
WELCOME

THE INSECT HEAD

Presented by:
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BAM-14-28

- The insect head is a hard, highly sclerotized compact capsule bearing a group of feeding appendages around the mouth, sensory organs and internally a major centre of neuroendocrine coordination.

Head Segmentation

- According to phylogenetic considerations, the insect head is in fact a product of evolution and can be termed as Syncephalon.
- It consists of two parts.

  An anterior procephalon and

  a posterior gnathocephalon.

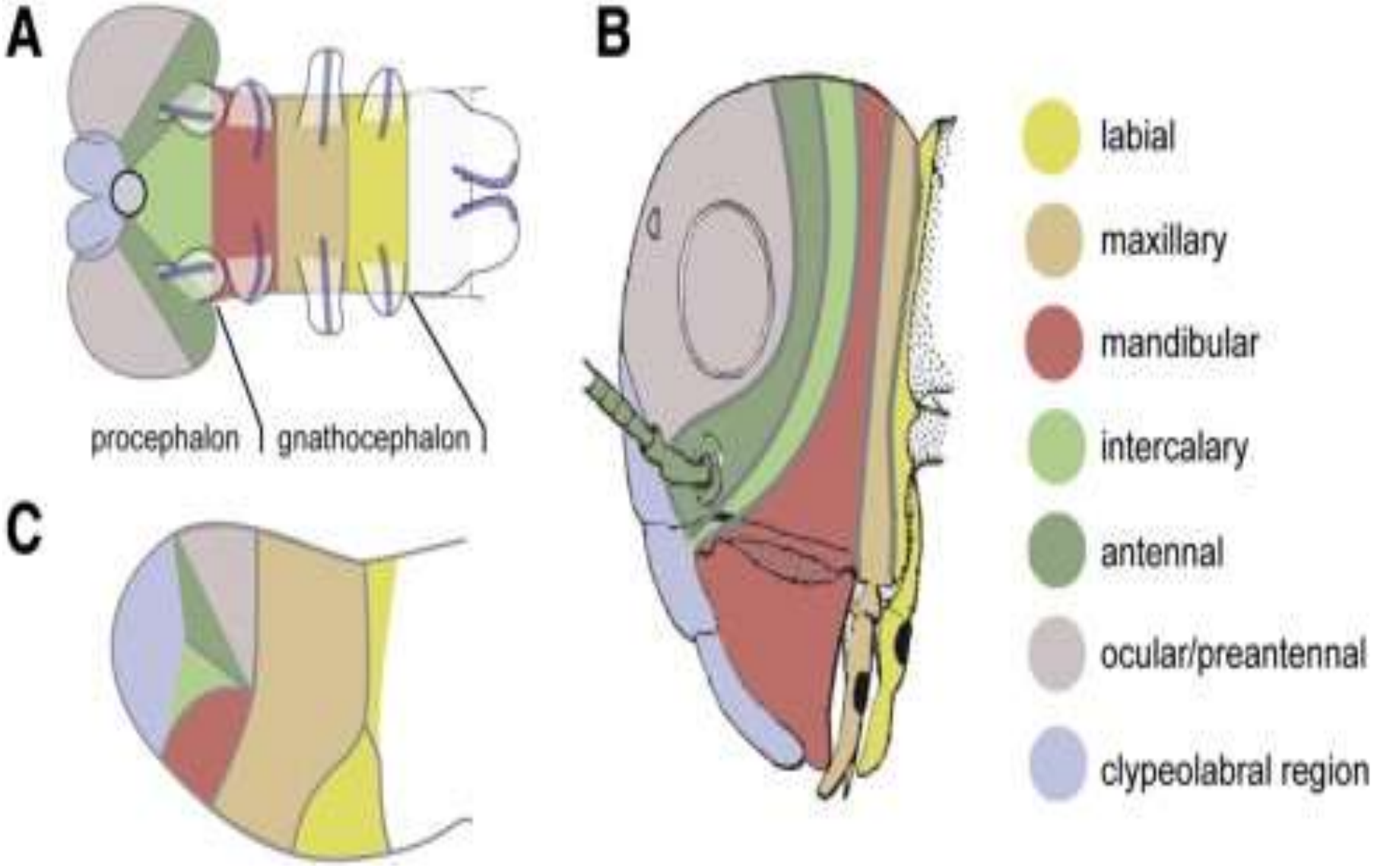
PROCEPHALON

- The procephalon represents preoral region of the head and bears two paired structures, the eyes and antennae.
- The procephalon is thought to be derived from the ancestral head, the archencephalon or blastocephalon, after an incorporation of at least one posterior trunk segment of the ancestor.
- The brain is considered as a fused ganglion of the procephalon.

GNATHOCEPHALON

- The gnathocephalon represents postoral region of the head.
- It bears three paired structures;

  the mandible, first maxillae and second maxillae or labium. It is mostly developed in order to equip the head with feeding appendages.

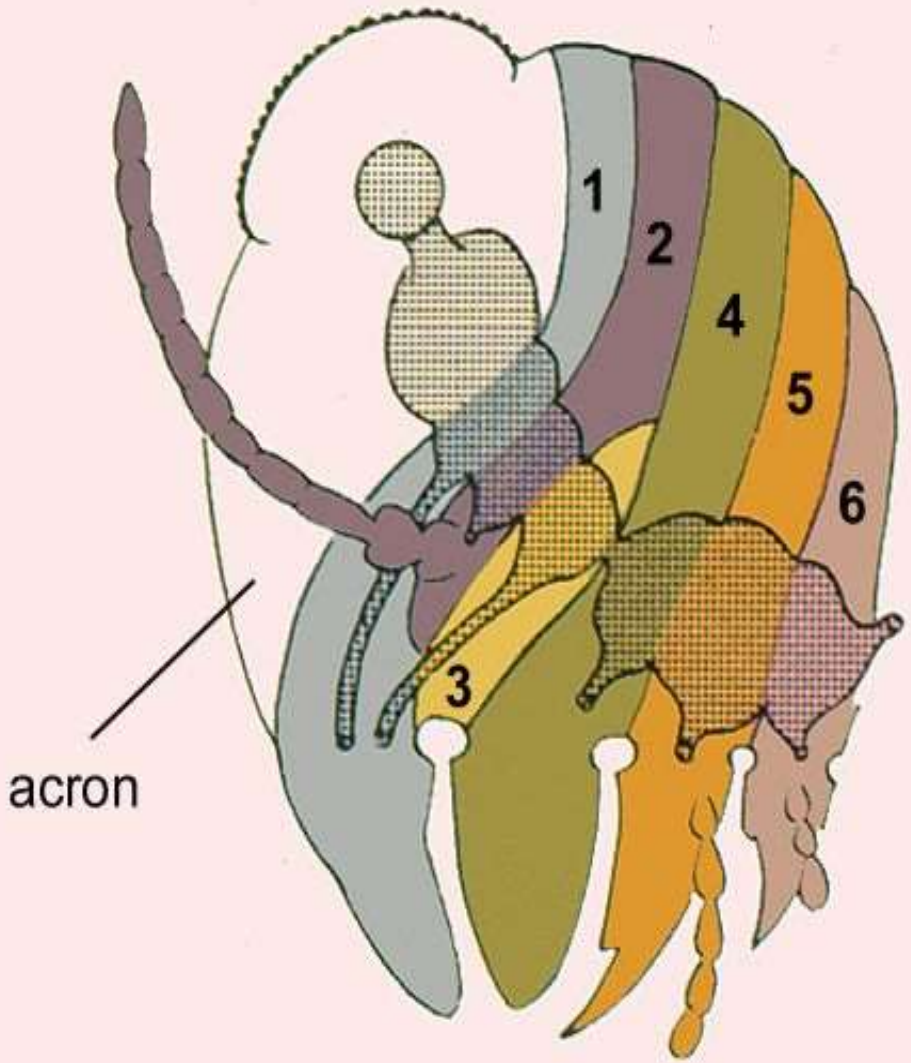

A
procephalon
gnathocephalon
B
C
labial
maxillary
mandibular
intercalary
antennal
ocular/preantennal
clypeolabral region

- Embryological and morphological studies suggest that the gnathocephalon is composed of three segments, viz., the mandibular, maxillary and labial segments.
- In an adult insect, these segments are evident from their paired appendages.
- The suboesophageal ganglion is undoubtedly, a composite ganglion of the gnathocephalon.

- Based on the embryological studies, the segments of insect head are six such as:

1. Pre antennal segment
2. Antennal segment
3. Intercalary segment
4. Mandibular segment
5. Maxillary segment
6. Labial segment

INSECT HEAD SEGMENTATION



HEAD OF INSECT

Acron + 6 segments

1 - labral
2 - antennal
3 - intercalary
4 - mandibular
5 - maxillary
6 - labial

- **1.Preantennary segment**:

  It is recognized by its neuromere that forms procerebrum of the brain and embryonic appendages.

- **2.Antennary segment**:

  It is indicated by its neuromere that forms deuterocerebrum of the brain and its appendages are antennae.

- **3. Intercalary segment:**

  Intercalary segment is with feeding appendages which are homologous with antennae of crustacean and its neuromere, tritocerebrum. Traces of this segment are found in most embryos.

- **4.Mandibular segment:**

  It is indicated by its neuromere, the mandibular ganglion and its appendages the first maxillae.

- **5.Maxillary segment:**

  It is recognized by its neuromere, the maxillary ganglion and its appendages the first maxillae.

- **6.Labial segment:**

  Labial segment in with its appendages the labium and neuromere, labial ganglion.

  The neuromeres of the last three segments fuse during development to form the sub-oesophagial ganglion.

HEAD SKELETON

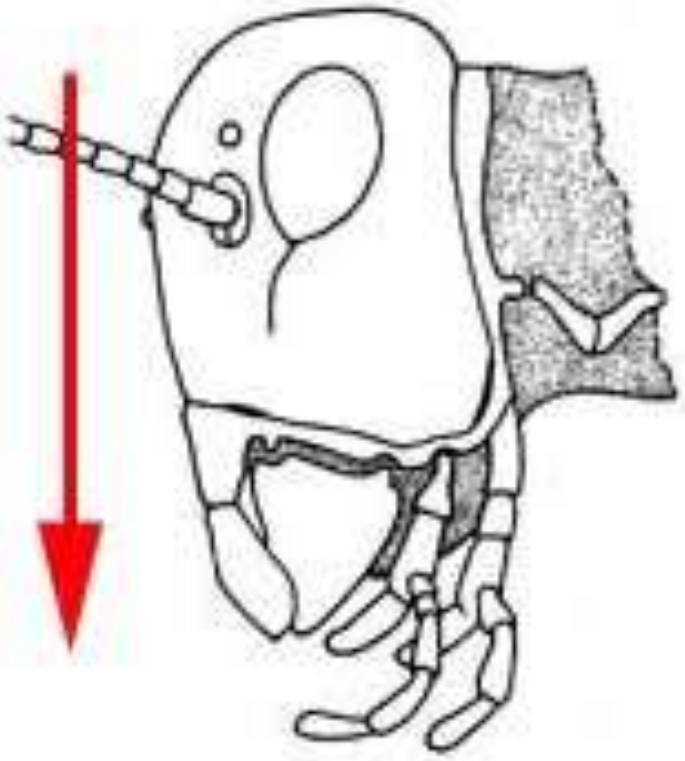
- The head of the insect loses its primary segmentation during the post-embryonic development.
- Due to enormous sclerotization, the head becomes a hard skeletal capsule.
- It bears externally a set of sensory and gnathal appendages.
- The sense organs include a pair of antennae, a pair of compound eyes and two or three ocelli.
- The gnathal appendages comprise a pair of mandibles, a pair of maxillae and a labium.

- The gnathal appendages constitute collectively along the labrum and hypopharynx, a well elaborated feeding apparatus.

- The position of mouth parts in relation to the body axis differs in different group of insects. The mouth parts may project downward, forward or backward and the head, accordingly, is designated as the following types.

Hypognathous head:

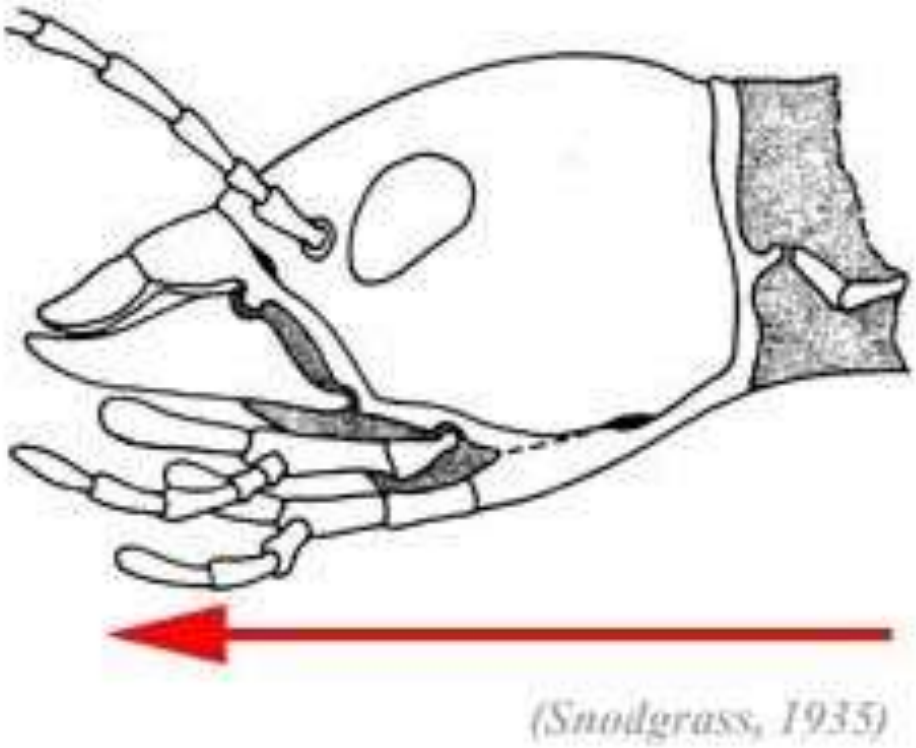
- The long axis of the head is vertical and mouthparts are ventral i.e., pointing downwards (primitive type). The occipital foramen lies in or near transverse plane. Ex: Grasshoppers, cockroach.



(Snodgrass, 1935)

Prognathous head:

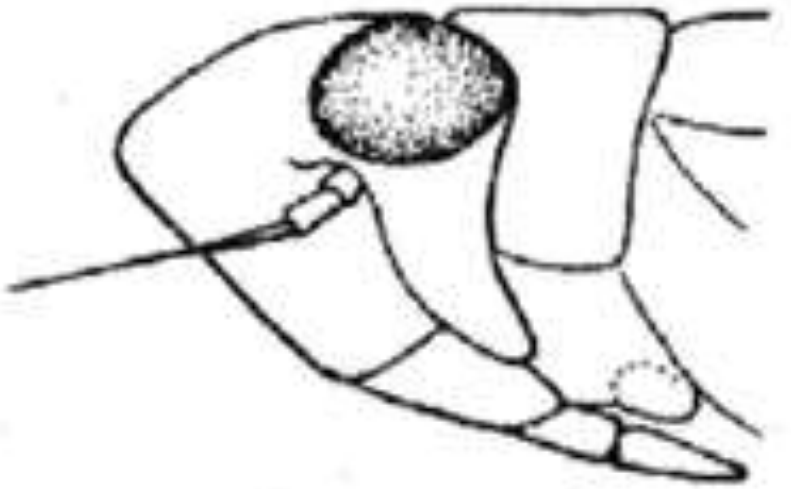
- The long axis of the head is horizontal, mouthparts are anterior in position occipital foramen is slightly inclined. Ex: Soldiers of termites and larvae of endopterygota



(Snodgrass, 1935)

Opisthognathous head:

- Occurs in Homoptera and Hemiptera where the head is deflexed backwards so that mouthparts / proboscis slopes backwards between the front legs.

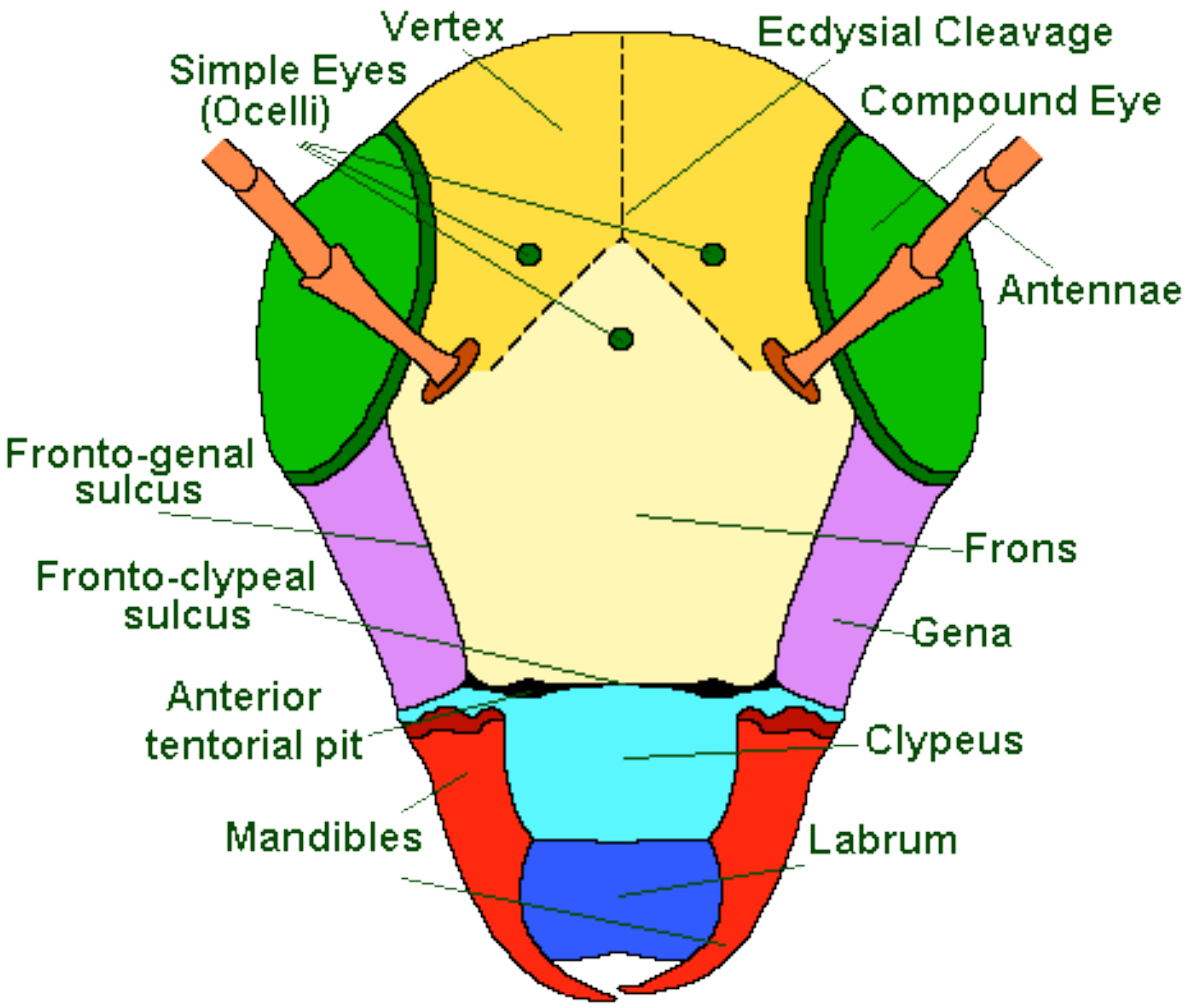


opisthognathous

HEAD SUTURES

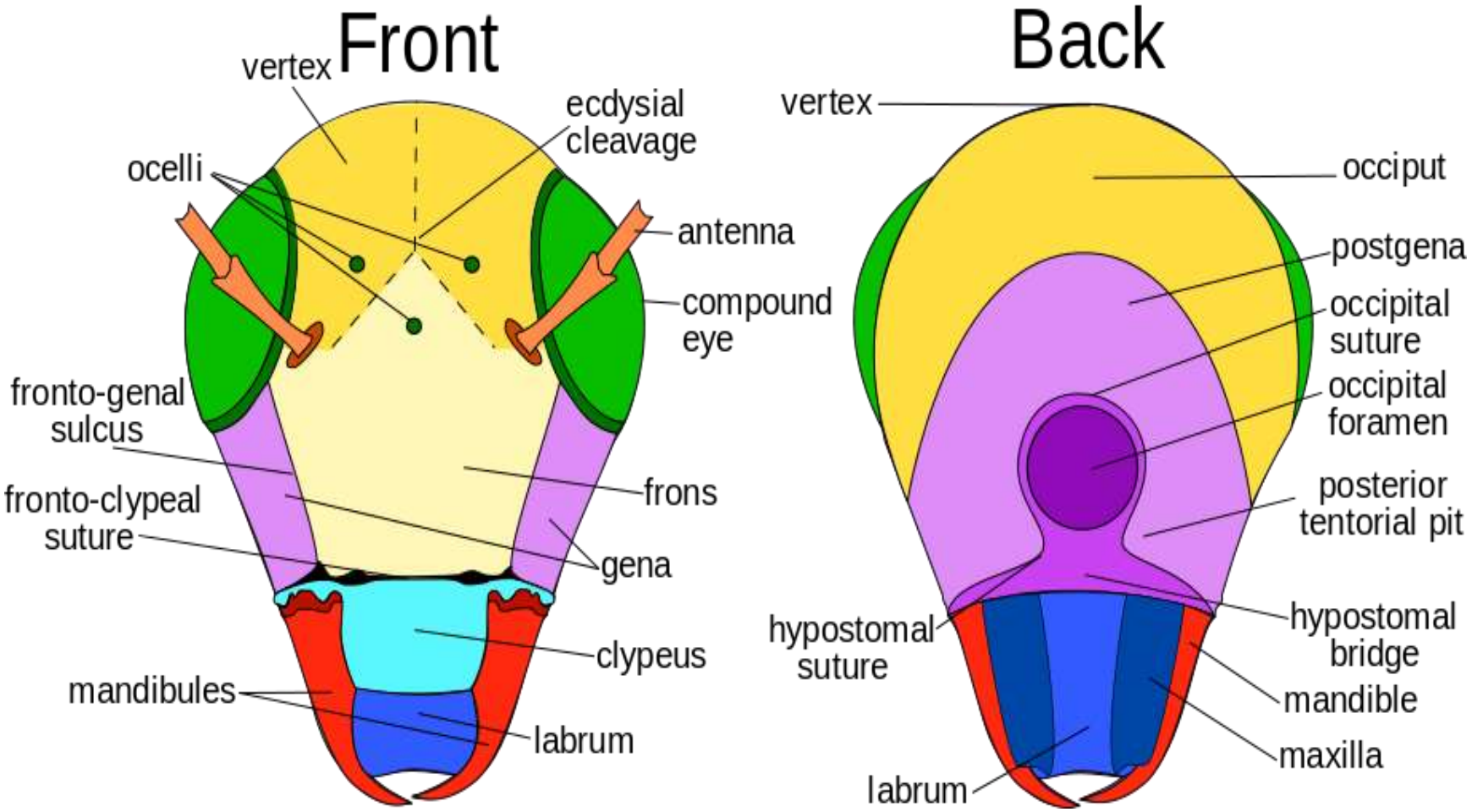
- The head capsule of the matured insects is differentiated into several regions by the sutures.
- The sutures are nothing but the secondarily developed fine groves.
- They are inflections or merely external impressions of the internal stiff cuticular ridges which provide mechanical support to the cranial wall.
- These sutures are the product of sclerotization and except the post-occipital suture, others have no metameric segmentation.

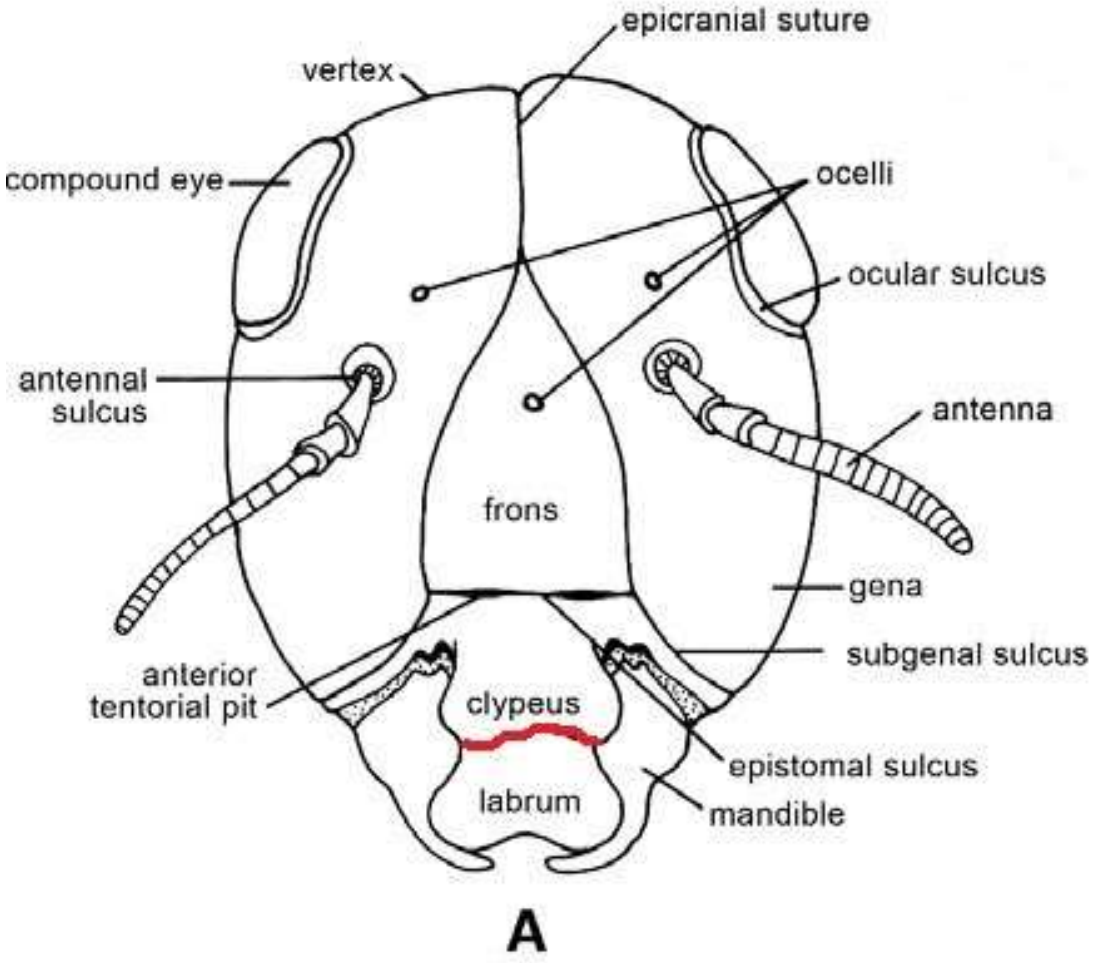
The Insect Head (Frontal)



The Clypeo-labral suture:

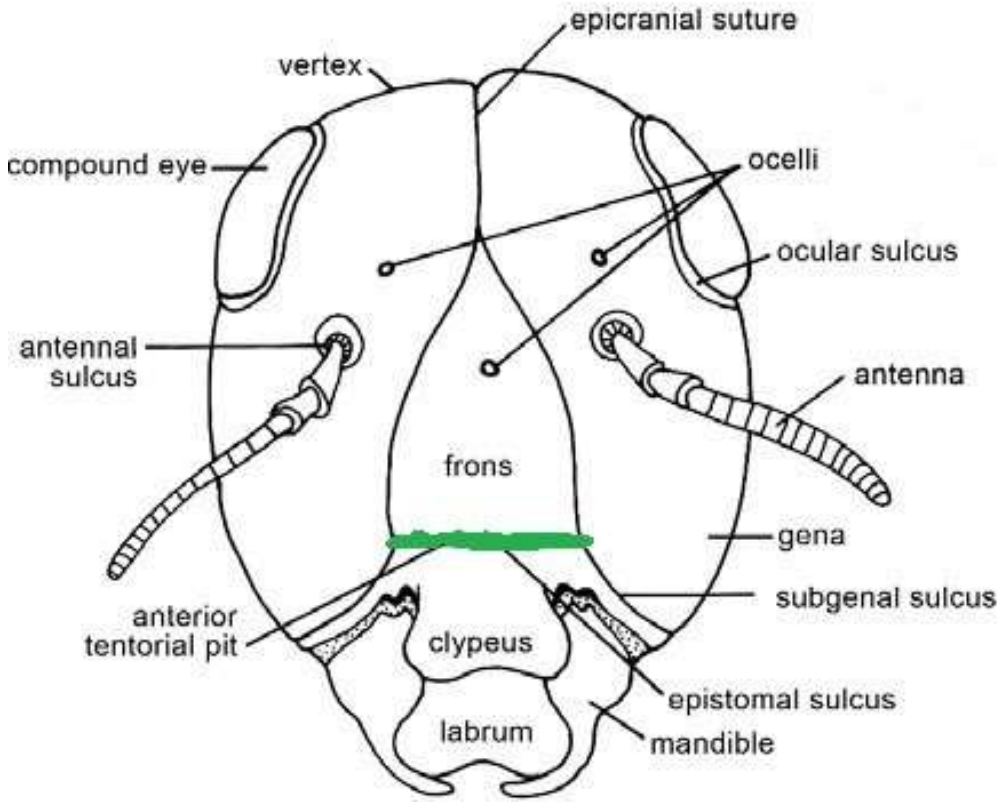
- This suture represents the lower margin of the clypeus.
- The labrum hanging down from the suture.
- It bears a prominent ridge internally.
- The ridge possesses an apodeme at the centre. The apodeme provides an insertion to the anterior retractor muscles of the labrum.


Front
vertex
ecdysial cleavage
ocelli
antenna
compound eye
fronto-genal sulcus
frons
fronto-clypeal suture
gena
clypeus
mandibules
labrum
Back
vertex
occiput
postgena
occipital suture
occipital foramen
posterior tentorial pit
hypostomal suture
hypostomal bridge
mandible
maxilla
labrum


epicranial suture
vertex
compound eye
ocelli
ocular sulcus
antennal sulcus
antenna
frons
gena
subgenal sulcus
anterior tentorial pit
clypeus
epistomal sulcus
labrum
mandible
A

The Clypeo-frontal or Epistomal suture:

- It occurs between the clypeus and the frons.
- It bears laterally the anterior tentorial pits.
- It internally bears a strong inflection.
- Those inflection strengthens the lower part of the head against the stretching of the mandibles.

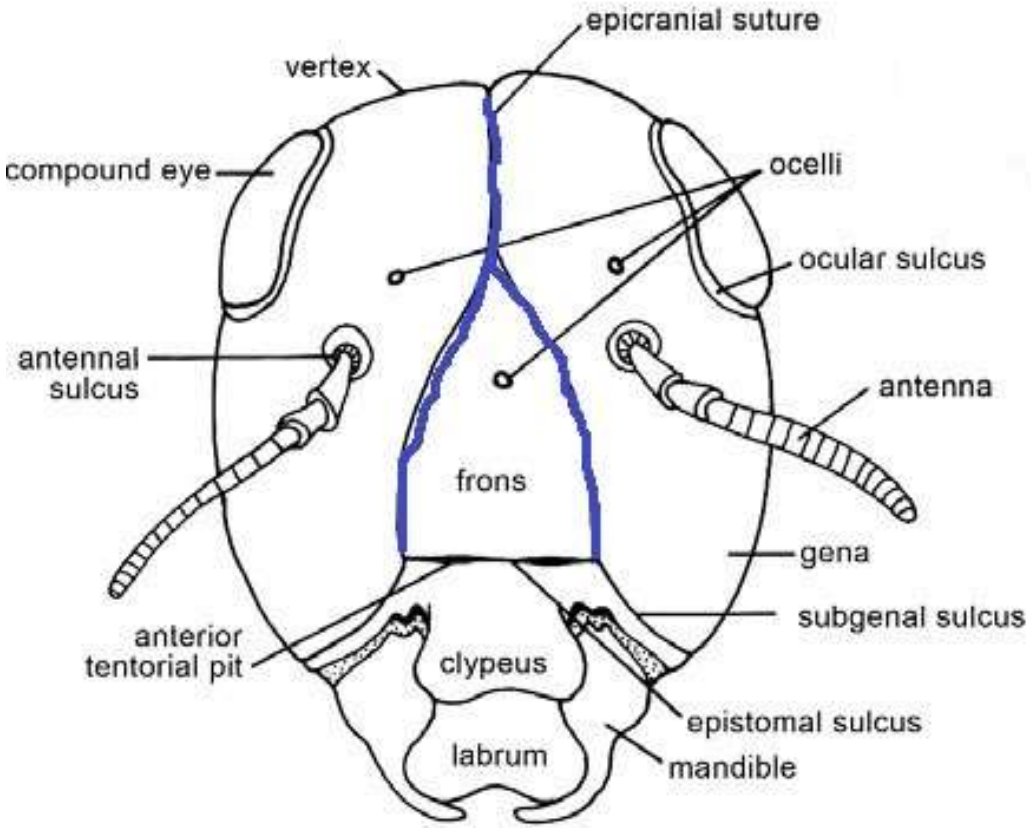

epicranial suture
vertex
compound eye
ocelli
ocular sulcus
antennal sulcus
antenna
frons
gena
subgenal sulcus
anterior tentorial pit
clypeus
epistomal sulcus
labrum
mandible

A

The Epircanial suture:

- It is a composite suture.
- It appears in the form of an inverted-Y above the facial region in most of the insects.
- The stem is known as the coronal and lateral arms, the frontal sutures.
- The epicranial suture is partially or even completely reduced in some insects.

- It is totally lacking from the head of apterygotes.
- Snodgrass (1935) and Du porte (1957) stated that the epicranial suture represents merely the line of weakness and can be said in true sense as the ecdysial suture.
- It does not bear the skeletal ridge on the inner surface and therefore does not provide either a site for muscle attachment or mechanical support to the head capsule


epicranial suture
vertex
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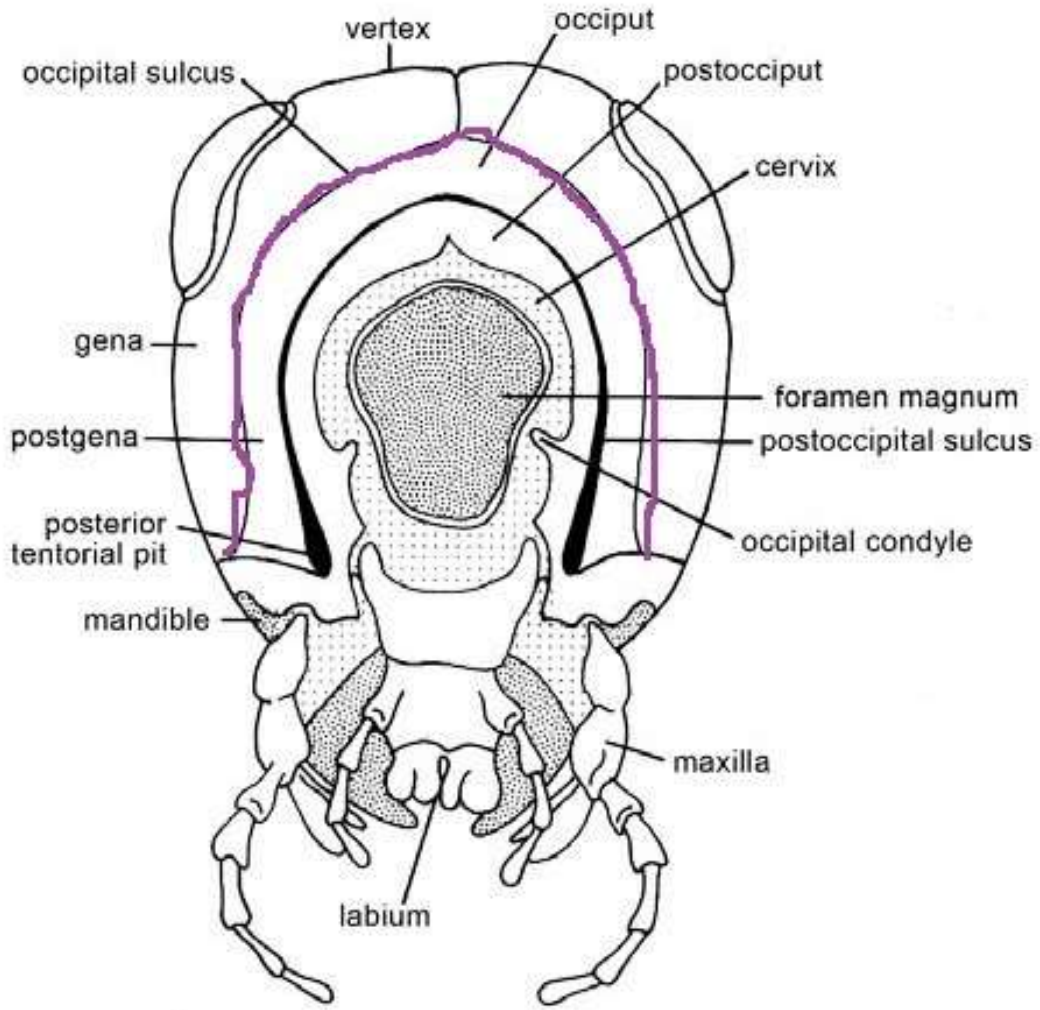
ocular sulcus
antennal sulcus
antenna
frons
gena
subgenal sulcus
anterior tentorial pit
clypeus
epistomal sulcus
labrum
mandible

A

The Occipetal suture:

- It is horse-shoe or U-shaped suture, and well evident on the posterior part of the head of the orthopteroid insects.
- It starts from posterior articulations of the mandibles of either side.
- Both the arms after running a long distance and join one another above the occipital foramen.

- It seperates the genal area from the post-genal area of the lateral region of the head.
- It also differentiates the vertex from the occiput in posterior region of the head.
- It forms an internal ridge strengthening the posterior epicranial wall.

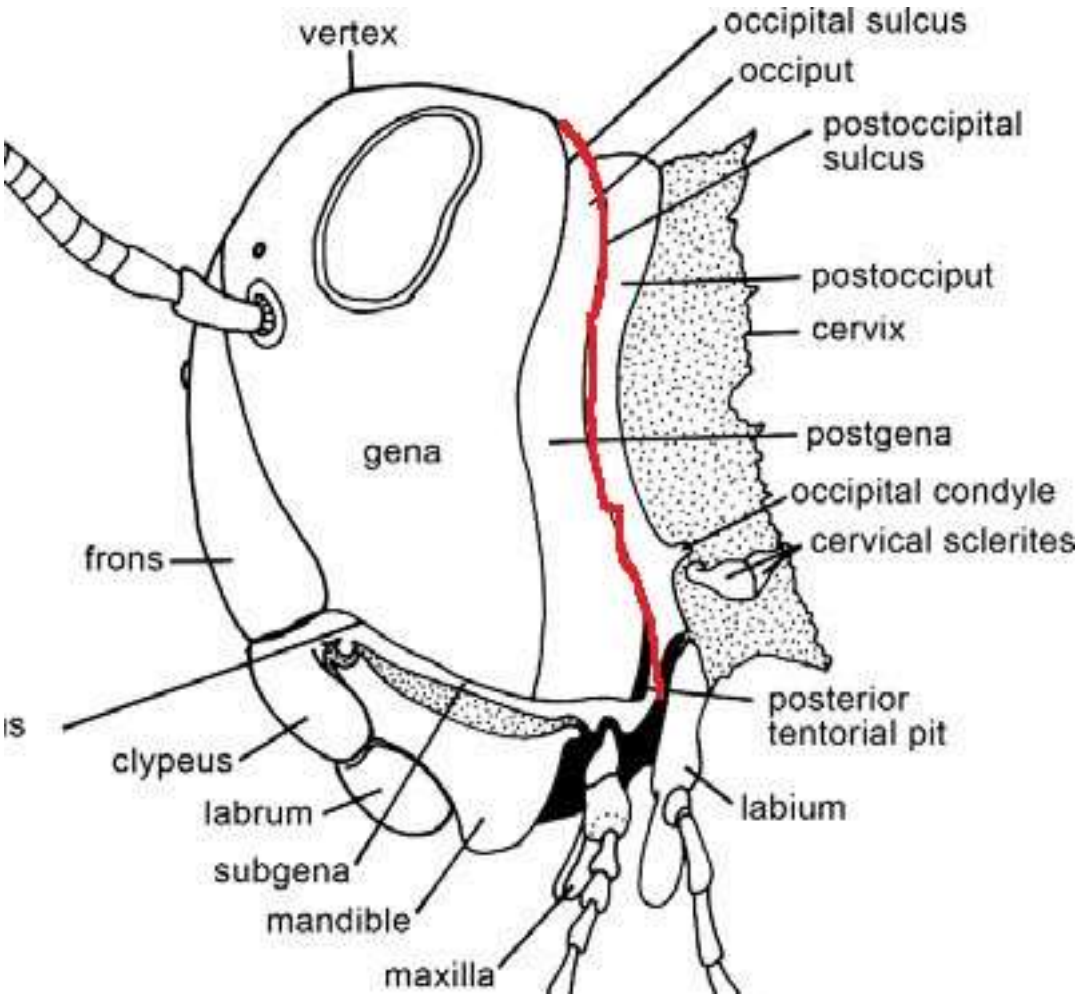

vertex
occiput
occipital sulcus
postocciput
cervix
gena
foramen magnum
postgena
postoccipital sulcus
posterior
tentorial pit
occipital condyle
mandible
maxilla
labium

C

The post-occiput suture:

- It embraces the occipital foramen magnum from the dorsal and lateral sides.
- Each end of the suture merges in the hypostomal suture in ventral region.
- This site is well defined due to the presence of the posterior tentorial pits.
- It possesses internally a strong epidermal ridge, the post-occipetal ridge.

- It provides a site for the attachment of prothoracic muscles which move a pair of ventro-lateral condyles. The neck membrane is firmly attached to this ridge.
- The condyles articulate with the neck sclerites.
- It is the only suture having the metameric significance. It alone marks the fusion of the maxillary and labial segments of the head.


vertex
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postocciput
cervix
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cervical sclerites
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clypeus
labrum
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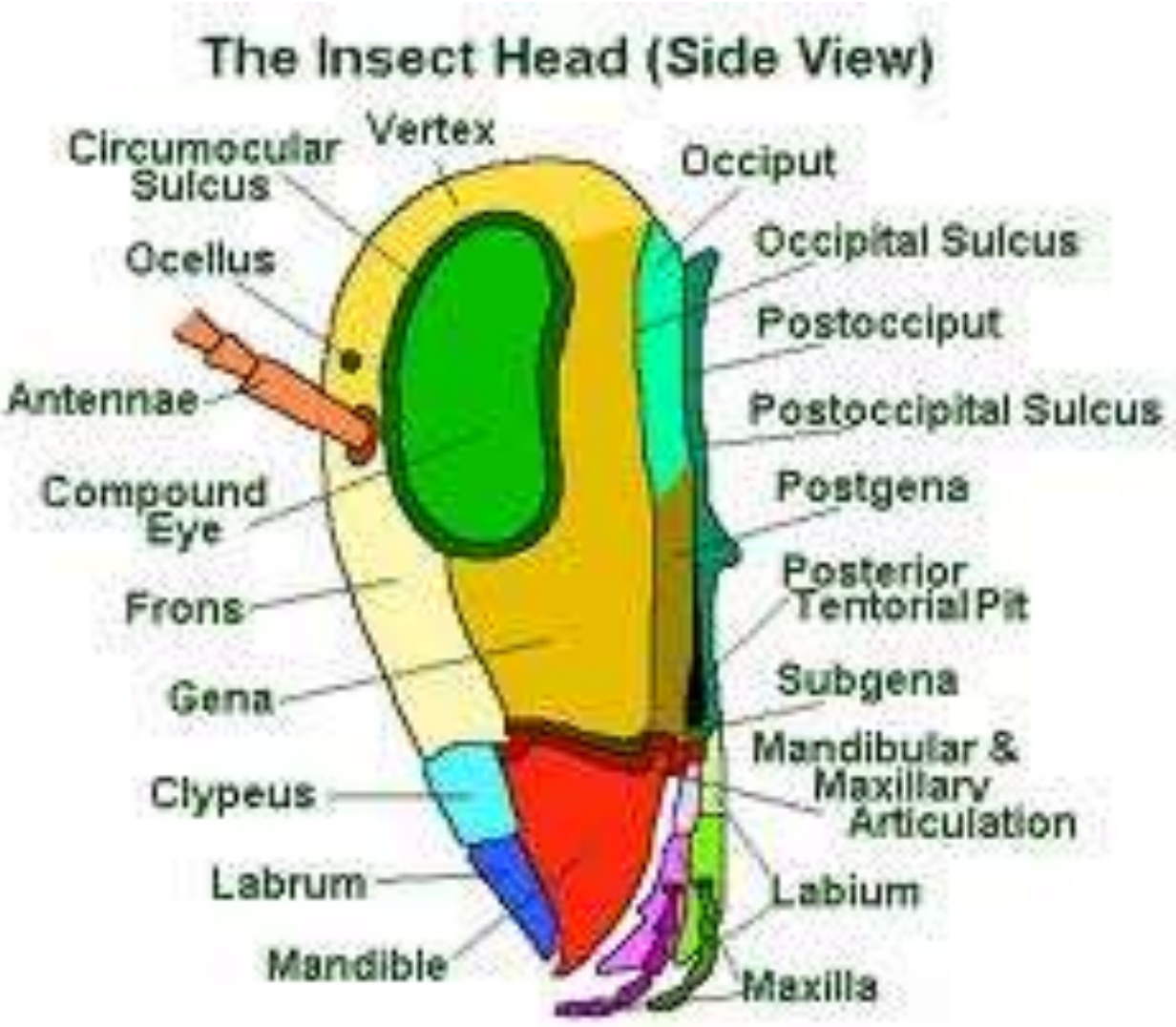
subgena
mandible
maxilla

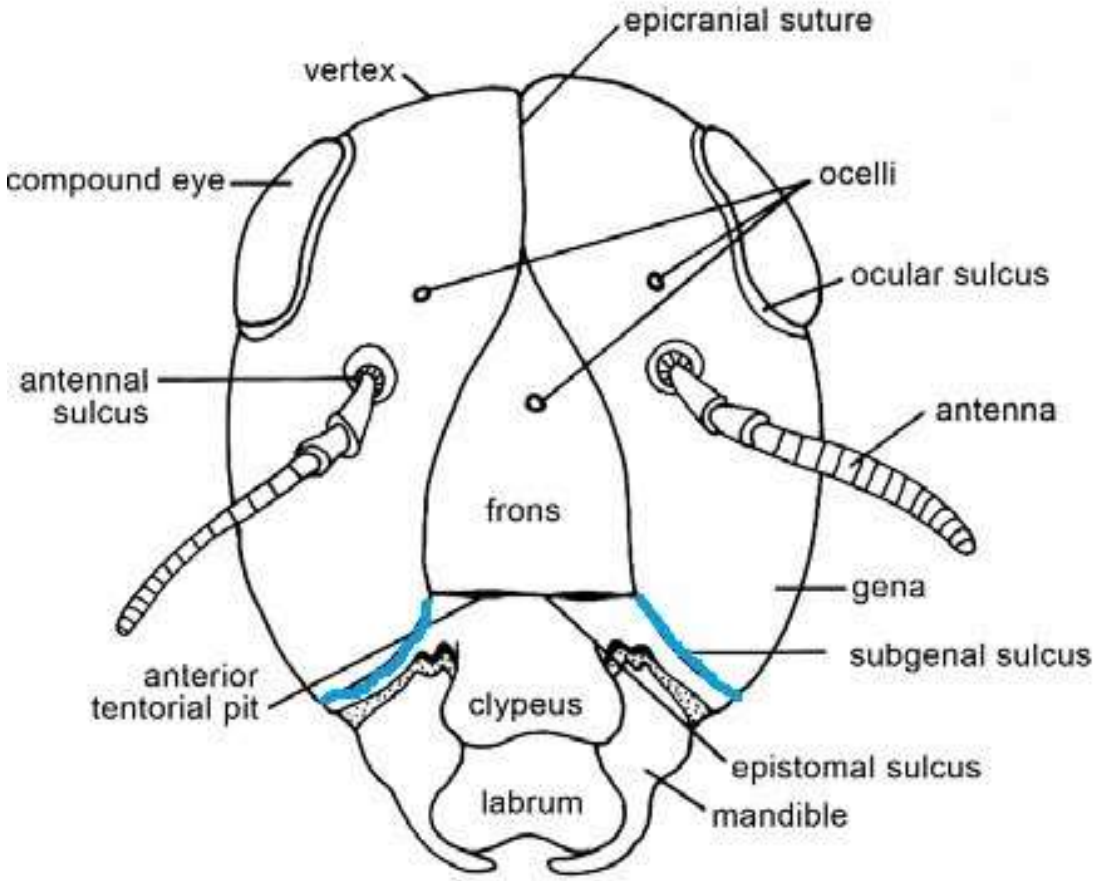

The Insect Head (Side View)
Vertex
Circumocular Sulcus
Occiput
Ocellus
Occipital Sulcus
Postocciput
Antennae
Postoccipital Sulcus
Compound Eye
Postgena
Posterior Tentorial Pit
Frons
Subgena
Gena
Mandibular & Maxillary Articulation
Clypeus
Labrum
Labium
Mandible
Maxilla

The Frontogenal or subocular suture:

- It develops on each lateral region of the head. It starts from the junction of the clypeofrontal and the subgenal sutures.
- It terminates in the close vicinity of the lower margin of each compound eye.
- It is virtually well evident in the orthopteroid insects.

The Subgenal Suture:

- These sutures occur on the lateral sides of the head.
- Each suture joins the posterior tentorial pit with the anterior tentorial pit of the same side.
- Each suture is divisible into two parts.
- One part of the subgenal suture is called the hypostomal suture.
- The hypostomal suture runs from the posterior tentorial pit up to the posterior articulation of the mandible.


epicranial suture
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subgenal sulcus
anterior tentorial pit
clypeus
epistomal sulcus
labrum
mandible

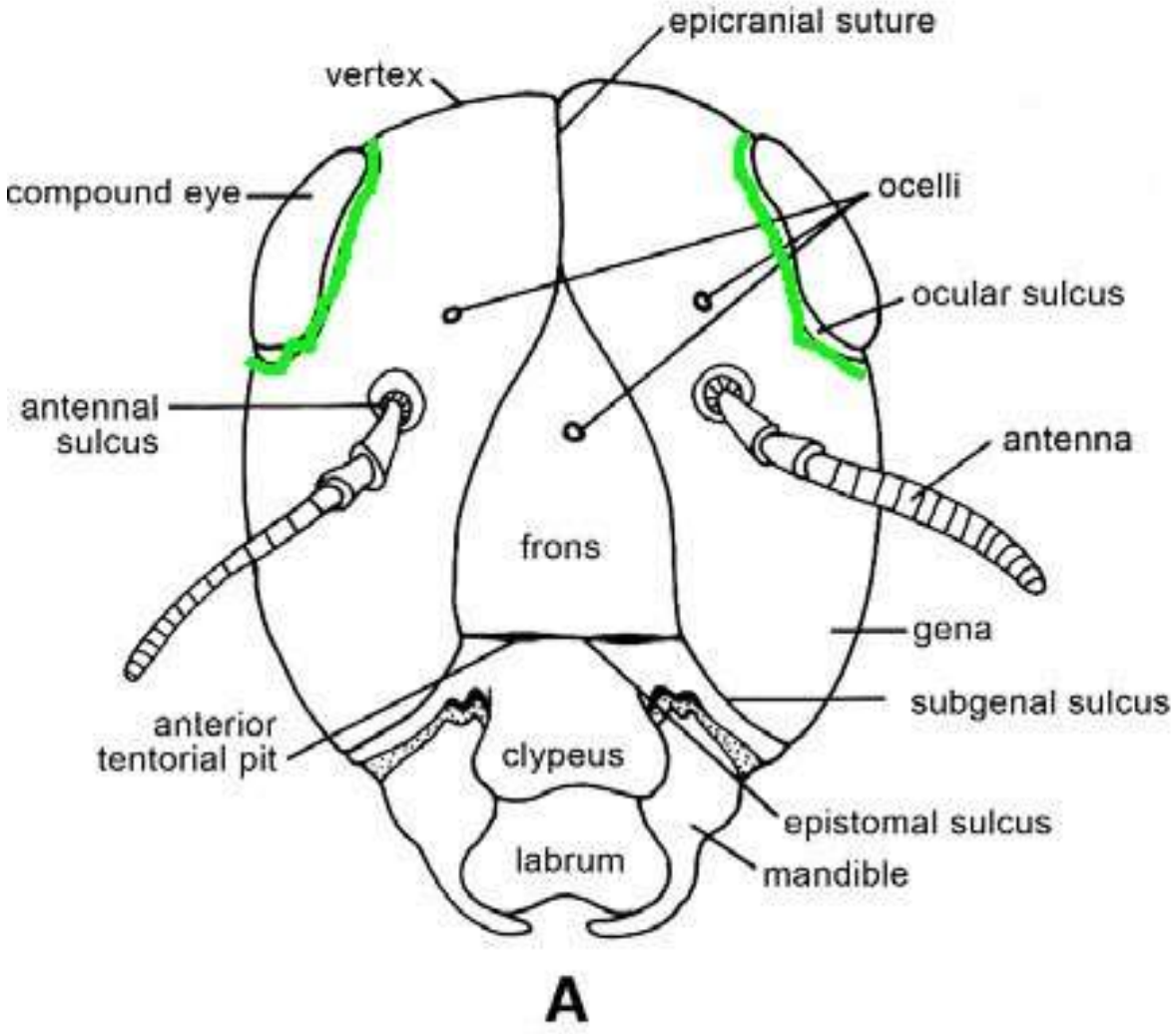
A

- The other part of the subgenal sututre is called the pleurostomal suture.
- The pleurostomal suture arches over the mandible and finally joins with the fronto-clypeal and the fronto-genal sutures just above the anterior articulation of the mandibles.
- Internally, the subgenal sutures form the submarginal, subgenal ridges.
- Each ridge extends from the posterior tentorial pit to point just above the anterior articulation of the mandible.

The subgenal sutures strengthen the cranial wall along the lines of attachment of the gnathal appendages

The Ocular suture:

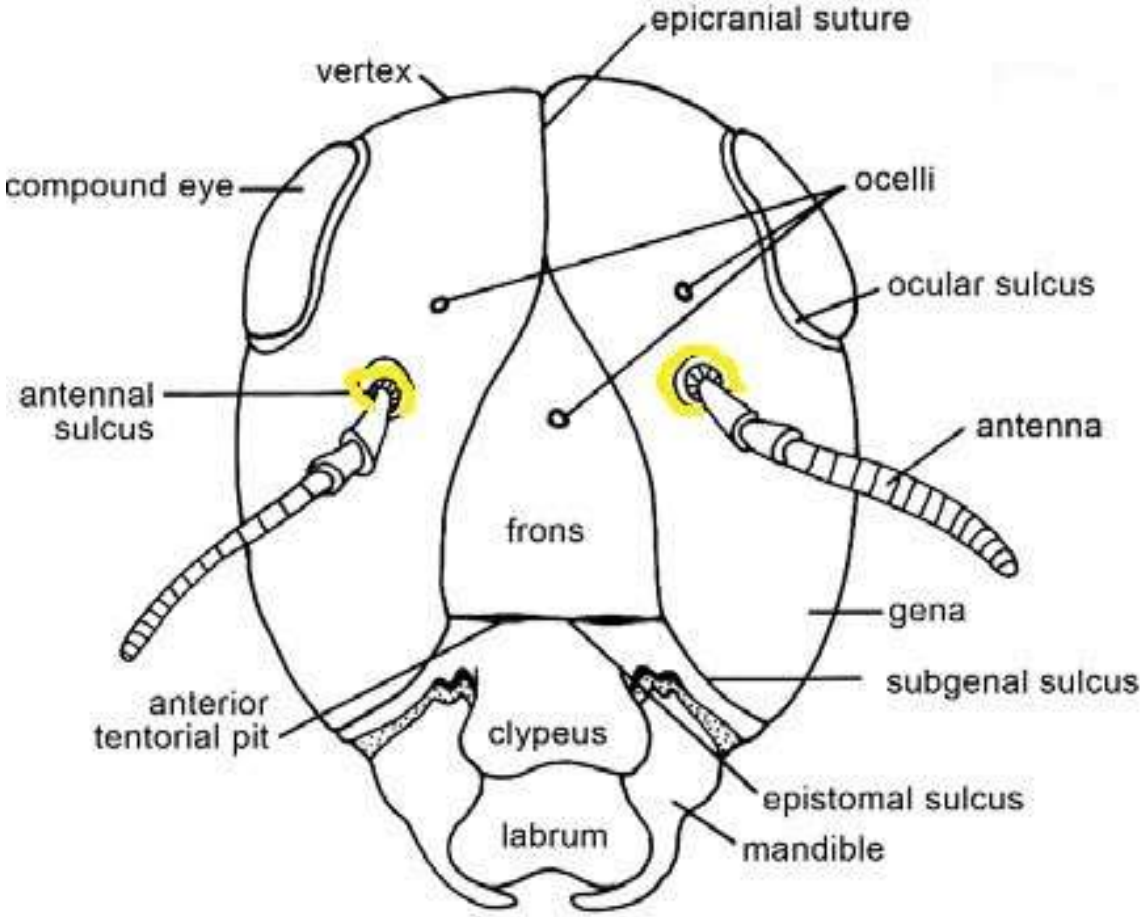
- These sutures are the annular grooves around the compound eyes. They form the skeletal ridges internally.


epicranial suture
vertex
compound eye
ocelli
ocular sulcus
antennal sulcus
antenna
frons
gena
subgenal sulcus
anterior tentorial pit
clypeus
epistomal sulcus
labrum
mandible

A

The Antennal Sutures:

- The marginal depressed ring around the antennal sockets are known as the antennal sutures.
- Each suture gives internally the submarginal ridge.
- The submarginal ridge in a large number of insects bears a pivot like process known as the antennifer.
- The antennifer provides articulation to the antenna.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A

HEAD SCLERITES

The sclerites represent simply, the intersutural areas.

The head of the generalized insect is typically exhibiting the following sclerites.

(a) The labrum

(b) The clypeus

(c) The frons

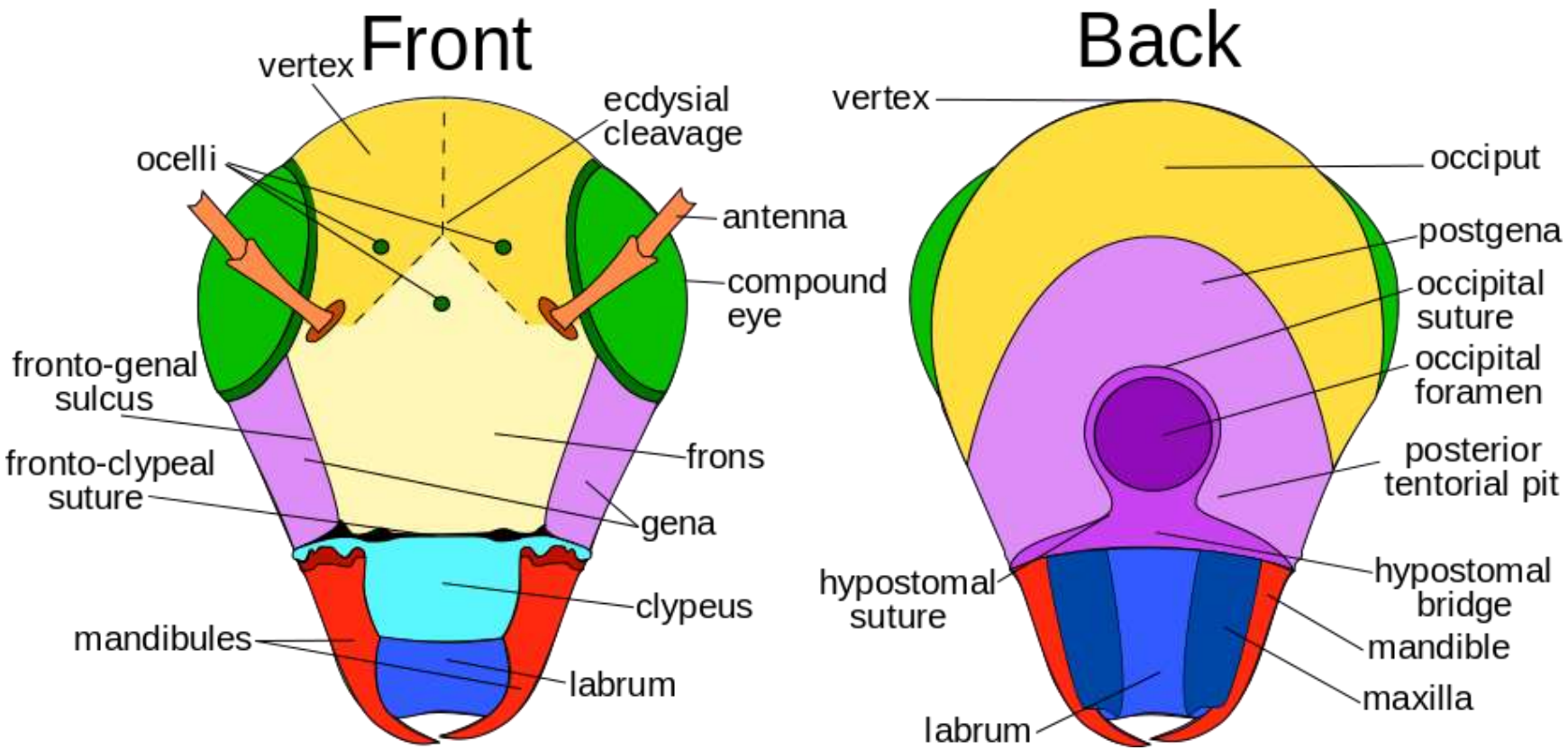
(d) The epicranium

(e) The occiput

(f) The post-occiput

(g) The Genae and subgenal areas

(h) The Ocular sclerites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fronto-genal sulcus
fronto-clypeal suture
frons
gena
clypeus
mandibules
labrum
Back
vertex
occiput
postgena
occipital suture
occipital foramen
posterior tentorial pit
hypostomal suture
hypostomal bridge
mandible
maxilla
labrum

(a) The labrum:

- It is freely attached to the lower margin of the clypeus by the clypeolabral suture, generally hanged over the mouth or preoral cavity and also termed as an upperlip.
- In the fluid-feeding insects it undergoes various modifications.
- Internally it forms anterior part of the epipharyngeal wall of the preoral cavity.
- It is internally lined with the gustatory receptors and can be moved upwards downwards and be pulled and pushed, to some extent, due to the elastic nature of the suture and muscle innervaton.

- The labrum is innervated by the following three types of muscles.

(i) **Compressor labral:**

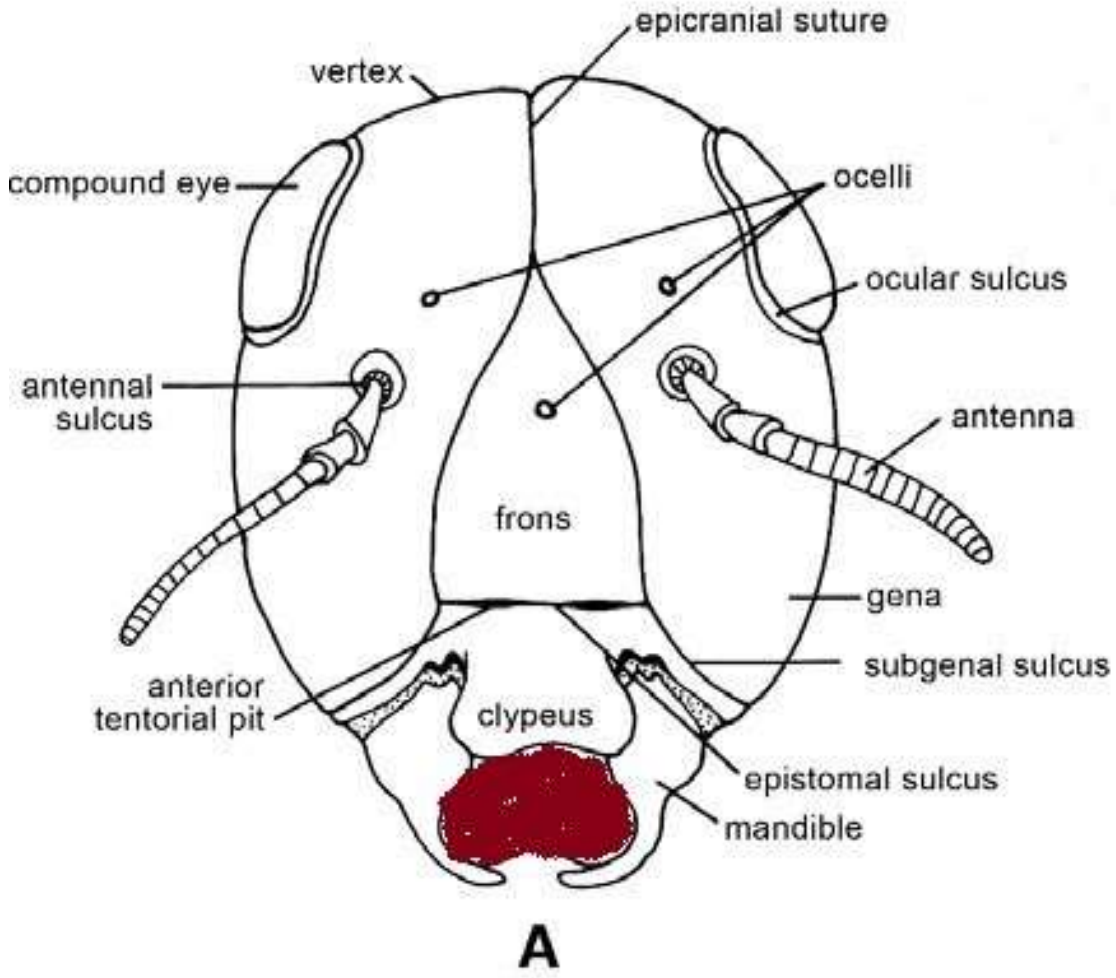
- They may occur in a pair on lateral sides or a single median one. They are attached by one end on the anterior and by the other end on the posterior end wall of the labrum. The compressors bring the retraction, prolongation and contraction of the labrum.

(ii) The anterior labral:

- They are paired but unbranched labral muscles. They originate from the inner surface of the frons. They move the labrum in forward direction.

(iii) T**he Posterior Labral:**

- They are the paired but branched labral muscles. They originate from the anterolabral regions of the frons. The muscles pull the labrum backward.


epicranial suture
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subgenal sulcus
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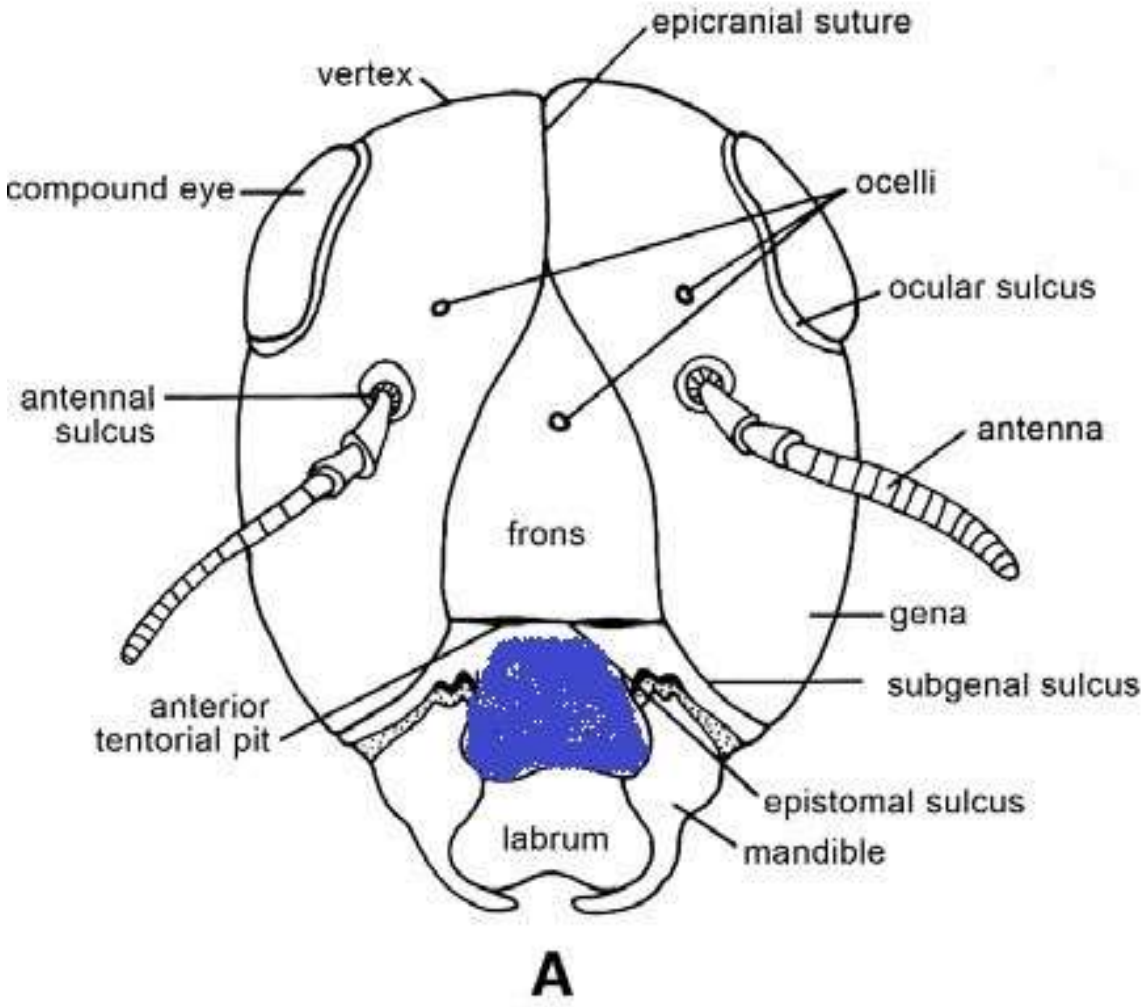
clypeus
epistomal sulcus
mandible
A

(b) The clypeus

- This sclerite is demarcated by the clypeolabral and clypeo –frontal sutures from the anterior and posterior sides.
- It thus occupies the position in-between the anterior labral and posterior frontal sclerites.
- In some insects, it is completely or partially divided into two parts by a transverse suture.

- The posterior part is termed as the post-clypeus and the anterior part is termed as anteclypeus.
- Both parts of the clypeus can be seen in the case of crickets.
- The post clypeus modifies into a convex process, termed as the ginglimus of the mandible.
- This is the sclerite on the head on which arise the cibarial dilator muscles.


epicranial suture
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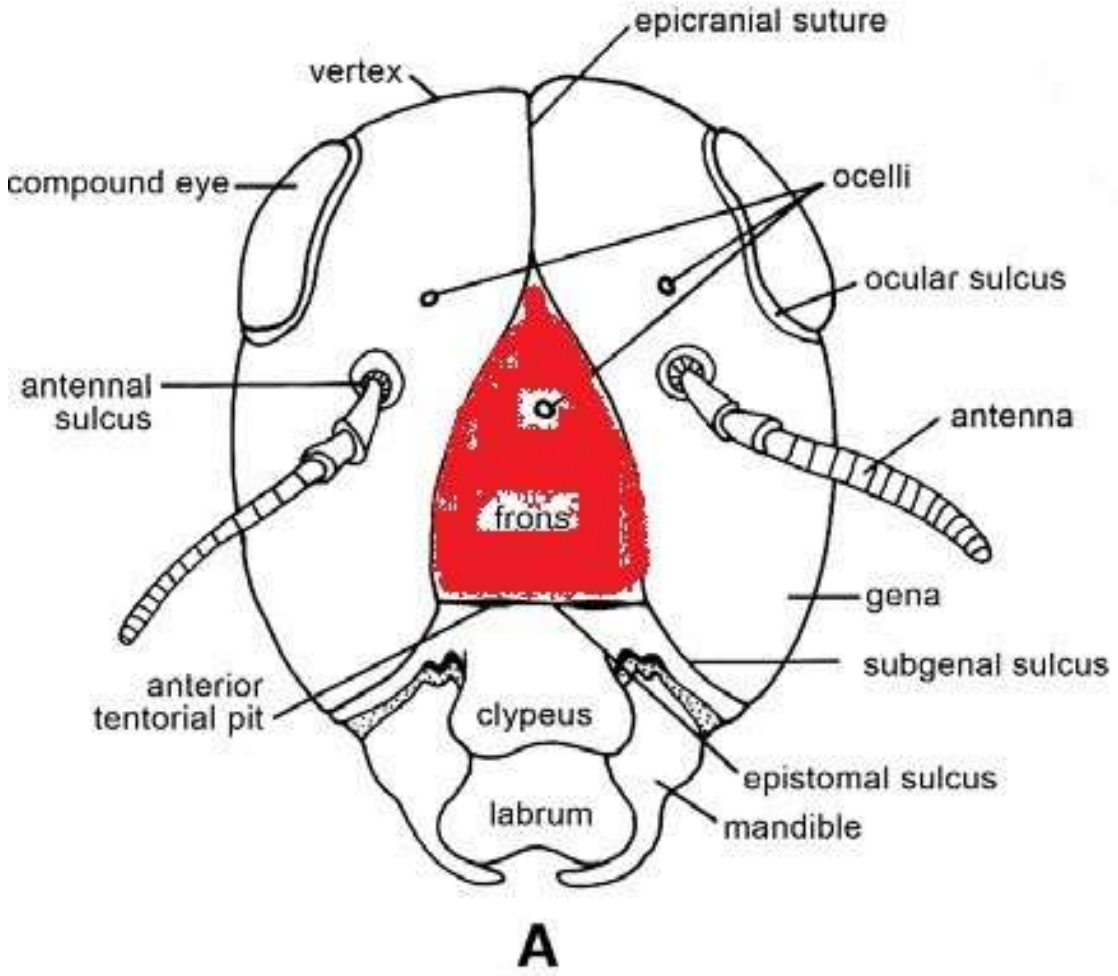
ocelli
ocular sulcus
antennal sulcus
antenna
frons
gena
subgenal sulcus
anterior tentorial pit
epistomal sulcus
labrum
mandible
A

(c) The frons:

- It extends from the anterior clypeo-frontal suture to the posterior frontal sutures.
- In the orthopteroid insects, it possesses the median ocellus.
- In some cases, it may bear the lateral ocelli also.
- The frons represent typically an upper facial region of the head.
- The pharyngeal dilators, labral, hypopharyngeal muscles and the adductors of mandibles are usually inserted on the middle of the frons.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clypeus
epistomal sulcus
labrum
mandible
A

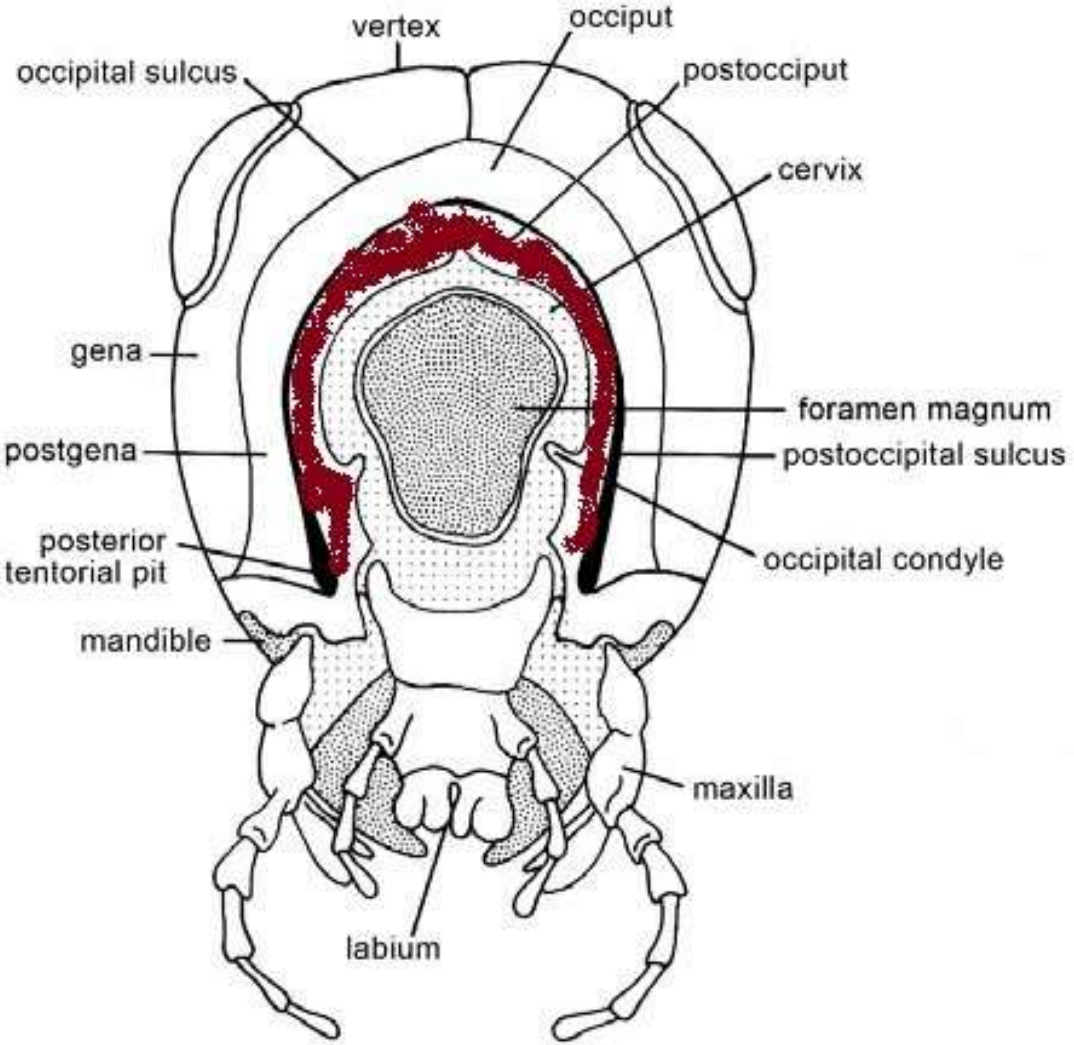
(d) The Epicranium:

- The epicranium suture separates the epicranium from the frons.
- It represents the entire upper region or top of the head.
- It extends from the anterior frontal to the posterior occipital suture.
- Above the frons, it is divided into two identical lateral plates, known as parietals.
- The parietals are characterised by bearing the antennae, lateral ocelli and compound eyes.
- The posterior undivided region of the epicranium is known as vertex.
- It forms top of the head.

(f) The post-occiput:

- The occipital foramen is encircled from the dorsal and lateral regions by a narrow sclerite, the post-occiput.
- It lies between the occiput and the neck.
- The post-occiput is marked off from the occiput by a transverse post-occipital suture.
- When the post-occipital suture remains absent, the posterior tentorial pits separate the post occiput from the occiput.

- The dorasal muscles are attached to the endoskeletal ridge of the post-occipetal suture.
- These muscles are articulate the head freely. The antero-lateral inner margin of the post-occiput produces small processes.
- These sutures are termed as the occipital condyles.
- Each condyle articulates with the anterior lateral cervical sclerites.


vertex
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cervix
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foramen magnum
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postoccipital sulcus
posterior
tentorial pit
occipital condyle
mandible
maxilla
labium

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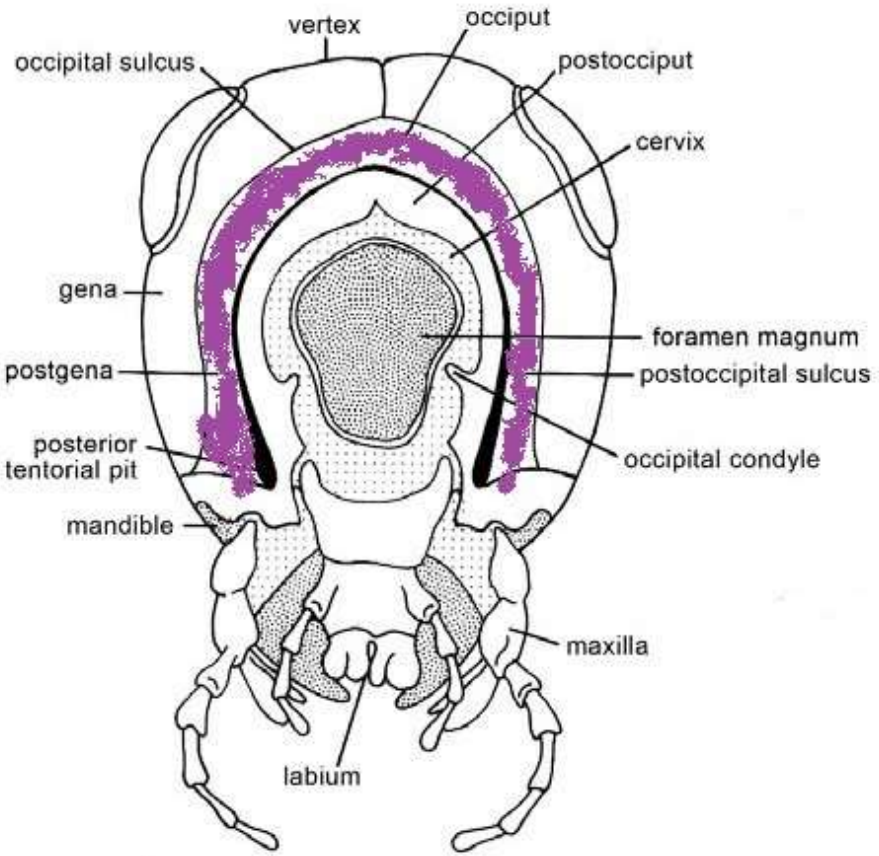
(e) The occiput:

- It is U-shaped posterior or hinder cuticular band. It represents the area from the occipital to the postoccipetal sutures.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postgena
postoccipital sulcus
posterior
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occipital condyle
mandible
maxilla
labium

C

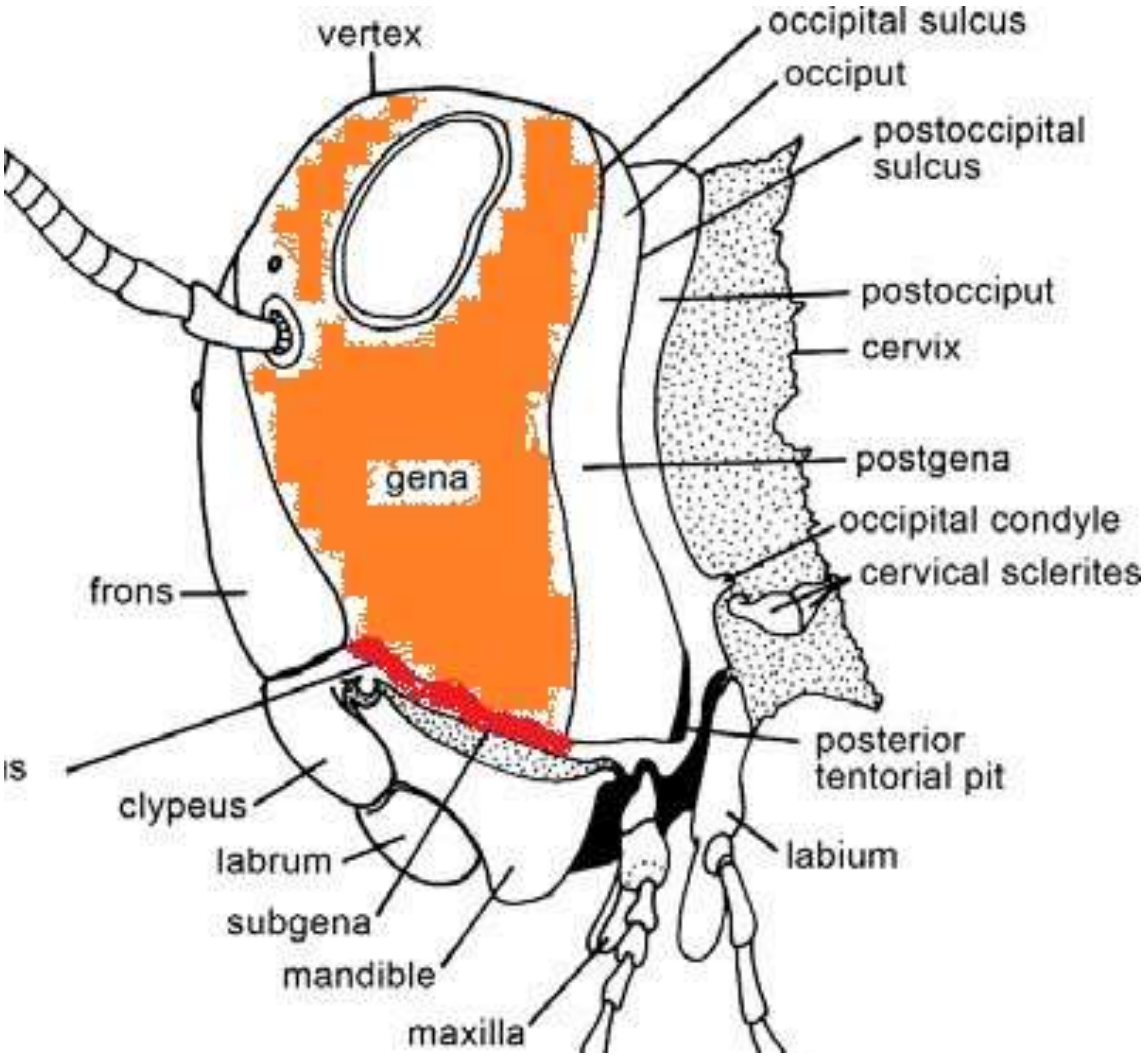
(g) The Genae and subgenal areas:

- The genae represent the lateral areas of the head.
- On either side, the genae extend from the compound eye to the mandibular trochantin.
- The hinder part develops in to the socket to accommodate the mandibular condyle.
- Posterior to the occipital suture, each lateral gena is commonly called as the postgena.
- Each postgena provides the condylar articulation for the maxillae.

- The subgenal area above and below the mandibles can be referred to as the pleurostoma and hypostoma, respectively. These areas are separated in some insects by the suture, the hypostomal suture.
- Similarly the pleurostomal suture separates the pleurostoma from the base of the mandibles.

(h) The Ocular sclerites:

- They form a cuticular ring around each compound eye.
- (i) The Antennal sclerites: They form an annulus at the base of the antenna. The antennal sclerites are well developed in the plecoptera.
- (ii) The Mandibular Trochantin: It occurs quite distinctly between the mandibular base and the pleurostoma or the pleurostomal suture.


vertex
occipital sulcus
occiput
postoccipital sulcus
postocciput
cervix
gena
postgena
occipital condyle
cervical sclerites
frons
posterior tentorial pit
clypeus
labrum
labium
subgena
mandible
maxilla

Tentorium:

- It is an endoskeleton structure.
- It is composed of three pairs of arms, the anterior, posterior and dorsal tentorial arms.
- The anterior tentorial arms develop from the anterior tentorial pits in the subgenal or epistomal suture.

- The posterior tentorial arms arise from the posterior tentorial pits in the lower ends of the post-occipital suture.
- The dorsal tentorial arms take origin in the form of secondary out-growths of the anterior arms.
- All these tentorial arms unite in the middle forming an expanded central skeletal platform.
- It may simply constitute a structure resembling the X.

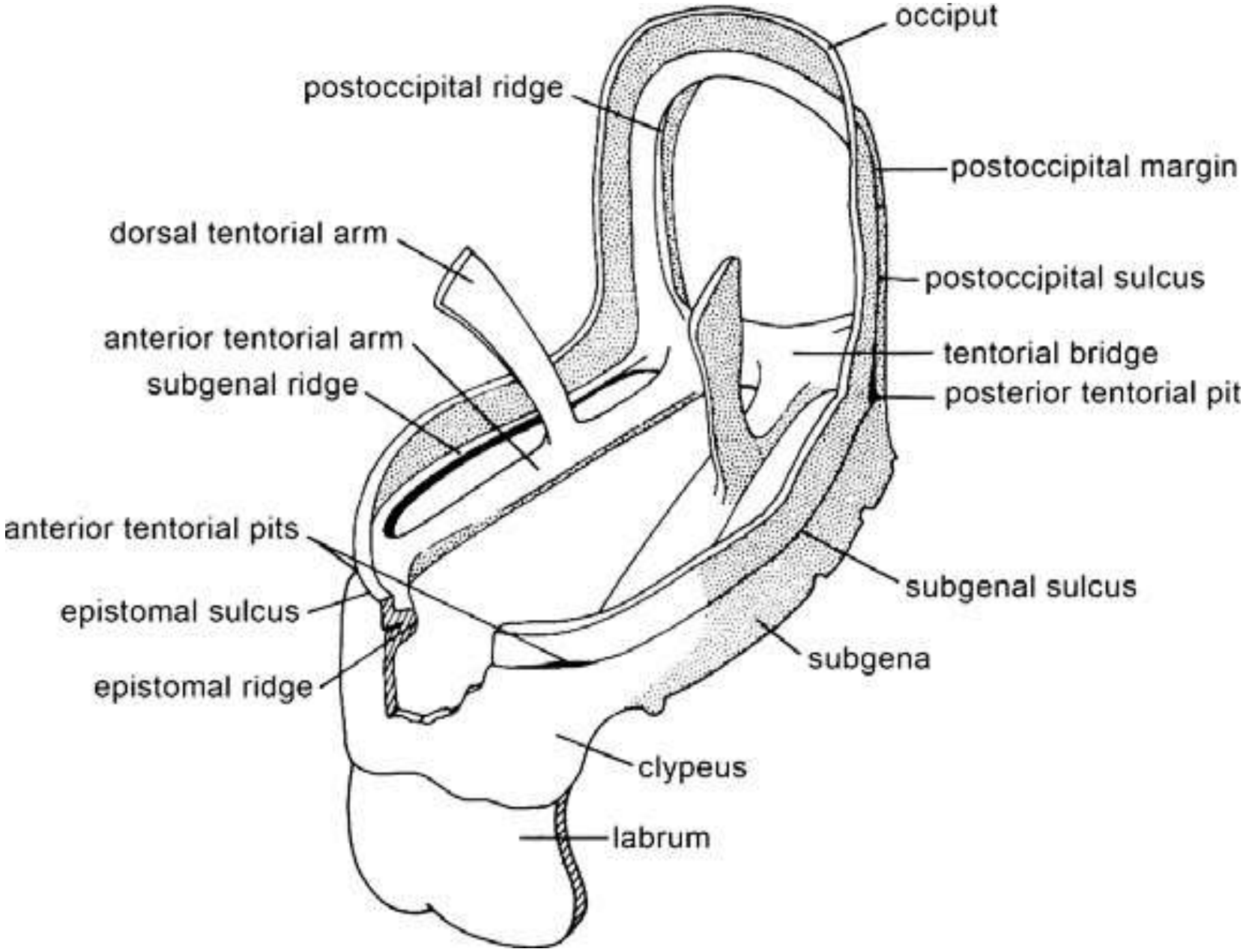
- The presence of a broad tentorial plate occurs commonly in the pterygote insects and is commonly known as the corporotentorium.

The anterior tentorial pits:

- The anterior tentorial arms of the tentorium arise from some part of subgena or epistomal suture.

The posterior tentorial pits:

- The posterior tentorial arms of the tentorium arise from ventral ends of post occipital suture and lie in the lower extremities of post occipital suture


occiput
postoccipital ridge
postoccipital margin
dorsal tentorial arm
postoccipital sulcus
anterior tentorial arm
tentorial bridge
subgenal ridge
posterior tentorial pit
anterior tentorial pits
subgenal sulcus
epistomal sulcus
subgena
epistomal ridge
clypeus
labrum

Modifications in head capsule:

- The anterior frontoclypeal and posterior, lateral as well as ventral regions of the head capsule are greatly modified in some insects.

1.Fronto-clypeal Region:

- The epistomal suture is wanting in cockroaches and some other insects in which the clypeal region can be separated from the frontal region by the position of anterior tentorial pits.
- Sometimes the frontal sutures are also indistinct.
- In the Hemiptera, Hymenoptera and Lepidopteran larvae, the frons is greatly suppressed.
- In these insects, on the basis of position of the dilators of cibarium or that of buccal cavity, the clypeal region can be recognised.
- Similarly the frontal region can be identified by the position of a median ocellus and origin of labral muscles.

2.Hypostomal bridge:

- In the lepidopteran larvae, the hypostomal lobes do not unite together while in other insects, they fuse at the middle forming a complete hypostomal bridge in order to close the foramen magnum ventrally

3.Gula:

- It is a ventral sclerotic plate of the head capsule separating the foramen magnum from the base of the labium.
- It is well developed in the insects having prognathous head in order to place the mouth parts in forward direction.
- The gula is separated from the laterally expanded postgenae by the gular structures.
- The gular sutures are in fact modified post-occipital sutures.
- The gula varies in length and width in different species of Coleopteran and Neuroptera.


THANK
YOU