Quadrant II – Transcript and Related Materials

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Notes

INTRODUCTION TO VISCERAL ARCHES

1.Visceral arches are a part of visceral skeleton also called splanchnocranium. Those visceral arches which contribute to the formation of the skull constitute the splanchnocranium. Visceral arches are horse- shoe shaped and encircle the pharynx all around except dorsally. Visceral arches are pieces of cartilage or bone that support the pharyngeal region of vertebrates and also help to attach the jaws with the skull. In other words, it was originally the support of the gills but it forms the jaws and suspensorium in gnathostomes.

2.The Visceral skeleton is formed from the splanchnic mesoderm in the wall of the pharynx between gill clefts for their support. In addition, cells of the neural crest depart from the sides of the neural tube and move into the walls of the pharynx between successive pharyngeal slits to differentiate into the respective pharyngeal arches.

3. Typically, there are seven pairs of visceral arches in vertebrates which are modified in various groups depending upon the presence of gills and type of jaw suspension.

The first visceral arch is the mandibular arch, the largest and most anterior of the modified series of arches. The mandibular arch is composed of the palatoquadrate dorsally and Meckel's cartilage (mandibular cartilage) ventrally. The palatopterygoquadrate or palatoquadrate forms the upper jaw, while the Meckel's cartilage forms the lower jaw.

4.The second arch, the hyoid arch, follows the mandibular arch. This arch is made of five cartilages, a lower or ventral, median basihyal in the floor of the pharynx, paired hyomandibular cartilages dorsally and ceratohyals laterally.

5.The remaining arches (third to seventh) are branchial arches because they generally support gills in lower aquatic vertebrates. Typically, each branchial arch is made of nine pieces of cartilages, a lower median rod- like basibranchial, to which are attached on each side, a ventral hypobranchial, a lateral ceratobranchial and epibranchial and a dorsal pharyngobranchial cartilage.

6. Primitive splanchnocranium

A varying number of branchial arches, often designated with Roman numerals, follow the hyoid arch.

Vertebrate Series – much variation in the visceral skeleton

7.Agnathans – CYCLOSTOMES (the only living agnathans) possess a splanchnocranium in which the usual cartilages are not identifiable and there is no resemblance with the typical pattern. In PETROMYZON, the whole pharyngeal skeleton fuses to form a branchial basket to support gills. The branchial basket is composed of nine irregularly curved vertical bars of cartilage on each side. The second lies immediately in front of the first gill cleft and the remaining seven just behind the seven gill clefts. The posterior part of the branchial basket is extended to form a cuplike pericardial cartilage to accommodate the heart. The whole branchial basket lies external to the gill pouches and branchial arteries, not like typical visceral arches, in the walls of the pharynx. The buccal funnel is supported by a ring like annular cartilage. An elongated lingual cartilage supports the tongue.

8.FISHES

Elasmobranchs: They contain full set of visceral arches and the arrangement is close to basic pattern as they have 5 pairs of functional gills and skeleton is all cartilaginous.

In Sharks, eg: *Scoliodon laticaudus and Squalus acanthias*, commonly called dog fish, the visceral skeleton consists of seven U- shaped, segmented visceral arches which lie in the sides and floor of the pharynx. All seven pairs conform to a basic pattern but the mandibular and hyoid cartilages are modified for feeding.

9.The first or mandibular arch, unlike the others is a complete ring, it forms the teeth bearing upper and lower jaws. The upper jaw or palatoquadrate (pterygoquadrate) has two cartilages joined in front. Near its anterior end it has an orbital process from which ligaments arise to join the cranium. The lower jaw has two Meckel's cartilages united anteriorly. At its posterior end, each Meckel's cartilage has an articular surface for a movable joint with the upper jaw. In the angles of the jaws of elasmobranchs are two or four labial cartilages, their origin may have been from a pre mandibular arch or from the mandibular arch, they reinforce the walls of the mouth cavity.

10.The second visceral arch or the hyoid arch is made of five cartilages, a lower median basihyal in the floor of the pharynx, paired hyomandibular cartilages dorsally and ceratohyals laterally. The ceratohyals bear a demibranch and articulate with the basihyal cartilage. Each hyomandibular is connected at its upper end to an articular facet in the cranium and at its lower end with the palatoquadrate and Meckel's cartilages. The jaws are not directly joined to the cranium but are only suspended by the hyomandibular. This suspensorium is Hyostylic and is found in most elasmobranchs. The remaining hyoid arch supports a gill.

The remaining five visceral arches are essentially alike and all but the last pair support gills, hence these are also referred to as branchial arches.

11.Typically, each branchial each branchial arch is made of nine pieces of cartilages, a lower median rod- like basibranchial, to which are attached on each side, a ventral hypobranchial, a lateral ceratobranchial and epibranchial and a dorsal pharyngobranchial cartilage. The ceratobranchials and epibranchials bear slender cartilaginous unbranched gill- rays which support the gills.

12. In Scoliodon, some of these cartilages are lost or fused with others. All five basibranchials are fused to form a single cartilage. The hypobranchials are small in the first branchial arch and absent in the fifth. All five ceratobranchials are present, fifth one being very large. The first four epibranchials are present but the fifth one is lost. There are four pharyngobranchials, those of the fourth and fifth branchial arches having fused into a single piece.

13. FISHES

The visceral skeleton of bony fishes resembles that of sharks except that bone is added.

The mandibular arch forms the two jaws. The upper jaw has three cartilage bones, they are palatine, metapterygoid and quadrate and two dermal bones, ectopterygoid and entopterygoid. Anteriorly are two premaxilla bones meeting each other, behind is a thick curved maxilla on each side. Both are dermal bones and, in most fishes, they bear teeth. The upper jaw is connected to the cranium partly by palatine articulating with the olfactory region and partly by a suspensorium formed by hyomandibular and a small symplectic, the hyomandibular articulates with auditory capsule and symplectic fits into quadrate (hyostylic). The hyomandibular and symplectic are the upper part of the hyoid arch.

The lower jaw has posteriorly to form an articular bone which articulates with a condyle in the quadrate. The Meckel's cartilage is encased by a large anterior dentary and a small posterior surangular, both are dermal bones. In some fishes, a segment of Meckel's cartilage at the chin is replaced by a mentomeckelian bone.

14.The hyoid arch besides hyomandibular and symplectic, has on each side, three bones, an epihyal above, then ceratohyal and a lower hypohyal, these bones are joined below to a basihyal which supports the tongue.

15.There are five branchial arches which become smaller posteriorly, on each side they have a pharyngobranchial, epibranchial, ceratobranchial and hypobranchial. The last branchial arch shows sign of degeneration as the number of gills is reduced to 4 pairs. The two hypobranchials are joined below to a median basibranchial. All basibranchials and the basihyal are joined together to form a median ventral bar in the floor of the pharynx.