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STUDIES ON THE INDIAN GHARIAL *GAVIALIS GANGETICUS* (GMELIN) (REPTILIA, CROCODILIA) IX. OBSERVATIONS ON THE DEVELOPMENT AND FATE OF EGG TOOTH

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ABSTRACT

The egg tooth of the Indian gharial *Gavialis gangeticus* (Gmelin) develops as a small papilla at the extreme tip of the snout on the upper jaw. As embryogenesis proceeds the papilla sinks down to the ventral surface of the upper jaw, but it simultaneously gives rise to a minute hard structure, the egg tooth, that projects out from the surface. The tooth punctures the shell membranes, making a passage for the young for liberating itself out of the egg. Within thirtyfive days of post-hatching period the egg tooth disappears due to wear off and cell overgrowth around it. In blind individuals the tooth is non-functional.

INTRODUCTION

The Indian gharial *Gavialis gangeticus* (Gmelin) lays eggs of calcareous nature. Underneath the shell, covering the albumen, are two membranes, an outer thick membrane of leathery texture and a fine inner membrane intimately applied to the outer membrane. As the process of incubation proceeds, due to imbibation of moisture and increase in size of the developing embryo, the egg swells up and develops cracks on the shell surface. Swelling up of the egg and the development of cracks are therefore, the characteristics of fertile eggs. An unfertile egg may however, on very rare occasions, show these characteristics probably due to water imbibation alone.

The incubation period for the gharial egg varies from eleven to thirteen weeks. Towards the end of seventh week of development, portions of the egg-shell fall off, a process called shell-fluffing (Bustard and Singh, *MS*) due to further swelling up of the egg coupled with the formation of more cracks on the shell. At this time the shell-membrane system may develop one or two micro-punctures through which albumen may be seen to ooze out as tiny droplets as a result

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of high turgor pressure exerted from within the shell. Prior to actual hatching, the shell-membrane system is punctured by a tooth called egg tooth, at the tip of the snout. The snout in gharial is very prominent, unlike other crocodilians, excepting *Tomistoma schlegelii* (Muller). The snout is an elongate, beak-like structure formed by the upper and the lower jaws. The upper jaw is slightly longer than the lower jaw. The egg tooth develops at the tip of the upper jaw.

During emergence, the snout protrudes out of the egg through the puncture made by the egg tooth on the shell-membrane system (Fig. 1). Once the egg tooth punctures the shell membrane and the tip of the snout protrudes out of the egg, the tooth is of no further utility. Slowly, the head (Fig. 2), followed by the whole body (Fig. 3) is liberated out from the egg.

The process of liberation of the hatchling from the egg therefore, is conditional to the act of puncturing the shell-membranes by by the egg tooth, preceded by a process of shell fluffing. The following account gives the description of development, size and the ultimate fate of the egg tooth in gharial.

MATERIALS AND METHODS

A series of different sized embryos freshly preserved in 5% formalin, were examined to obtain a preliminary idea on the development of the egg tooth. Altogether twentyseven preserved specimens were examined. These specimens were collected at the end of 1976-season's hatchery-incubation process by operating out several unhatched eggs. Therefore, the age of the specimens could not be determined.

The smallest embryo to be examined was 10.4 cm long. Furthermore, to understand the fate of egg tooth in post-hatching period, records were maintained weekly for fiftysix hatchlings and daily for a group of five hatchlings, all reared in captivity at the Gharial Research and Conservation Unit, Tikerpada.

All measurements given in the text below refer to lengths. The length is the distance between the tip of the snout at the anterior end to the tip of the tail at the posterior end. The length of the snout is the distance of the tip of the snount from the lower edge of the eye ball (i. e., the anterior limit of the eye ball). The length of the egg tooth is the distance between its tip and its base.

OBSERVATIONS

In embryos less than 17cm long, the snout is soft. The snout possesses two minute but distinct papillae—one the 'nasal papilla' surrounding the nostrils (non functional at this stage), and the other, a soft 'egg tooth papilla', projected anteriorly from the extreme tip of the snout on the upper jaw. Fig. 4A shows the basic design

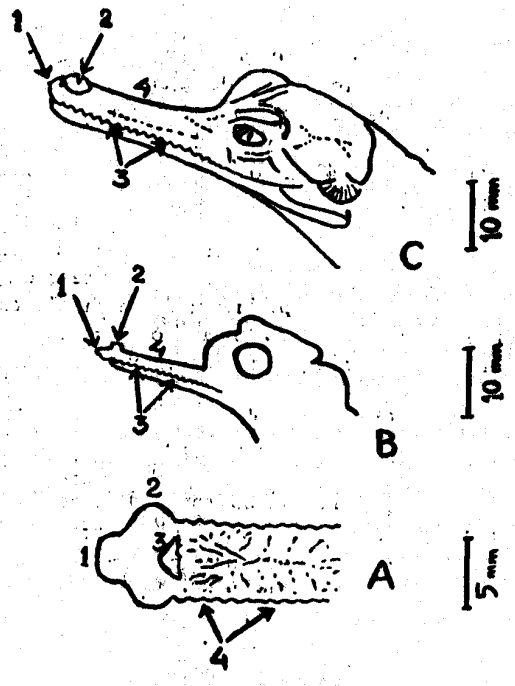

Fig. 4. A. Basic design of the tip of the snout in gharial. At the tip the premaxilla is three lobed, a frontal lobe (1) and two lateral lobes (2). The nasal opening is situated over a papilla (3) between the lateral lobes. The lateral margins of the premaxilla bear the dental papillae (4).

B. The head of an early embryo of gharial. The snout (4) at this stage shows the various dental papillae (3), nasal papilla (2) and the egg tooth papilla (1).

C. The head of a gharial hatchling just after hatching. The snout (4) at this stage bears the dental papillae (3), the nasal papilla (2) and the egg tooth (1).

of the snout at its tip and Fig. 4B shows the head of an embryo showing the various papillae. At this stage the snout measures between 0.95cm and 1.5cm and egg tooth papilla about 0.5mm.

In larger embryos the snout is comparatively a hard structure, the hardness increasing with increase in size of the developing young. In these specimens the papilla is replaced by a minute, hard and pointed projection, the egg tooth proper which is detectable by close observation and by touching it.

At the time of hatching, when the body length is 37.4cm on an average and the snout is 3.4cm on average, the egg tooth measures about 0.3mm. The egg tooth is detectable in all the hatchlings upto 20th day of post-hatching period. After hatching, the egg tooth disappears within twenty to thirtyfive days. After 35th day, when the hatchlings are on an average 42cm long, the tooth is no more detectable in any of the hatchlings.

Curiously enough, it was noticed that in embryos more than 20cm long, a distinct, hard papilla was present on the ventral side of the upper jaw at the tip, just underneath the externally sited egg tooth. This structure was found to persist in juveniles of even 1.7 metre long. Larger individuals have not been examined.

The experimental sample also consisted of four blind gharials including one live individual 95cm long. One of the preserved embryos, measuring 10.6cm, had the egg tooth at its papilla stage and two others, measuring 22.7cm and 33.2cm, had it at the definite tooth stage with the usual ventral papilla. The measurements of the egg tooth papilla and the egg tooth proper were concurrent with the measurements made for normal-eyed individuals.

DISCUSSION

From the foregoing account the following pattern for the development of egg tooth in *Gavialis gangeticus* is well envisaged.

The snout, during the course of its very early stage of development, differentiates its various finer armaments. These armaments include all papillae that are to develop into teeth, the papilla-like elevation bearing the nasal opening, and the egg tooth papilla (Fig. 4B). At this stage the egg tooth papilla is soft and anteriorly projected

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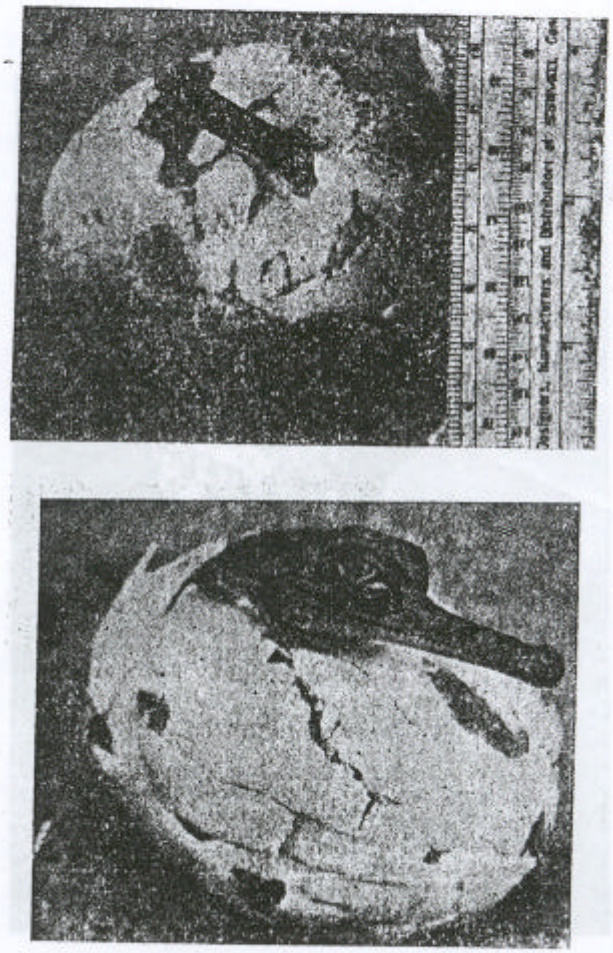

Fig. 1. (Top) – Protrusion of snout after puncturing the shell membranes.
Fig. 2. (Bottom)—The emergence of the head.

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Fig 3—Hatching in *Gavialis gangeticus* (Gmelin)—liberation of the body.

from the tip of the snout on the upper jaw. As development proceeds the papilla sinks into the tissue at the snout tip, assumes a harder texture and ventrally remains as a persistent structure. However, on the surface, at the previous position of the papilla, a minute tooth-like hard pointed structure develops from the papilla itself (Fig. 4C).

The disappearance of the tooth is due to rapid growth of the snout, adding cells around the base of the tooth. During this period the growth of the the snout is extremely rapid (Singh, MS). Furthermore, the disappearance of the tooth may also be due to gradual wear off.

Observations made during handling of the juveniles at the time of hatching suggest that blind gharials are incapable of liberating themselves from the egg. For liberation they have to be helped out by operation. It is presumed that either the egg tooth is not strong enough at the base to puncture the shell membranes as a result of some effect due to interaction between the determinant factors responsible for the development of the eyes and the snout (Singh, *MS*), or because of blindness, the subject, in absence of any photo-stimulus, does not get initiated to manoeuvre the tooth for puncturing the membranes. These hypotheses will be explored in future work.

The presence of a pointed calcareous projection, the "caruncle" on the snout is reported in the hatchling of many chelonian species (Muller, 1921; Einem, 1956; Allard, 1935; Legler, 1960; Booth, 1958; Cahn, 1937; Caldwell *et al.*, 1959; Cagle, 1950 and Moll and Legler, 1971). But the caruncle is not a true tooth and it is not always used for puncturing the egg shell membrane. The prime function of the caruncle, therefore, is suggested to be for rupturing the extra-emryonic membranes, amnion, chorion, yolk sac and allantois (Moll and Legler, 1971). The caruncle is reported to be lost within ten to sixty days after hatching. However, whatever may be the nature and fate of the caruncle in chelonians, it is analogous to the egg tooth in the gharial.

The egg tooth in birds is of two types—deciduous type, where it is quickly lost after hatching of the young, and disappearing type, where it does not fall off but gradually loses it identity (Clark, 1961; Collins and Naik, 1975; and Parkes and Clark, 1964).

The function and fate of the egg tooth is known for the American alligator *Alligator mississippiensis* (Daudin) and the Nile crocodile *Crocodylus niloticus* Laurenti, the two most widely mentioned species. The tooth, is reported to be deciduous type, falling off immediately after the embryo hatches out (Guggisberg, 1972). But as described above the gharial never drops off the egg tooth; rather the latter gradually disappears. Thus the current investigation demonstrates that the Order Crocodilia is characterized by both deciduous and disappearing types of egg tooth.

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