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Development of mandible in prenatal buffalo

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The literature pertaining to developmental features of mandible particularly in buffalo is not available. The prenatal development of buffalo mandible was studied in detail. The present study will be contributory to the existing anatomical knowledge and form the basis for further investigations.

Buffalo embryos and foetii 509 starting from 26 to 310 were collected from different slaughter houses irrespective of age, breed and nutritional status of the mother. The age of the specimens was calculated by adopting Soliman's (1975) formula coined for buffalo i.e.

Y=28.66 + 4.496 X if CVRL is < 20 cm and Y=73.544 + 2.256 X if CVRL is ≥ 20 cm, where Y is the age in days and X is the curved crown rump length in centimeters. The age of embryos of 26 and 27 days was arrived based on external features (C shaped structure, heart and liver prominences, distinct branchial arches, ridge form of limb buds) since minimum standard value of Soliman's formula is 28.66. The CVRL (Curved Crown Rump Length) of the specimens studied ranged from 2.1 cm (38 days) to 105 cm (310 days). All the embryonic specimens and heads of foetii from 50 to 101 days of age were fixed in 10% buffered neutral formaline and Bouin's fluids and processed for serial paraffin sections of 6–8µ thickness. The heads of foetii from 70 days (9.2 cm CVRL) and above were subjected to decalcification by formic acid - sodium citrate method after fixation. The sections were subjected to Mayer's haematoxylin and eosin method (Singh and Sulochana 1997) for routine developmental study and Alizarin Red S and Toluidine blue method for differentiating cartilage and bone (Burdi 1965) in embryos. The heads of 90 (13.7 cm) to 310 days (105.0 cm) specimens were preserved in 10% formaline and dissected to study gross aspects of mandible.

The mandible was one of the first bones to show ossification in buffalo skull along with maxilla and molar. The mandible was reported to be site of earliest ossification in the skull of bovines (Matthews 1972). Most of the mandible was developed by intramembranous ossification from one center on each side representing 2 halves. It was developed initially lateral to Meckel's cartilage but ossification extended later to the medial side of the cartilage also.

The first indication of ossification in mandible appeared on 45th day in incisive and molar parts of the body (Fig. 1) and extended subsequently into the ramus. Matthews (1972) and Soana *et al.* (1996) reported the ossification of mandible at 42 days and 52 days, respectively, in bovines. Ossification of coronoid process was observed at 61 days while the same in bovines was reported to be observed at 56 days (Matthews 1972). Most of the body and ramus of mandible showed complete ossification at 64 days. The mandibular canal was very much distinct at 70 days.

Two to six membranous areas seen on the molar part of body of mandible above the ventral border from 125 to 229 days may be attributed to developing cheek teeth. The rami of mandible were obliquely bent outwards from 66 days and became least curved beyond the age of 170 days resulting in formation of mandibular space throughout from 168 days onwards. The angle of mandible was more prominent from 93 days to 159 days. In skulls of 98 days to 164 days mandibular space was evident only between caudal parts of 2 halves of mandible near the angles, while anteriorly the 2 halves were touching each other. The lingual groove was evident on mandible at 128 days.

The condyle of mandible was developed by endochondral ossification as in rat (Yamak *et al.* 2005) and its ossification was first evident at 75 days (Fig. 2). The condyle was covered by fibrocartilage at 93 days which was formed by condensation of mesenchyme. The mandible was almost completely ossified at 90 days except the condyle and coronoid process of mandible which were completely ossified at 93 days. The formation of meniscus of temporomandibular joint was observed at 72 days (Fig.3). A thin fibrocartilaginous meniscus was observed at 143 days,

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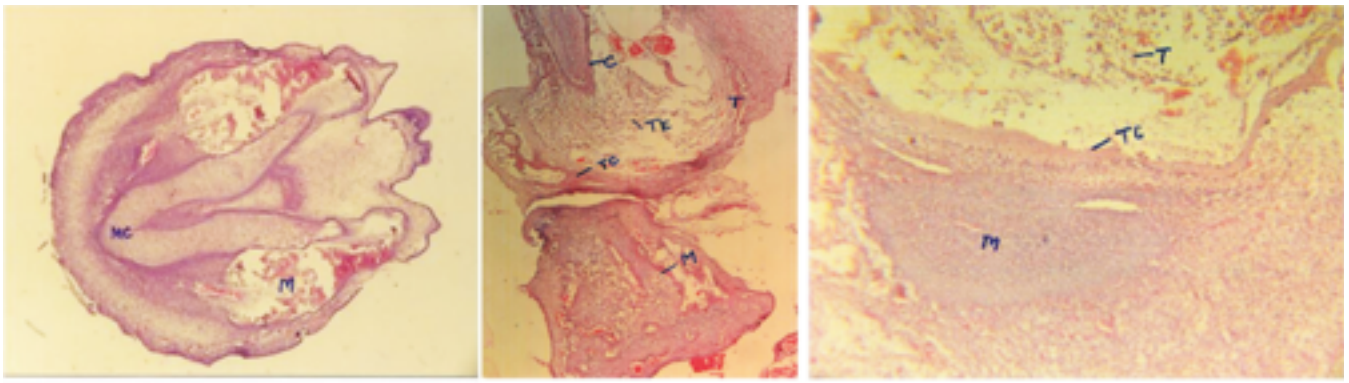

Figs 1–3. **1.** Photomicrograph of frontal section of lower jaw of 45 day embryo showing early ossification of mandible (M) and cartilaginous form of Meckel's cartilage (MC). H & E×40 **2.** Photomicrograph of cross section of head of 75 day foetus showing endochondral ossification of condyle of mandible (M). Ossification of squamous temporal C. Coronoid process TC. Temporal condyle TE. Temporalis muscle. H & E×40 **3.** Photomicrograph of cross section of head of 72 day foetus showing formation of fibrocartilaginous meniscus (M) at temporo mandibular joint. H & E×100 TC. Temporal condyle *T. Temporalis* muscle.

which has attained the features of the adult by 231 days.

The paired Meckel's cartilages were differentiated from the mesenchyme in the middle of mandibular processes and the 2 were united at cranial end of the lower jaw (Fig.1) which is similar to the findings of Yamak *et al.* (2005) in rat. The Meckel's cartilages appeared oval in cross section and they were precartilaginous at 43 days and cartilaginous at 45 days (Fig. 1).

Early formation of Meckel's cartilage was evident at 41 days in the form of mesenchymal condensation (Fig.4). No part of the Meckel's cartilage was involved in the formation of mandible and tip of mandible in domestic animals (Latshaw 1987). The caudal portion of Meckel's cartilage extended into tympanic cavity and ossified to form the malleus and incus (Fig. 5). However Ishizeki *et al.* (1999) observed the contribution of posterior portion of Meckel's cartilage in the formation of mandible by endochondral ossification in rodents. The Meckel's cartilage of buffalo was resorbed during sixth month as reported by Chauveau (1981) in domestic animals.

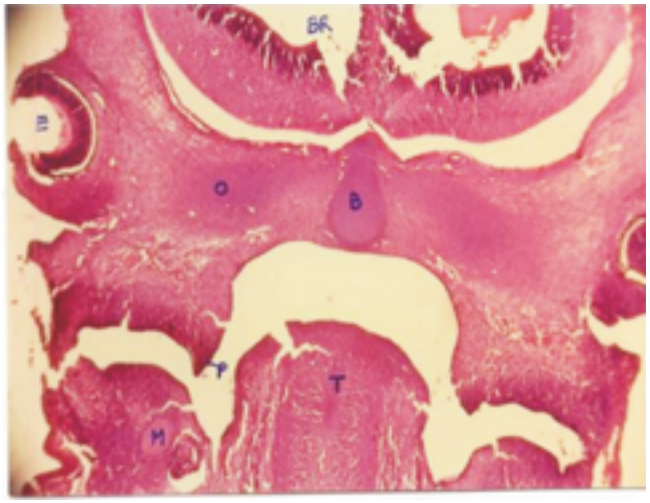

Fig. 4. Photomicrograph of cross section of head of 41 day embryo showing early formation of meckel's cartilage (M) in the form of mesenchymal condensation. H & E×40 O, Orbitosphenoid, B. body of presphenoid BR, Brain E, Eye P. Palatine process T. Tongue.

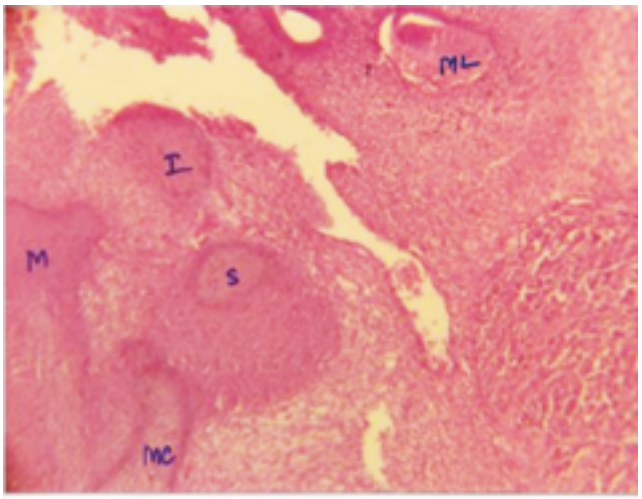

Fig. 5. Photomicrograph of sagittal section of head of 43 day embryo showing formation of malleus (M), incus (I) from the caudal portion of Meckel's cartilage (MC). S stapes; ML, membranous labyrinth H & E×100.

SUMMARY

The mandible was one of the first bones that showed ossification in buffalo skull along with maxilla and maolar. Early formation of Meckel's cartilage was evident at 41 days and was resorbed during sixth month of age. Most of the mandible was developed by intramembranous ossification from one center on each side at 45 days. The early formation of meniscus of temporomandibular joint was observed at 72 days. The condyle of mandible was developed by endochondral ossification at 75 days.

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