Vertebrate Skull

Splanchnocranium and Origin of Mammalian Middle Ear Bones

BIO308/508 Comparative Anatomy
Splanchnocranium

Generalized branchial arch and derivatives

A. Basic Pattern
- Pharyngobranchial
- Epibranchial
- Ceratobranchial
- Hypobranchial
- Basibranchial

B. Hyoid Cartilages
- Hyomandibula
- Ceratohyal
- Basihyal

C. Mandibular Cartilages
- Meckel's Cartilage
- Adductor mandibulae process
- Orbital process
- Palatoquadrate cartilage
- Label cartilage
- Meckel's cartilage
- Gill raker
- Pharyngobranchials
- Epibranchial
- Ceratobranchial
- Ceratohyal
- Basihyal
### Basic Components of Vertebrate Skull

<table>
<thead>
<tr>
<th>Replacement Bones and/or Cartilages</th>
<th>Dermatocranium</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Region</strong></td>
<td><strong>Components</strong></td>
</tr>
<tr>
<td>Occipital</td>
<td>Basioccipital</td>
</tr>
<tr>
<td></td>
<td>Exoccipital</td>
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<tr>
<td></td>
<td>Supraoccipital</td>
</tr>
<tr>
<td>Otic</td>
<td>Prootic</td>
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<tr>
<td></td>
<td>Opisthotic</td>
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<td></td>
<td>Epiotic</td>
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<tr>
<td>Sphenoid</td>
<td>Basisphenoid</td>
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<td>Sphenethmoid</td>
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<td>Pleurophenoid</td>
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<td>Orbitosphenoid</td>
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<tr>
<td>Ethmoid</td>
<td>Turbinals (mammals)</td>
</tr>
<tr>
<td>Visceral arch I (mandibular arch)</td>
<td>Upper Jaw</td>
</tr>
<tr>
<td></td>
<td>Quadrate and epitypertygoid (ossifications of palatoquadrate cartilage)</td>
</tr>
<tr>
<td>Lower Jaw</td>
<td>Articular (ossification of Meckel's cartilage)</td>
</tr>
<tr>
<td>Visceral arch II (hyoid arch)</td>
<td>Branchials</td>
</tr>
<tr>
<td>Visceral arches III–VII (branchial arches)</td>
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</tr>
</tbody>
</table>
Evolution of Jaw Suspension

**Euautostyly** - Primitive Gnathostomes (e.g., placoderms & acanthodians)

- Hyomandibula
- Pharyngobranchial
- Epibranchial
- Ceratobranchial
- Hypobranchial
- 1st Branchial Arch

**Amphistyly** - Early Sharks and Some Living Sharks, Sarcopterygian Fish

- Hyomandibula

**Hyostyly** - Most Living Sharks and Most Living Bony Fish

- Hyomandibula
Evolution of Jaw Suspension

Metaostyly - Non-Mammalian Tetrapods (i.e., Amphibians, Modern Reptiles and Birds)

Cranioostyly - Mammals
Evolution of Mammalian Middle Ear Bones
Evolution of Mammalian Middle Ear Bones

Comparison of middle ear bones in an adult and young opossum with the therapsid *Thrinaxodon*.
Classic Hypothesis

Basal Synapsid: *Dimetrodon*

- Elongate neural spines (no lateral tubercles)
- Caniniform tooth
- Reflected lamina of angular
Classic Hypothesis

Figure 2. Paleontological evidence for mammalian middle ear evolution. (A) Diagrams of lateral views of jaw skeletal elements showing modifications leading to the mammalian condition (after Allin, 75). The geological record and occurrence of each animal are indicated on the left. For clarity of comparison, no teeth are shown. Note that a set of postdentaly elements (articulär, surangular, and angular) and the upper jaw elements (quadrate and quadraatojugal), indicated by gray, became separated from the dentary and reduced in size during the transition from pelycosaurs to mammals. The sequence of changes in the fossil record does not represent a true ancestor–descendent relationship, but only structural grades. (B) Changes in jaw articulation during mammalian evolution. In a pelycosaur, Dimetrodon (top), the quadrate and articular formed a functional jaw joint (black arrow). In an "advanced" cynodont, Diarthrognathus (middle), an additional jaw joint was observed between the squamosal and dentary (white arrow). In an extant marsupial, Didelphis (bottom), the functional jaw joint has been taken over only by the squamosal and dentary. Takecki and Kuratani (2010)
Transition Between Jaw Joints

*Trinaxodon*

Skull in dorsal, lateral, and palatal views. Adapted from Carroll (1988)

Jenkins (1971)
Transition Between Jaw Joints