

PRENATAL DEVELOPMENT OF CARTILAGINOUS VISCEROCRANIUM OF SKULL IN THE BUFFALO (*Bubalus bubalis*)

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ABSTRACT

The cartilaginous viscerocranium of buffalo skull includes the Meckel's cartilage and its derivatives malleus and incus, mandibular condyle, Reichert's cartilage and its derivatives including stapes, styloid process of temporal, tympanohyoid and hyoid. The formation of Meckel's cartilage was recognized first at 41 days. The ossification of the cartilaginous viscerocranium appeared first in the stylohyoid at 62 days. The bone wise sequence of appearance of ossification in the cartilaginous viscerocranium was the stylohyoid, the malleus, the body and the other cornua of the hyoid, the incus and the stapes.

Keywords: prenatal development, cartilaginous viscerocranium, buffalo

INTRODUCTION

The skull is a very complicated structure of the body, which houses and supports the digestive, respiratory, nervous, sensory and endocrine structures (Nickel *et al.*, 1986). Very little information is available on the prenatal development of the cartilaginous viscerocranium in buffalo at different embryonic and foetal stages among farm animals. Hence the present study was

conducted.

MATERIALS AND METHODS

The present study was conducted on 75 buffalo embryos and fetuses from 26 days to 310 days. The prenatal specimens of unknown age and irrespective of the sex were collected from different slaughterhouses. The CVRL (Curved Crown Rump Length) of the specimens studied ranged from 2.1 cm (38 days) to 105 cm (310 days). The age of the specimens was estimated by adopting Soliman's (1975) formula for buffalo.

The embryos and fetuses from 26 days to 100 days of age were fixed in 10% Buffered neutral formaline and Bouin's fluids and processed for serial paraffin sections of 6-8 μ thickness. The foetal heads of 70 days and above were subjected to decalcification by the formic acid - sodium citrate method after fixation. The sections were subjected to Mayer's Haematoxylin and Eosin staining method for routine developmental study (Singh and Sulochana, 1997). The foetal heads beyond the age of 70 days (9.2 cm CVRL) to 310 days (105 cm CVRL) were also subjected to the Alizarin Red S method for studying the extent of bone formation (Humason, 1967).

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RESULTS AND DISCUSSION

The bones of the cartilaginous viscerocranium were derived from cartilaginous rods of the branchial arches which include Meckel's cartilage and its derivatives the malleus and incus, Reichert's cartilage and its derivatives the stapes, styloid process and hyoid as reported by Latshaw (1987) in domestic animals. Besides this, the mandibular condyle, the tympanohyal and the hamulus of the pterygoid were also included in the cartilaginous viscerocranium as they were developed by endochondral ossification.

Meckel's cartilage

The central cartilage of mandibular prominence formed Meckel's cartilage (Figure 1). Early formation of Meckel's cartilage was evident at 41 days in the form of mesenchymal condensation (Figure 2). It was precartilaginous at 43 days and cartilaginous at 45 days (Figure 1). Meckel's cartilage was reported to appear at 32 days in human by Lorentowicz - Zagalak *et al.* (2005). The Meckel's cartilages of both sides were united at cranial end of the mandibular process at 45 days (Figure 1).

The extreme caudal part of Meckel's cartilage extended into the tympanic cavity and ossified to form the malleus and incus (Figure 3) as reported in domestic animals (Latshaw, 1987). There was no evidence of ossification in Meckel's cartilage in the formation of the mandible except in its extreme caudal part. This was contrary to the reported participation of Meckel's cartilage in mandible formation close to the mental foramen in human (Orliaguet *et al.*, 1994). The Meckel's cartilage of buffalo was resorbed during the sixth month. However the disappearance of Meckel's cartilage was observed by the sixth month in human

(Orliaguet *et al.*, 1994).

Middle ear ossicles

The malleus and incus were chondrified in the mesenchyme of Meckel's cartilage. The middle ear ossicles were in mesenchymal form at 43 days (Figure 3), precartilaginous at 47 days (Figure 4) and cartilaginous at 49 days. The middle ear ossicles were in cartilaginous form till 140 days. They developed from single ossification centers as reported by Arey (1965) in human. The ossification of the malleus, incus and stapes was observed at 141 days, 170 days and 173 days, respectively, the stapes being the last to ossify among ossicles as reported by de Beer (1937) in pig.

Reichert's cartilage

Reichert's cartilage contributed to the formation of the stapes, the styloid process of temporal bone, the tympanohyoid and the greater part of the hyoid, which were formed by endochondral ossification. The upper end of Reichert's cartilage formed the stapes (Figure 3). The tympanohyal between the styloid process of the temporal and the stylohyoid remained fibrocartilaginous and remained separate throughout prenatal life. The tympanohyal and stylohyal were reported to be ossified in dorsal and ventral portions of Reichert's cartilage to form styloid process in human (Williams *et al.*, 1989).

Hyoid

The hyoid was developed by endochondral ossification from nine centers, one center in each cornu and body. It was in precartilaginous form at 41 days and cartilaginous at 45 days. Early ossification of the stylohyoid was observed at 62 days and its ossification was well marked at 93 days (Figure 5). Matthews (1972) reported the ossification center of

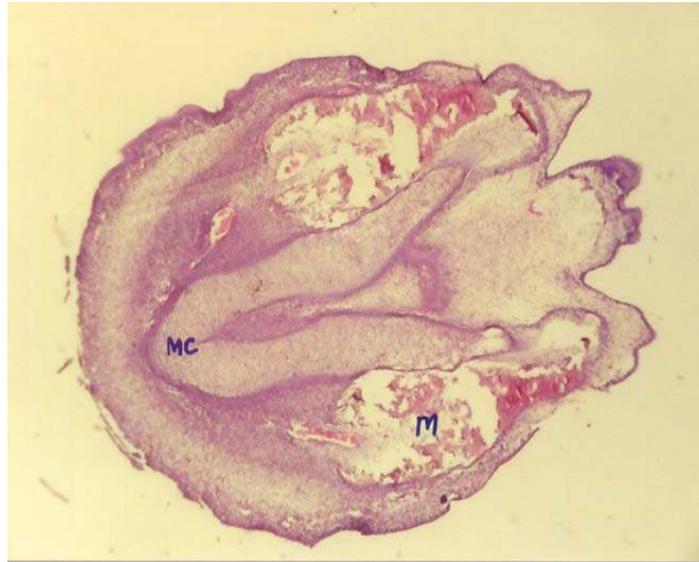


Figure 1. Photomicrograph of the frontal section of the lower jaw of a 45 day embryo showing cartilaginous form of fused Meckel's cartilages (MC) at the cranial end of the mandible (M). H & E x 40.

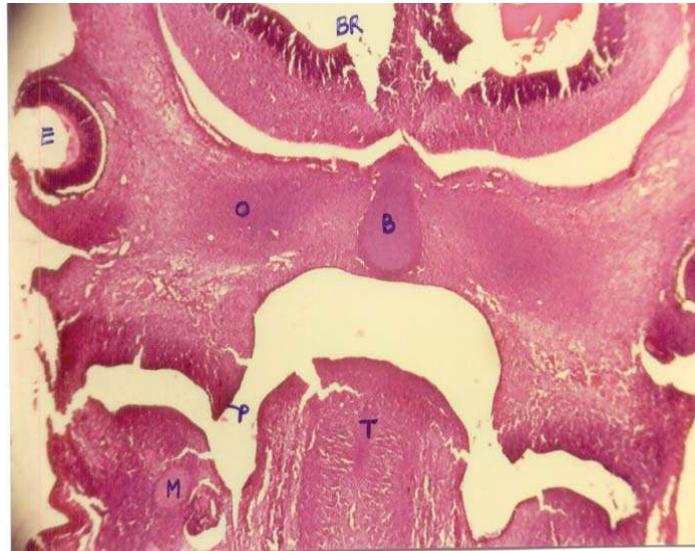


Figure 2. Photomicrograph of a cross section of the head of a 41 day embryo showing early formation of Meckel's cartilage (M) in the form of mesenchymal condensation. O. orbitosphenoid, B. body of presphenoid, BR. Brain, E. Eye, P. Palatine process, T. Tongue. H & E x 40.

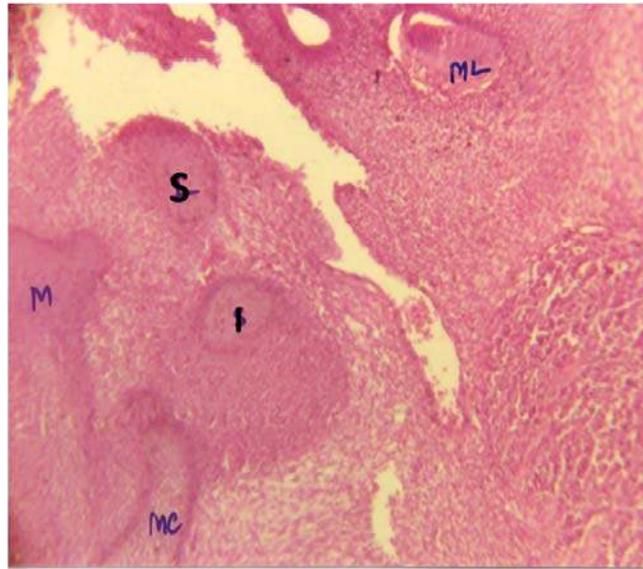


Figure 3. Photomicrograph of a sagittal section of the head of a 43 day embryo showing the malleus (M) and the incus (I) derived from Meckel's cartilage (MC). S. Stapes, ML. Membranous labyrinth H & E x 100.



Figure.4. Photomicrograph of a cross section of the head of a 47 day embryo showing the malleus (M), the incus (I) and the stapes (S) in precartilaginous form. H & E x 100 T1 Tympanic bulla, E. External ear, P. Petrous temporal, ML. Membranous labyrinth, T. Tensor tympani muscle.



Figure 5. Photomicrograph of a cross section of the skull of a 93 day foetus showing advanced ossification in the stylohyoid (S). H & E x40.

each segment of the hyoid in bovines at 56 days. The stylohyoid was completely ossified except at the extreme ends at 93 days (Figure 5), while the other cornua and the body were cartilaginous upto 158 days. The ossification of the body of the hyoid, keratohyoid, epihyoid and thyrohyoid was observed at 159 days and it was well marked at 180 days. All the cornua of the hyoid were ossified completely at 310 days. In buffalo the part between the styloid process and the stylohyoid remained fibrocartilaginous. A similar feature was reported by Nickel *et al.* (1986) in domestic animals.

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