Pharyngeal Teeth of Porgies

by

Sohiti ISOKAWA,* Heiji ONUMA* and Haruhiko YOSHIDA*

Jaw teeth of porgies have been previously investigated in detail by ISOKAWA (1954), and YOSHITANI (1959). No further research into their pharyngeal teeth, however, is attempted so far. The present study which concerns itself with the morphological observations on pharyngeal teeth of fish of porgy family reveals the fact that they do not differ much from ordinary jaw teeth under both macroscopic and microscopic aspects.

I Materials and Methods

The porgies used were Pagrosomus major, Evynnis japonicus and Sparus swinhonis. They were 10-75 cm in total length except for Sparus swinhonis. Each Sparus swinhonis was 45 cm in length. The pharynges of the porgies were ventrally dissected. Two bones were found in the upper and lower regions of the pharynx, with many teeth on the surface of the bones. These bones have been separated by means of a knife, as the bones were closely attached to pharyngeal regions with dense connective tissues. The bones thus obtained were prepared and investigated as follows:

1) Some of the bones were sufficiently boiled so that the soft tissues might be fully removed from the bones with tiny pincettes and a soft brush. Following this, these were desiccated at room temperature after defatting process, that is, bone-bleaching was done. These were observed with naked eye or stereoscopic microscope.

2) Some bones were fixed with 10 percent formaldehyde, and were decalcified with 5 percent nitric acid-alcohol. The decalcified bones were embedded in celloidin. Some of these were prepared for sections of 10-15 microns, and the others were for serial sections of 20 microns. The sections were stained with hematoxylin-eosin and picric-fuchsin of VAN GIESON, and by MASSON-GOLDNER's stain, PAP's silver impregnation and SCHMORL's stain.

3) Some ground sections from teeth in the bleached bones and from isolated teeth were stained with carbol-fuchsin. The other ground sections remained unstained and decalcifying behaviors of these sections treated with a diluted hydrochloric acid solution were directly observed under the microscope.

II Macroscopic Observation

The porgy's pharyngeal bones consist of two parts in upper and lower regions, and the pharynx is surrounded with these bones. Upper bones are made of three ossicles firmly bound with some connective tissue. These bones form a bony dental plate, and these attach to pharyngeal regions exclusively with soft tissue. These bones are composed

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of anterior, medial and posterior bones. That is, the anterior is semicircular, and the medial and posterior are triangular as seen in Fig. 1. On the whole they look like an oval. There are seen teeth crowded on these bones. Namely, these teeth found on the whole surface of pharynx are smaller and more slender than those in the jaw. These bones are more or less similar in size. Of these the medial bone has the biggest teeth, and the anterior the smallest. In the lower region of pharynx, there is seen a bone in its each side respectively. The form of this bone is similar to that of the mandible. The lower bones have teeth of various sizes as seen in the mandible.

Fig. 1. Upper tiny bones

![Sockets in bony dental plate](image1)

A: anterior bone  
M: medial bone  
P: posterior bone

**Pagrosomus major** of 75 cm in length whose biggest teeth seen on the pharynx's lower bone are 6.5 mm in length, and 2 mm in breadth. Teeth numbers in each bone are seen on Table 1. In other words roughly speaking pharyngeal teeth of a fish are about 300. The teeth form of pharynx is conical. However, these teeth are more slender than those in the jaw according to their narrow crown breadth. Pharyngeal teeth are all conical, and nothing of them is hemispherical as teeth in the jaw. All of them post-medially curves. The enamel that covers the crown is rather yellowish-white. The tips of bigger teeth are seen dark gray, but the crown enamel glitters with bright gloss. After bones had been dried up, teeth could be easily pulled out of the adjacent underlying bones. When the teeth were removed, hollow sockets remained alone which outline the

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<th>Upper bone</th>
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<td><strong>Number (ea.)</strong></td>
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<td>140</td>
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<td><strong>Maximum size (mm)</strong></td>
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form of these tooth bases (Fig. 1). Through these procedures, the authors could count sockets as teeth with the stereoscopic microscope or magnifying glass.

### III Microscopic Observation

The histological structures of porgies's pharyngeal teeth have been found to be same with those of their jaw teeth. The pharyngeal tooth consists of enamel, dentin, and pulp. The tooth is attached to the underlining bone at contact area.

![Longitudinal section of porgy's pharyngeal tooth](image)

1) Enamel.

Fish enamel forms a protective covering over the entire surface of tooth. Near the top of tooth, its thickness becomes largest and towards the tooth base it becomes gradually thinner. Enamel is the hardest calcified tissue in fish body. This is obviously due to the high concentration of mineral salts. The enamel is the so-called tubular enamel. MUMMERY claimed that enamel is composed of enamel prisms and fine tubules. However, they do not exist there, as ISOKAWA (porgy 1954, and file-fish 1955) and YOSHITANI (porgy 1959) have proved respectively. There probably exists a fibulous system containing
mineral, and this system may be embedded with inorganic materials. Consequently, it appears like tubules, but not like canaliculi. This system disappears entirely after decalcifying process because of high mineral contents. These structures run perpendicularly from the tooth surface to the medium layer of enamel. Near medium layer, they run obliquely and become gradually fine. They are not distinct in the neighborhood of dentin, but numberless fine fibers forming a network are stained out by silver impregnation. As previously reported by ISOKAWA, it seems that the enamel of most fish appears before dentin formation (porgy, file-fish, etc.). Such findings were often recognized by the authors.

2) Dentin.

Even if dentin is one of the hardest tissue, it does not change its form through decalcifying process. For this reason, its sectioned specimens as well as its ground sections are utilized for the purpose of the investigation of dentin. The outer dentin is the mantle dentin (outside dentin), and inner dentin is peripulpal dentin (inside dentin). A tissue found between the peripulpal and mantle dentins is a layer of connective tissue fibers (MORGENSTERN 1909). The bottom of this layer connects with fibers seen in contact area, underlining bones and periodontal connective tissues. By this fibulous system teeth are tightly connected with sockets of the underlining bone (ISOKAWA and YOSHITANI).

In porgies, the dentin structures are similar to those seen in human dentin. That is, there are found numerous dentinal tubules. These tubules seen in dentin matrix radially run from the pulpal cavity to the dentino-enamel junction. Some of them go into the medium layer of enamel. Interglobular dentin and granular layer of TOMES have not been detected in the present investigation. OWEN’s contour lines, as ORBAN reported (1949, Fig. 82), are often detected. Each dentinal tubule contains TOMES’s
fiber as seen in the human, and it branches like a tree from main canalculus to peripheral dentin layer.

3) **Contact Area.**

The contact area is a disc-like connective tissue which occupies some space between the tooth and underlining bone. This area was named as a pedicle by YOSHITANI. YOSHITANI concluded, as a result of his study on the subject, that the contact area is a calcified tissue. In spite of the minute observation of ash-preparation made by the present authors, they could not obtain any finding as to evidence for calcification in this area. Consequently, teeth are easily pulled out of the underlining bone through boiling and putrefaction.

The tissue elements seen in contact area are large fibers which are all connected with underlining bone and peripheral connective tissue. Large fibers seen in contact area are collagenous fibers. These fibers run into two different directions. They are,

a) Longitudinal fibers connecting teeth with underlining bone.

b) Transverse fibers which radiate from the contact area and branch into peripheral connective tissues.

Some of these fiber bundles run up between two dentin layers, and reach the crown. The running directions of these fibers hint that the fibers have supporting function. By this supporting function, teeth are tightly connected with the surrounding soft and hard tissues.

4) **Pulp.**

The pulp is found in the center of dentin except for the pulp base occupied with the underlining bone, which enters into the peripheral connective tissue beyond the bone. The shape of pulp chamber roughly parallels to that of the tooth contour. The pulp is a loose connective tissue which consists of cells, fibers, and cementing substance. Most of fibers seen in the pulp are collagenous, and the cells are fibroblasts. Its histological structure changes with age. Namely, at the initial stage pulp is found to be very abundant in cells but fibers are scanty there. Later the pulp, however, becomes poor in cells and shows an increase in collagenous fibers.

In the outer layer of pulp adjacent to the dentin, highly differentiated connective tissue cells are found. These tissue cells are odontoblasts with oval and columnar nuclei. Dentin is formed by the activity of the odontoblasts. From each odontoblast a cytoplasmic process named as TOMES's fiber extends into a dentinal tubules.

On the other hand, the inner wall of the bone forms tooth base lined with a layer of columnar cells. It is considered that cells have nothing to do with the formation of dentin matrix, and they morphologically resemble osteoblasts.

**IV References**


ORBAN, B.: Oral histology and embryology. 1949, 2nd ed. Mosby Co., St. Louis