



Prenatal development of membranous viscerocranium in buffalo

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ABSTRACT

The present work was undertaken on Buffalo embryos (509) and fetuses starting from 26 days to 310 days to study the development of different bones forming the membranous viscerocranium. The ossification of skull was first appeared in mandible, maxilla and malar at 45 days. Early ossification of lacrimal, squamous temporal and tympanic ring was evident at 49 days. The ossification of palatine was first observed at 53 days while premaxilla and vomer showed ossification at 56 days. Early ossification of nasal bone was observed at 61 days. The vomer was in contact with the floor of the nasal cavity throughout separating two posterior nares completely.

Key words: Buffalo, Prenatal development, Membranous viscerocranium

MATERIALS AND METHODS

The present work was conducted at Department of Veterinary Anatomy and Histology, College of Veterinary Science, Tirupati on embryos (509) and fetuses belonging to 112 age groups starting from 26 days to 310 days. The prenatal embryos and fetuses of unknown age irrespective of the sex were collected from different slaughter houses. The CVRL of the specimens measured was ranged from 2.1 cm (36 days) to 105 cm (310 days). The age of the specimens was calculated by Soliman (1975) formula coined for buffalo.

The embryos for serial microtomy were collected starting from earliest possible age i.e. 26 days. The specimens were fixed in 10% buffered neutral formaline and Bouin's fluids and processed for serial paraffin sections of 6–8m. The foetal heads of 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 routine and special staining methods (Gurr 1956, Humason 1967, Singh and Sulochana 1997). The specimens from the age of 90 days (13.7 cm CVRL) were preserved in 10% formaline and were made to study gross aspects of membranous viscerocranium after dissection.

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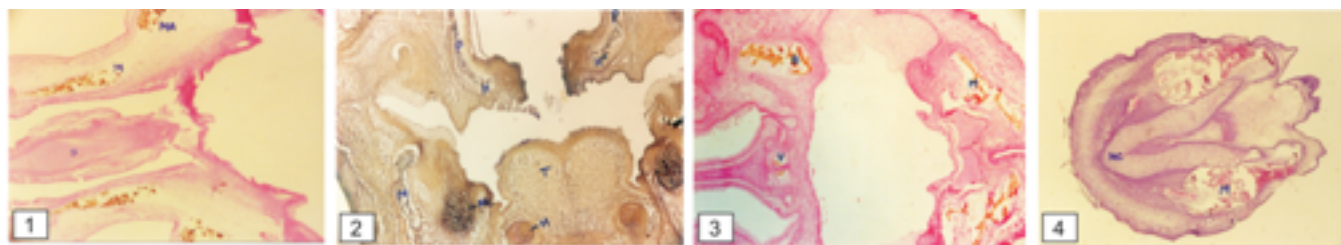
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RESULTS AND DISCUSSION

The bones of the membranous neurocranium were derived from first branchial arch and frontonasal prominence, which constituted premaxilla, maxilla, palatine, malar, pterygoid, nasal, lacrimal, vomer, squamous temporal, tympanic ring and mandible. Most of the facial bones except mandible, vomer and hyoid were ossified from single centers.

The ossification of premaxilla was first observed at 56 days in body and spread upwards and backwards from body to form the nasal and palatine processes. Both nasal and palatine processes were completely ossified by 64th days. The early ossification of maxilla was observed at 45th days (Fig. 1) in the region of facial tuberosity as reported by Matthews (1972), which extended into palatine process at 59th days. The maxillary ossification was reported to be observed at 52nd days in bovines (Soana *et al.* 1996). The complete ossification of maxilla was observed at 64 days. The ossification of palatine appeared first at 53rd days in horizontal part which extended into perpendicular part at 56th days (Fig.2). Matthews (1972) reported the beginning of ossification in horizontal and perpendicular parts at 52nd and 56th days respectively in bovines. Both horizontal and perpendicular parts of palatine were completely ossified at 95 days.

The malar bone was developed in the space between zygomatic process of squamous temporal and maxilla in the floor of orbit. The ossification of malar was appeared first at 45th days (Fig. 1). Soana *et al.* (1996) observed the beginning of ossification at 52 days in bovines. The zygomatic process



Figs 1-4. **1.** Photomicrograph of frontal section of head of 45 day embryo showing early ossification of part of membranous viscerocranium i.e maxilla (M) and malar (MA). Von Kossa method. $\times 4$. S. Septum nasi. **2.** Photomicrograph of cross section of head of 56 day foetus showing ossification in horizontal (H) and perpendicular (P) parts of palatine. Bismarck brown - Methyl green method $\times 40$. T. Tongue, M. Mandible, MC. Meckel's cartilage, H. Hyoid. **3.** Photomicrograph of cross section of head of 56 day foetus showing early ossification of vomer (V) with two ossification centers. Von Kossa method $\times 40$. B. Ossification in body of maxilla, M. Mandible. **4.** Photomicrograph of frontal section of lower jaw of 45 day embryo showing early ossification of mandible (M) with two ossification centers in incisive part of body and cartilaginous form of fused Meckel's cartilages (MC) at the cranial end respectively. H & E $\times 40$.

of malar was joined with the zygomatic process of squamous temporal at 83 days. The pterygoid was developed in membrane, while hamular process was formed by endochondral ossification. The beginning of ossification in pterygoid was observed at 83 days. The hamulus was cartilaginous at 75 days and continued to be cartilaginous even at 310 days. The membranous part was completely ossified by 92 days.

The nasal bone was developed first in the posterior part of the future nasal bone at 61st days. However complete ossification of nasal was observed at 89th days. Early ossification of lacrimal was evident at 49th days. Early formation of lacrimal bulla was observed at 238 days. The lacrimal was completely ossified at 141th days.

The vomer was developed from two intramembranous ossification centers along the ventral edge of cartilaginous nasal septum at 56 days (Fig. 3), while the same was reported during 8th week (Williams *et al.* 1989) in human. The fusion of ossification centers was observed at 62 days. The vomer was completely ossified at 110th days. The squamous temporal was developed first in the root of zygomatic process at 49 days. The bone showed complete ossification by 83 days. The fibrocartilage covering the temporal condyle was formed first at 72th days, thin and membranous at 143th days and attained a fundamental shape of adult by 231 days.

The early intramembranous ossification of tympanic ring was observed at 49th days. Distinct annulus tympanicus was evident at 90th days. The external acoustic process developed as an outgrowth from tympanic ring at 62th days and showed complete ossification at 200th days. The external acoustic meatus was distinct at 193th days.

The mandible was one of the first bones to show ossification in the Buffalo skull at 45 days in incisive and molar parts of the body (Fig. 4) along with maxilla and malar. However, the mandible was reported to be site of earliest ossification in the skull of bovines (Matthews 1972). The mandible except its condyle was developed intramembranously initially lateral to Meckel's cartilage but

ossification extended later to the medial side of the cartilage into the ramus. At 70th days mandibular canal was distinct. The condyle was developed by endochondral ossification first at 75th days. Complete ossification of mandible was evident at 93th days.

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