeared clean and whitish in appearance (Choudhary *et al*., 2020). Finally, the processed mandibles were sun-dried for three days. The macerated mandibles of the Murrah buffalo were used for the gross anatomical studies. The buffalo mandibles were photographed with a mobile phone (iPhone 14) and labeled accordingly with Adobe Photoshop and Microsoft Office Publisher. Anatomical nomenclatures follow Nomina Anatomica Veterinaria (NAV, 2017). Ethical approval was not required since the mandible samples were collected from dead Murrah buffalo.

RESULTS AND DISCUSSION

The mandible (mandibula) was a paired bone consisted of a body and a ramus (Figure 1 and 2). The mandible was the heaviest bone of the skull and both mandibles were unossified (mandibular synchondrosis) rostrally as also reported in ox (Raghavan, 1964), buffalo (Khatra, 1979), mithun (Choudhary *et al*., 2020) and blue bull (Bharti *et al*., 2020). In contrast, the mandibular symphysis was completely ossified in camel (Singh, 1984) and horse (Getty, 1975). The two halves of the mandible diverged from the synchondrosis, enclosing the mandibular space (spatium mandibulae) between them as mentioned in mithun (Choudhary *et al*., 2020). The mandible was divided into body (corpus mandibulae) and ramus (ramus mandibulae).

The body of the mandible (Figure 1) was subdivided into a rostral part (pars incisiva), that contained the incisor teeth and a caudal part (pars molaris), that contained the cheek teeth as reported in mithun (Choudhary *et al*., 2020). The body of the mandible consisted of the mandibular canal for the passage of the mandibular artery, vein and

mandibular alveolar nerve as reported in mithun (Choudhary *et al*., 2020). The caudal opening of the mandibular canal was mandibular foramen (foramen mandibulae). The rostral opening was of mandibular canal was in the form of small foramen i.e. mental foramen (foramen mentale) on the lateral surface of intraalveolar margin (margo interalveolaris). The rostral opening of the mental foramen was single in Murrah buffalo as reported previously in ox (Raghavan, 1964), buffalo (Khatra, 1979), mithun (Choudhary *et al*., 2020) and blue bull (Bharti *et al*., 2020). The mandibular foramen was rounded, whereas the mental foramen was oval or elliptical in shape in the mandible of Murrah buffalo. The molar part diverged caudolaterally from the incisive part to enclose the "V" shaped intermandibular space as reported in buffalo (Khatra, 1979), yak (Archana *et al*., 1998), mithun (Choudhary *et al*., 2020) and blue bull (Bharti *et al*., 2020).

The ramus of the mandible was a vertical bony plate that extended from the mandibular body towards the zygomatic arch. The mandibular ramus presented two surfaces, two borders and two extremities. Two surfaces were medial and lateral surfaces. The masseteric fossa (fossa masseterica) was present on the lateral surface of the ramus for attachment of masseter muscle (m. masseter). The pterygoid fossa (fossa pterygoidae) was present on the medial surface of the mandibular ramus for the medial pterygoid muscle (m. ptrygoidues medialis). The caudoventral part of the mandibular ramus formed the angle of the mandible.

The horizontal part of the mandibular ramus (pars molaris) was slightly curved; when it was located on a horizontal or flat surface, it did not touch the surface of both ends. The incisive parts of the body remain dispersed from the ground as previously noticed in camel (Singh, 1984), ox (Raghavan, 1964) and mithun (Choudhary *et al*., 2020). The vertical part of the ramus was the non-tooth bearer as recorded in yak (Archana *et al*., 1998).

The free end of the mandibular ramus was composed of condylar process (processus condylaris) and mandibular head (caput mandibulae) for the formation of temporomandibular joint caudally as mentioned earlier in ox (Raghavan, 1964), in yak (Archana *et al*., 1998). Rostrally, it was extended to form a long coronoid process as described in ox (Raghavan, 1964), buffalo (Khatra, 1979), mithun (Choudhary *et al*., 2020) and blue bull (Bharti *et al*., 2020). The condylar process and coronoid process were separated by a mandibular notch (insicura mandibulae) as mentioned earlier in mithun (Choudhary *et al*., 2020). The condylar process head was elongated transversely in Murrah buffalo as described earlier in camel (Singh, 1984), ox (Raghavan, 1964), buffalo (Khatra, 1979) and mithun (Choudhary *et al*., 2020).

The mandibular borders were alveolar and ventral. The alveolar border was slightly concave as reported in mithun (Choudhary *et al*., 2020); however, it was straight in camel (Singh, 1984). The alveolar border of the mandible presented three incisor teeth and the molar part of the mandibular body presented alveoli cheek teeth (three premolar and three molar teeth) on either side in Murrah buffalo as mentioned in ox (Raghavan, 1964), horse (Getty, 1975), buffalo (Khatra, 1975), yak (Archana *et al*., 1998), adult buffaloes (Singh *et al*., 2017), mithun (Choudhary *et al*., 2020) and blue bull (Bharti *et al*., 2020). The mandibular tuberosity was observed as reported in ox (Raghavan, 1964), horse (Getty, 1964), buffalo (Khatra, 1979), mithun (Choudhary *et al*., 2020) and blue bull (Bharti *et al*., 2020); however, a tubercle had been reported in camel instead of

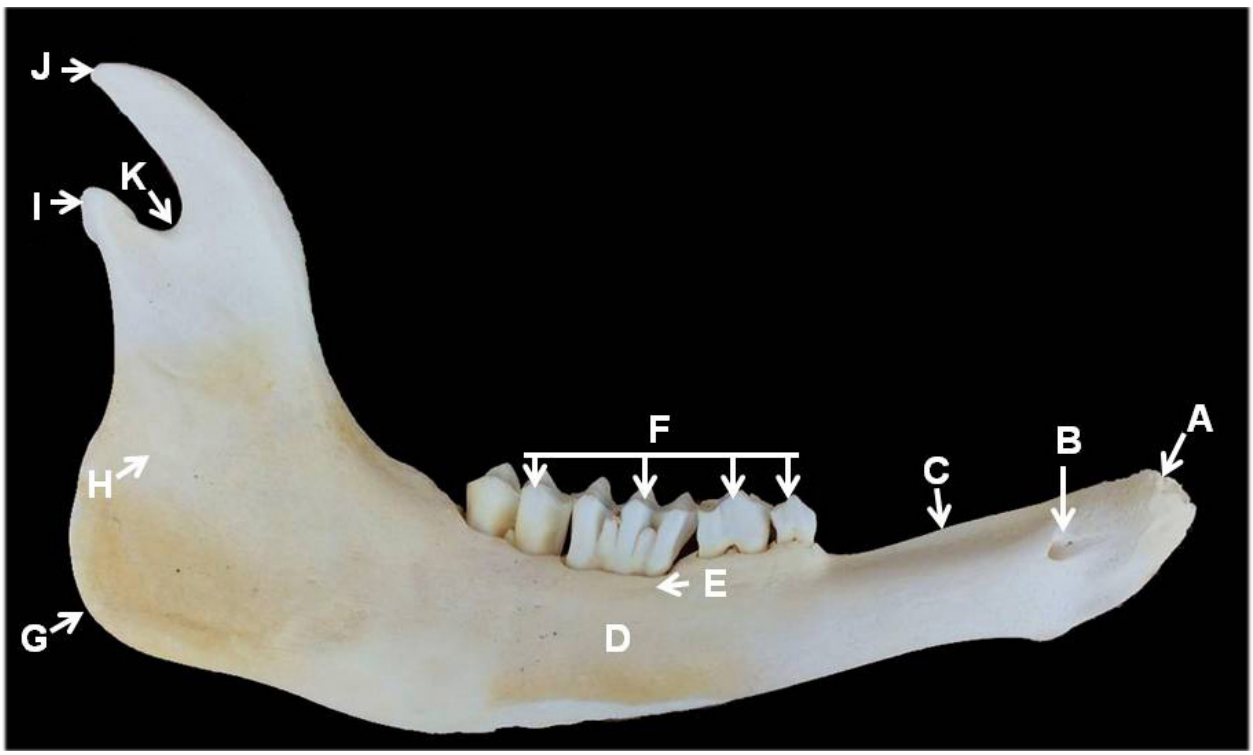

Figure 1. Lateral view of the mandible of Murrah buffalo showing alveolar socket for incisor tooth.

(A): incisor tooth
(B): mental foramen
(C): interalveolar margin or diastema
(D): body of mandible
(E): alveolar border of mandible
(F): premolar and molar teeth
(G): mandibular angle
(H): masseteric fossa
(I): head of condylar process of mandible
(J): coronoid process
(K): mandibular notch

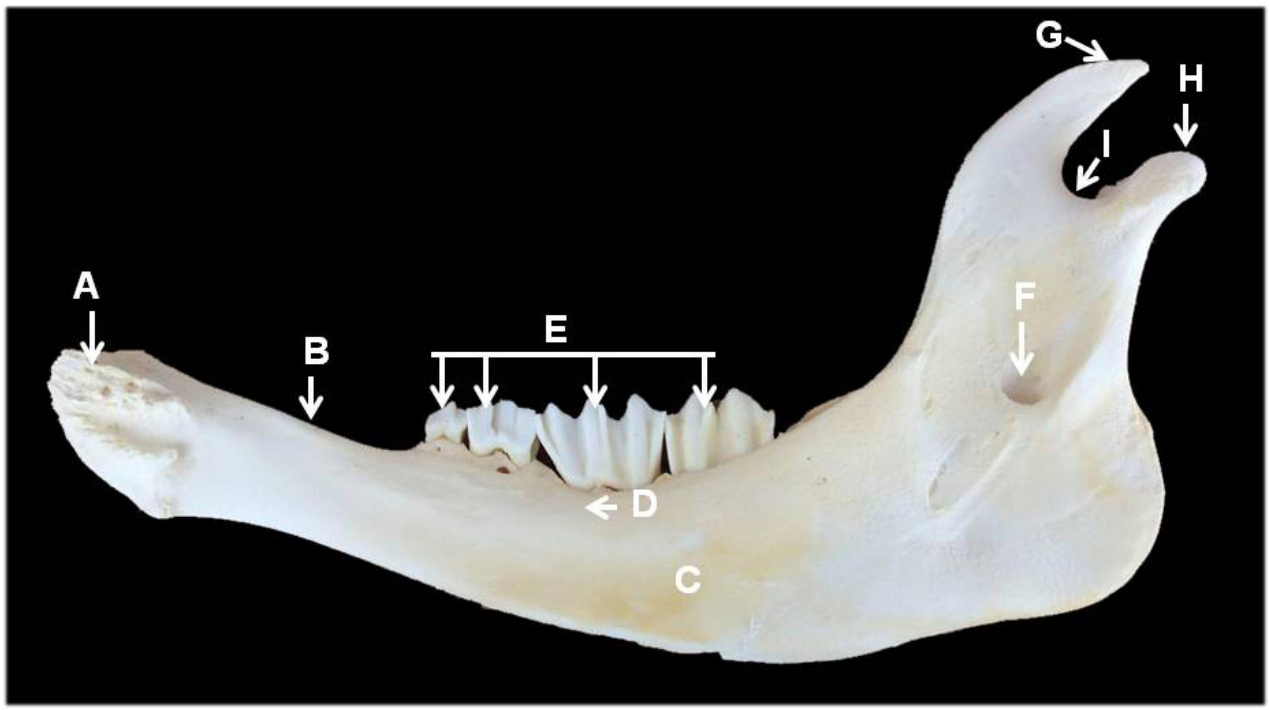

Figure 2. Medial view of the mandible of Murrah buffalo showing alveolar socket for incisor tooth.

(A): incisor tooth

(B): interalveolar margin or diastema

(C): body of mandible

(D): alveolar border of mandible

(E): premolar and molar tooth

(F): mandibular foramen

(G): coronoid process

(H): head of condylar process of mandible

(I): mandibular notch

mandibular tuberosity (Singh, 1984).

The ventral border of the mandibular ramus was convex in its length as described earlier in ox (Raghavan, 1964), yak (Archana *et al*., 1998c), buffalo (Khatra, 1979) mithun (Choudhary *et al*., 2020) and blue bull (Bharti *et al*., 2020). Whereas it was thick, rounded and nearly straight in young horses, but it became narrower, sharp in older horses (Getty, 1975).

CONCLUSION

It can be concluded from the present study that the mandible of the Murrah buffalo resembled that of other large domestic and wild animals like ox, buffalo, horse, camel, mithun and blue bull; however, some minor morphological characteristics of the mandible were different in camel and horse.

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