THE UNIVERSITY OF MELBOURNE

Melbourne Veterinary School

Digestive System
Lecture 5:
From Mouth to Stomach

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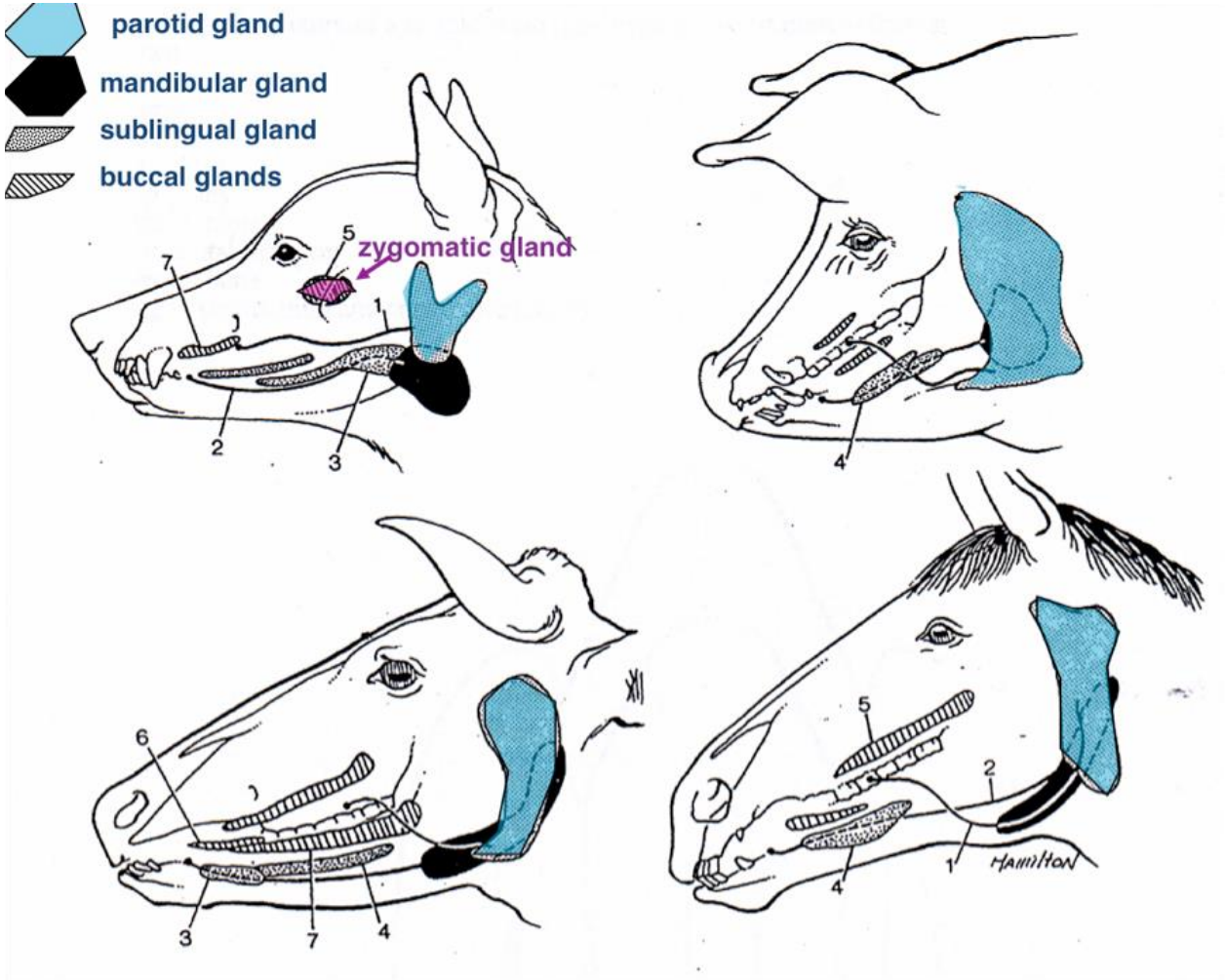
VETS30016 / VETS90120

Salivary glands

- Saliva:
  - moistens food, assists in taste and mastication
  - lubricate bolus during deglutition
  - amylase for starch digestion (some spp.)
  - oral hygiene
  - alkaline buffering (ruminants)
  - evaporative cooling (panting)

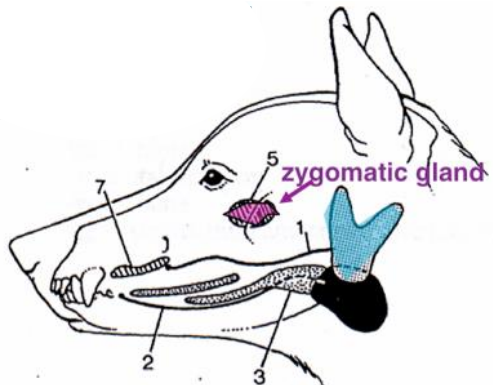
- Scattered salivary glands:
  - lips, cheeks, soft palate and tongue
  - secretions mostly mucous (carbohydrate-rich)
- Distinct large salivary glands:
  - secretions mostly serous (watery and protein-rich)

Salivary glands



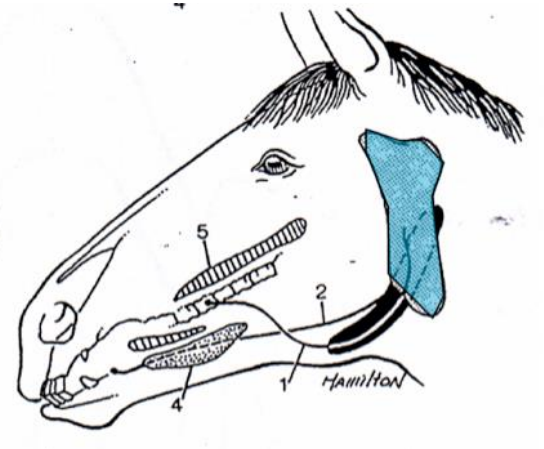
Parotid salivary gland

- located superficially, ventral to ear
- larger in herbivores than in carnivores

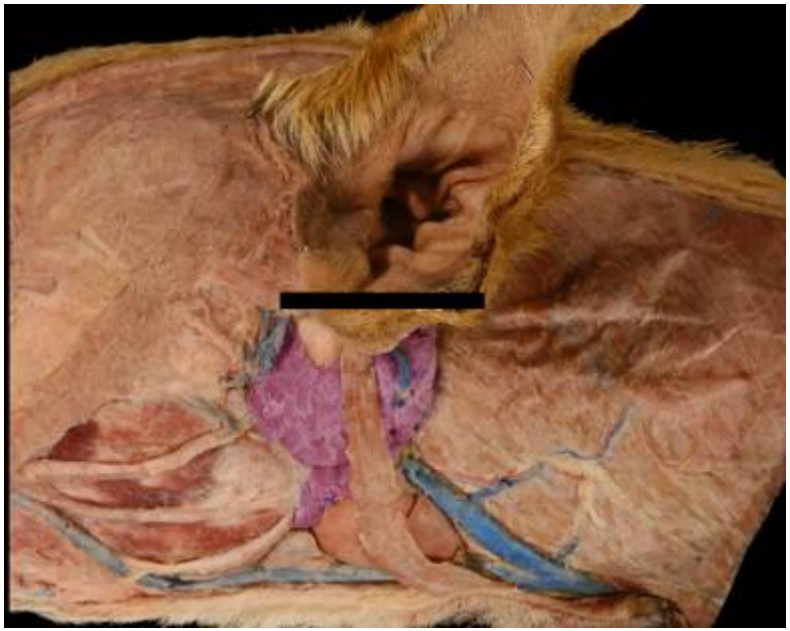


Duct:

- Dog:
  - Travels across lateral surface of *masseter* muscle
  - opening in vestibule adjacent to upper fourth premolar tooth
- Horse and cow:
  - medial to ventral border of mandible
  - crosses ventral border of mandible laterally
  - enters vestibule as for dog



Parotid salivary gland



Parotid gland and duct in the horse

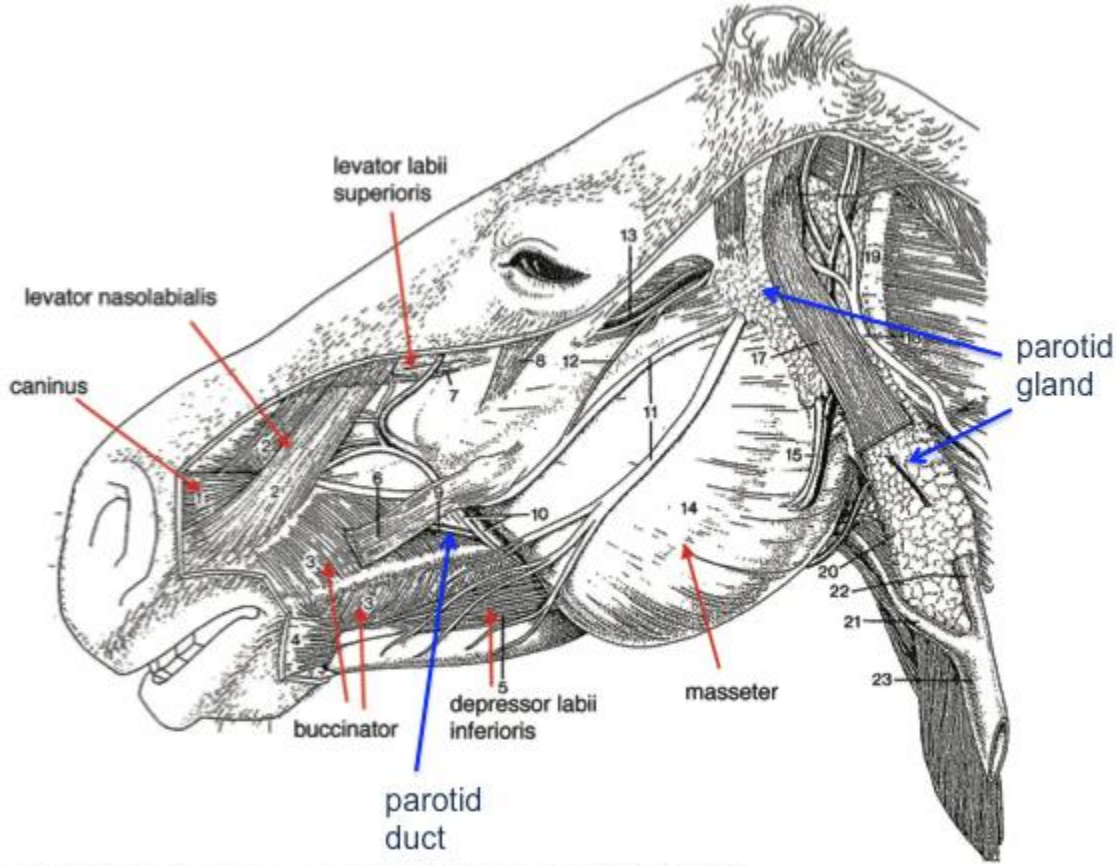
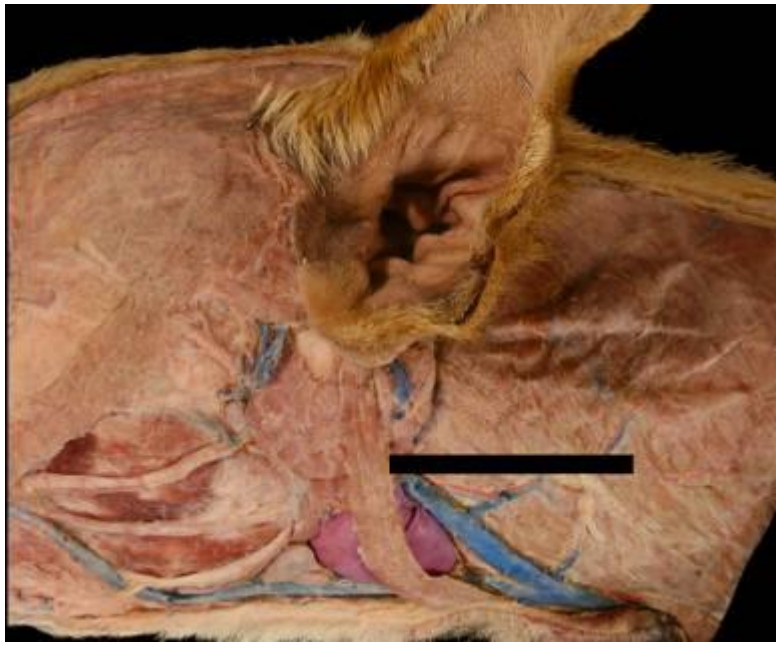


FIGURE 18–6. Superficial dissection of the head of the horse. (Dyce et al, 1987, p. 466)

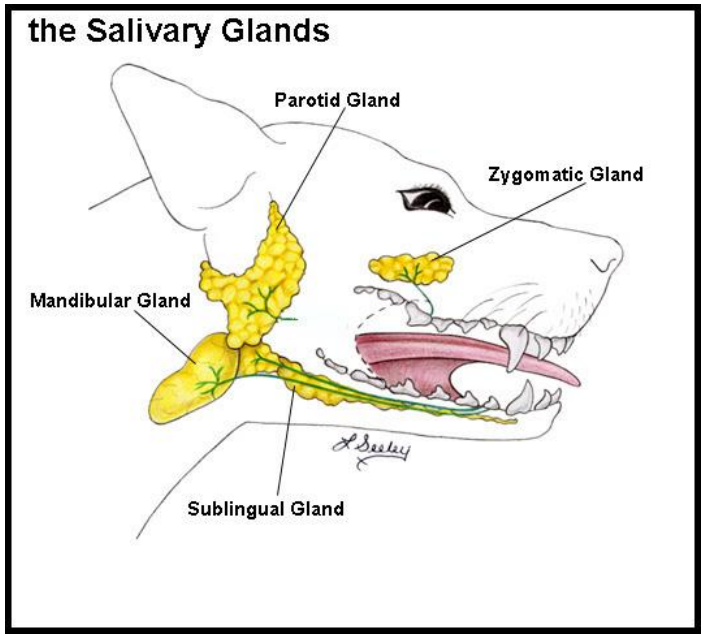
Mandibular salivary gland

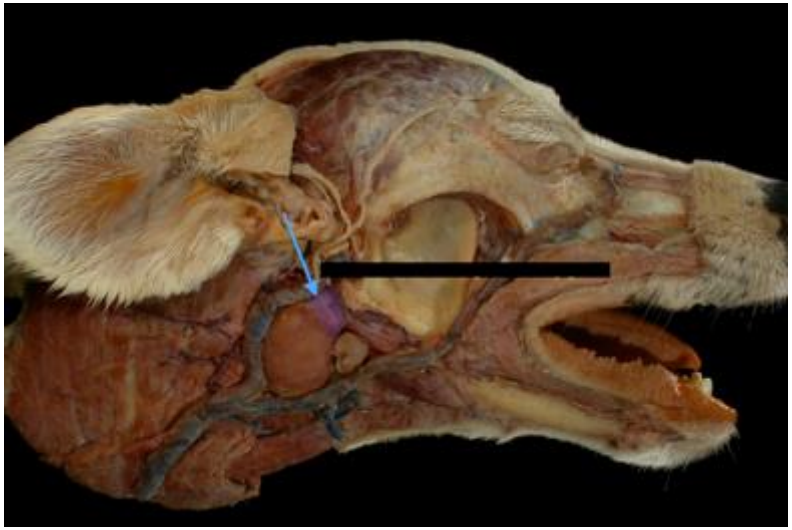
- located at angle of jaw
- deeper and larger in herbivores
- duct opens at sublingual caruncle
  - (close to frenulum)



Sublingual gland:

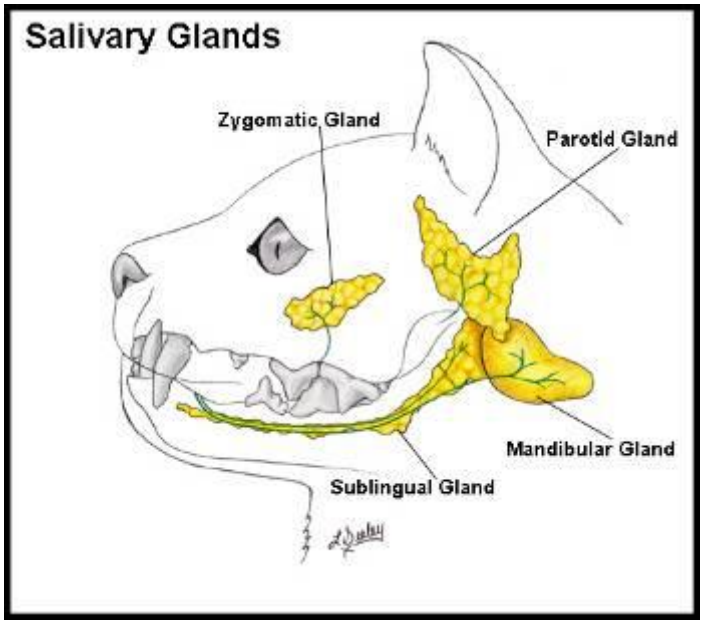
- Monostomatic (single duct) and polystomatic (multiple ducts) parts
- Ducts run along floor of oral cavity and open adjacent to frenulum

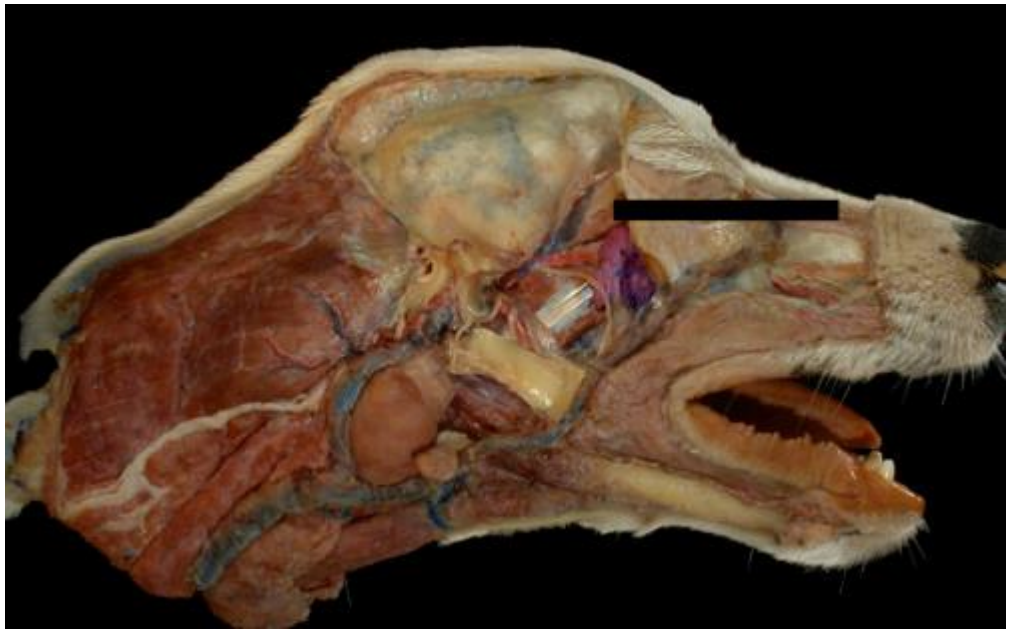


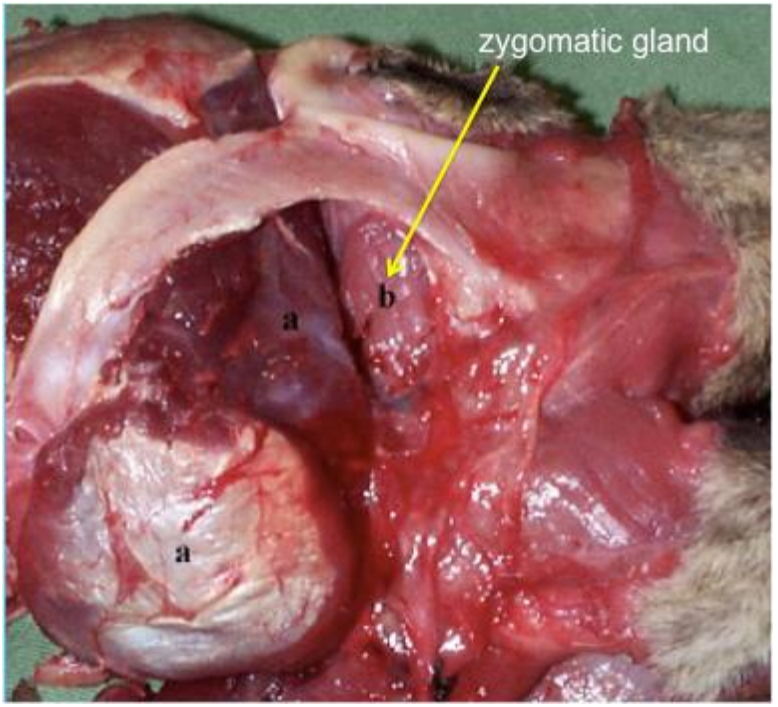


Zygomatic gland:

- dog and cat
- medial to zygomatic arch (in orbit)
- duct opens opposite last upper molar





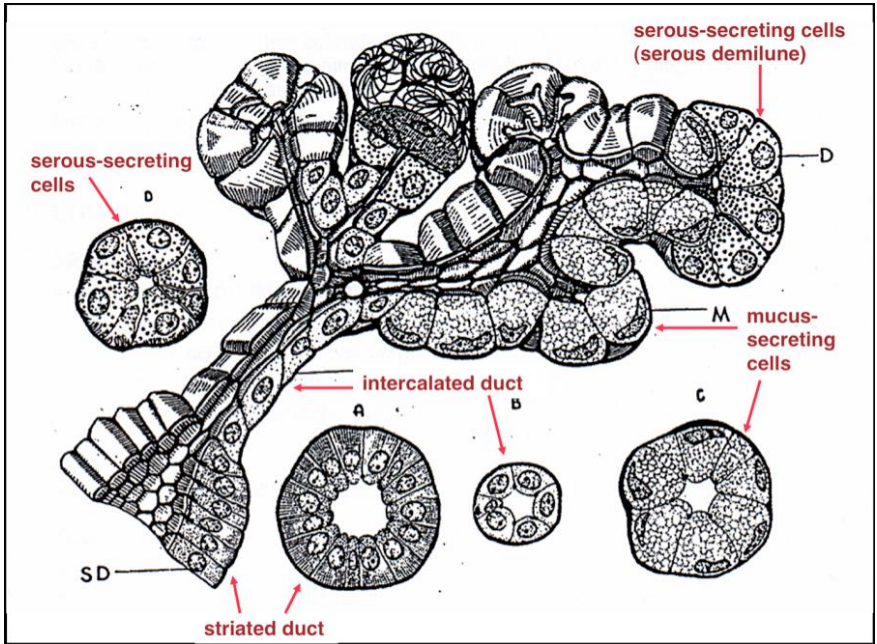


Microscopic structure of salivary glands

Branching duct system:

acinus → intercalated duct → striated duct → interlobular duct → primary duct

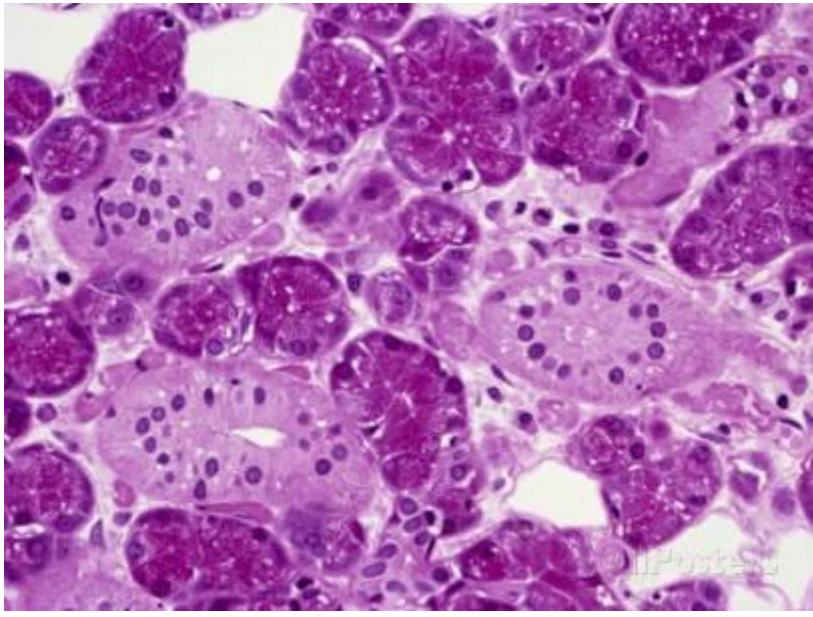
- secretory cells arranged in acini
  - (clusters of cells arranged around a lumen)
- surrounded by basement membrane
- contain serous or mucous acini, or both



Salivary gland acini

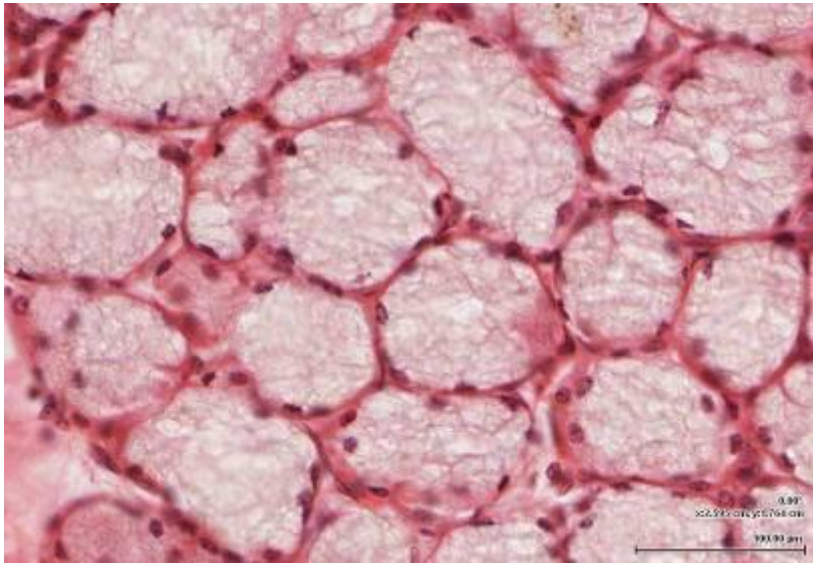
Serous

- cells pyramidal
- round basal nuclei
- basophilic perinuclear cytoplasm
- secretory granules in apical cytoplasm



Mucous

- cells swollen with mucous secretions
- flattened basal nucleus



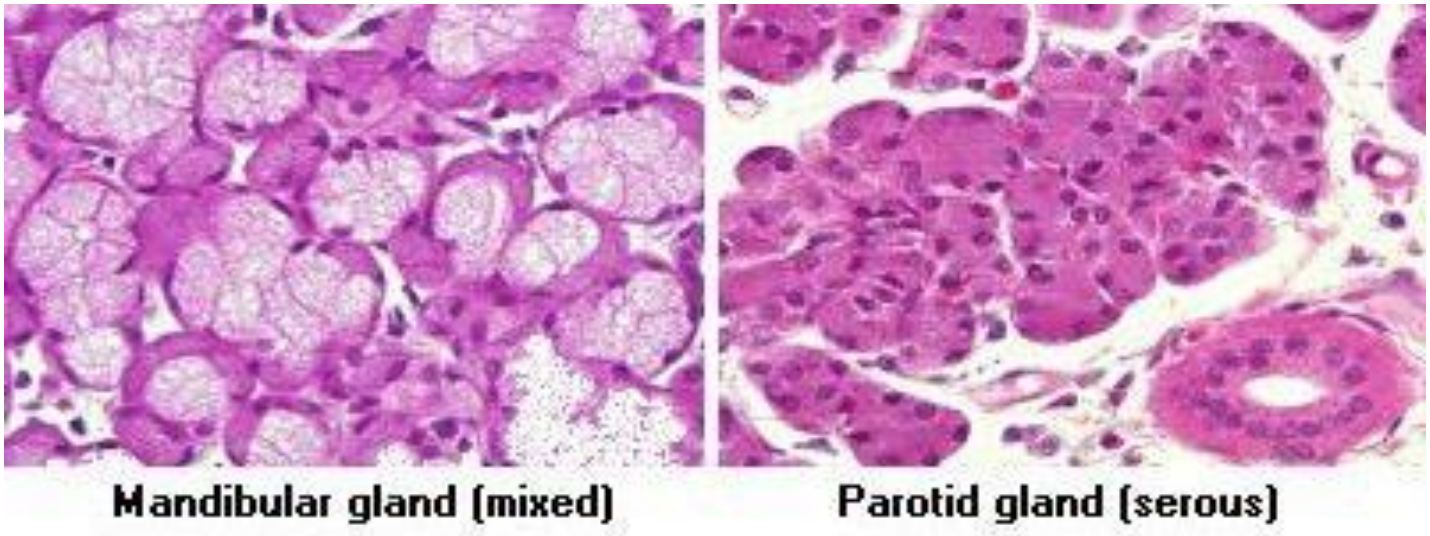
Salivary gland acini

Mixed glands

- individual acini composed entirely of serous or mucous cells, or both:
- *serous* demilunes in mixed acini

Examples:

- *Parotid gland:* purely serous in most species (not dog)
- *Mandibular and sublingual glands:* mixed mucous and serous



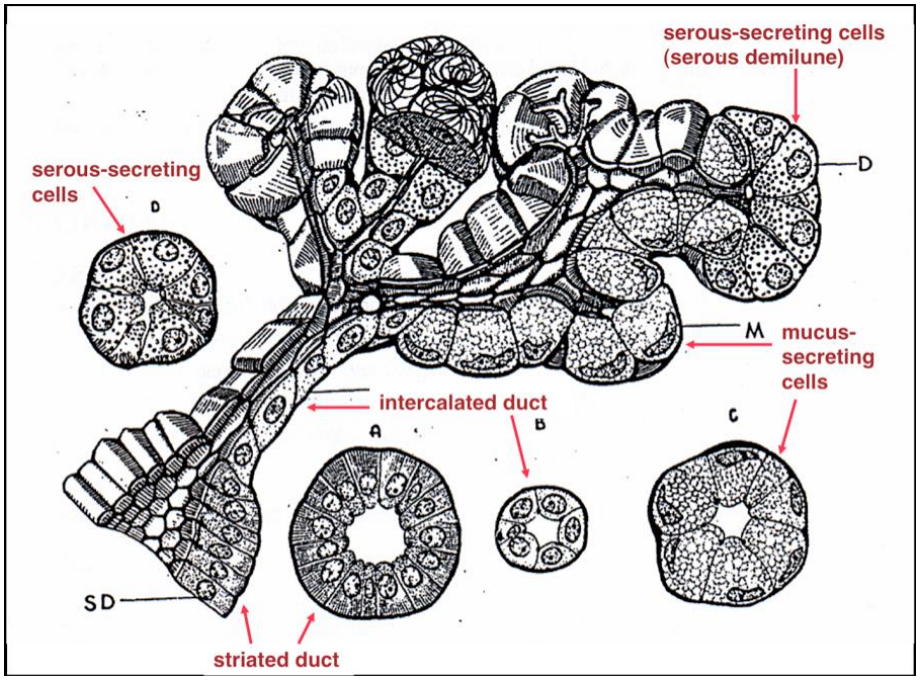
Salivary gland ducts

- *Intercalated duct:*
  - low cuboidal epithelium
- *Striated duct:*
  - columnar epithelium with basal striations (alignment of mitochondria)
- *Intralobular duct:*
  - (larger duct within lobule)
- *Interlobular duct:*

simple columnar

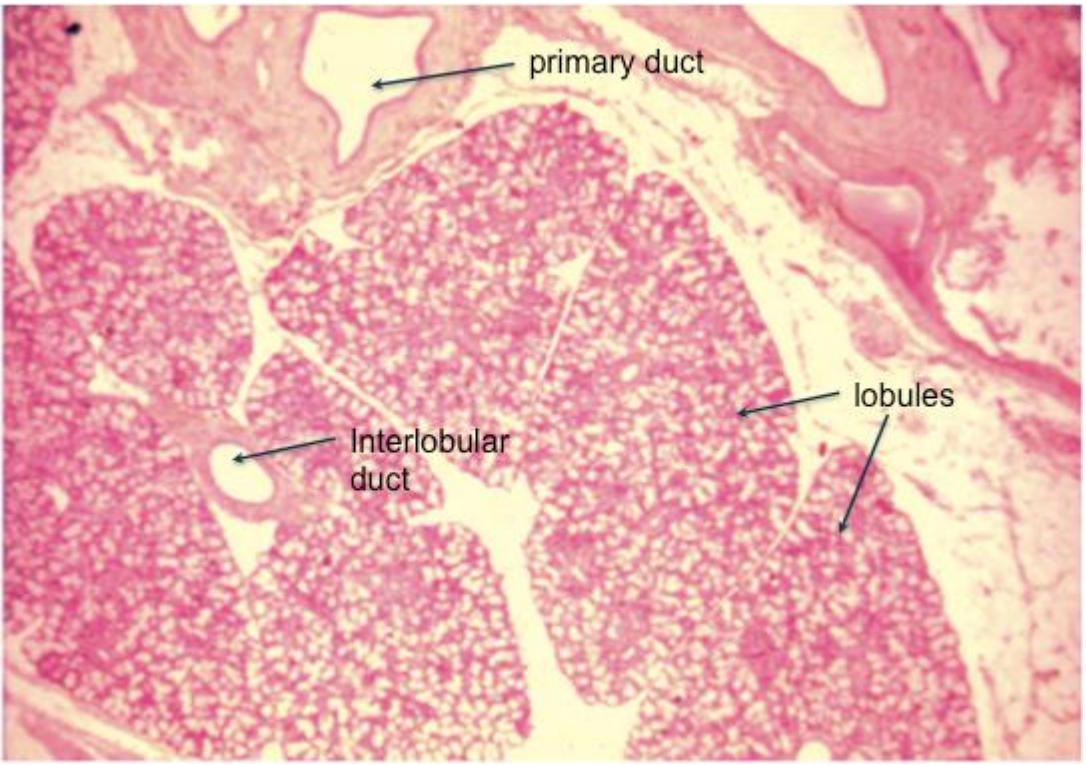
↓

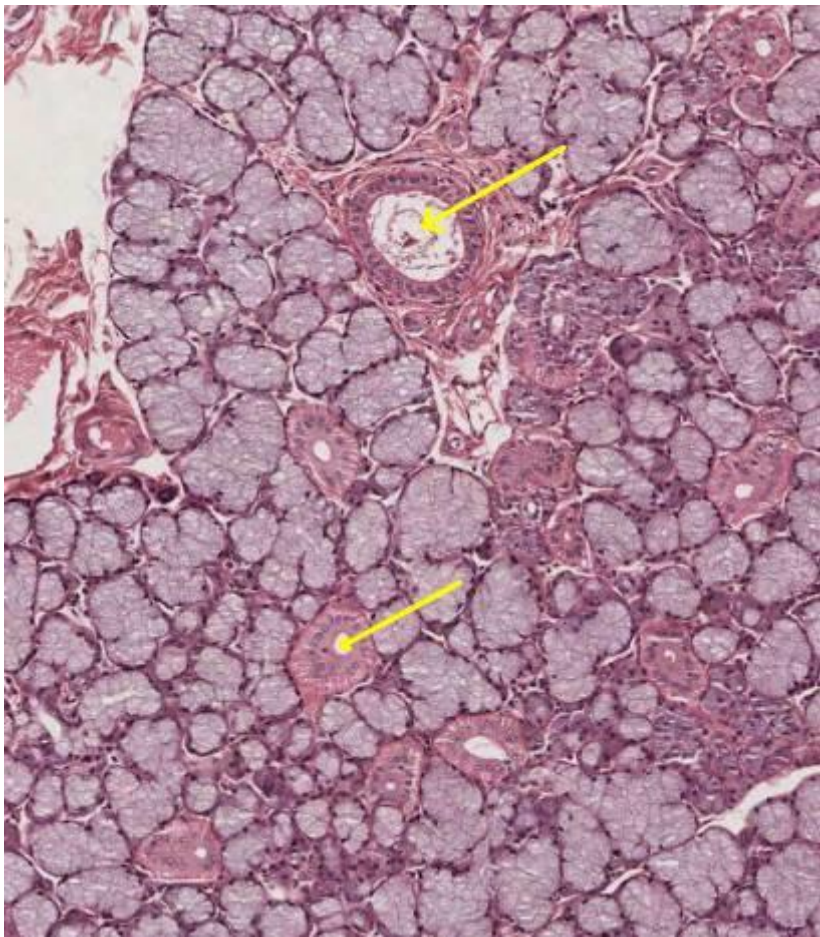
stratified columnar



Salivary gland ducts

- Mixed salivary gland – low power





Control of salivary secretion

- secretion under autonomic nervous system (parasympathetic) control
- mandibular, sublingual, buccal and zygomatic glands innervated by cranial nerve VII (facial)
- parotid gland innervated by cranial nerve IX (glossopharyngeal)

- Parasympathetic stimulation from the brain results in greatly enhanced secretion, as well as increased blood flow to the salivary glands.

- Potent stimuli for increased salivation:
  - presence of food or irritating substances in the mouth
  - thoughts of or the smell of food (demonstrated by Pavlov)
  - many stressful stimuli also induce excessive salivation – e.g. thunder

Pharynx

- funnel-shaped muscular tube
- region common to digestive and respiratory tracts
- demarcated from oral cavity by *palatoglossal arch*
- lined by mucosa with mucous glands, collagen, elastic fibres

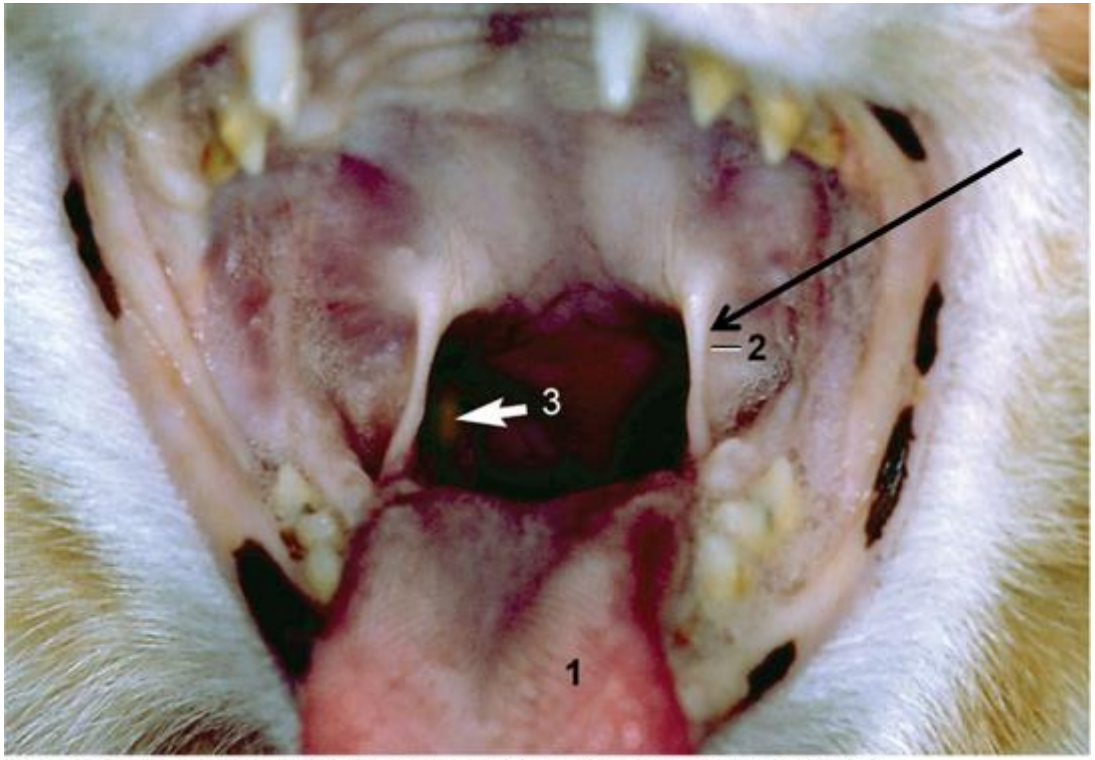


Fig. 11-18. Oropharynx (cat). 1, Tongue; 2, palatoglossal arch; 3, position of right palatine tonsil (arrow).

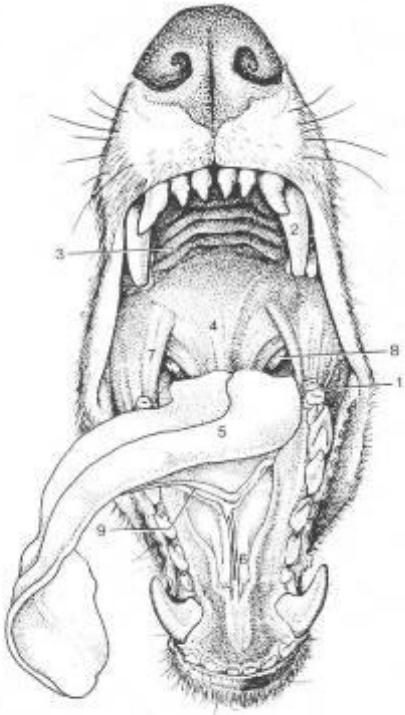


FIGURE 3–3. General view of the oral cavity of the dog.

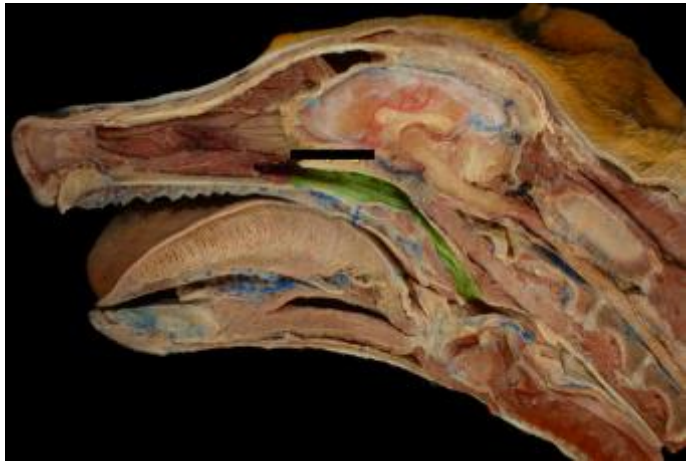
Dyce, Sack and Wensing; Textbook of Veterinary Anatomy

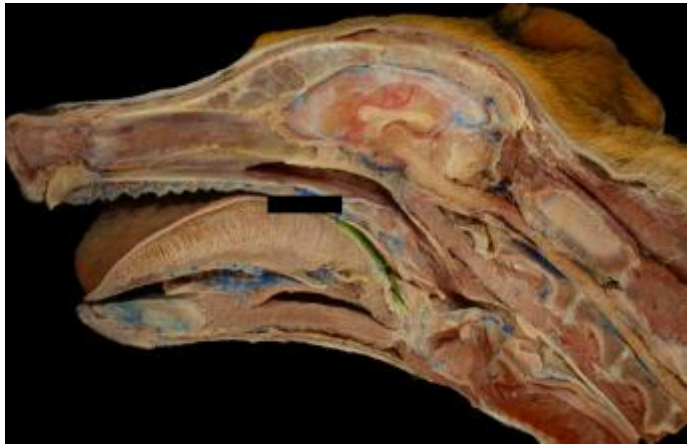
Pharynx

- region common to digestive and respiratory tracts
- partially subdivided by soft palate into
  - *nasopharynx* (dorsal to soft palate) and
  - *oropharynx* (ventral to soft palate)

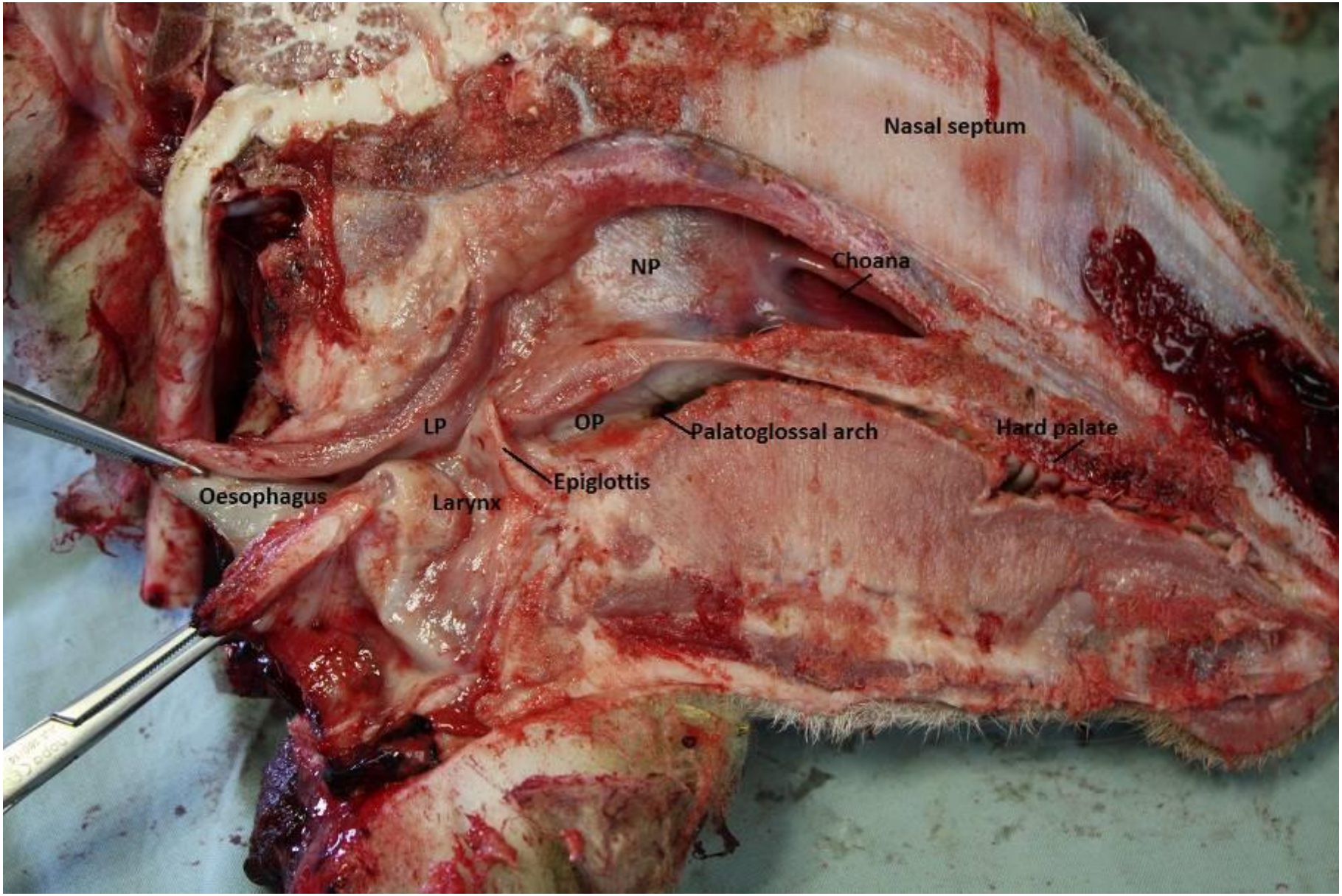
- Wall formed by three groups of muscles:
  - constrictors
  - dilator
  - Shortener

- *Innervation:*
  - *Motor and sensory:* - contributions from cranial nerves IX and X (vagus).





Pharynx

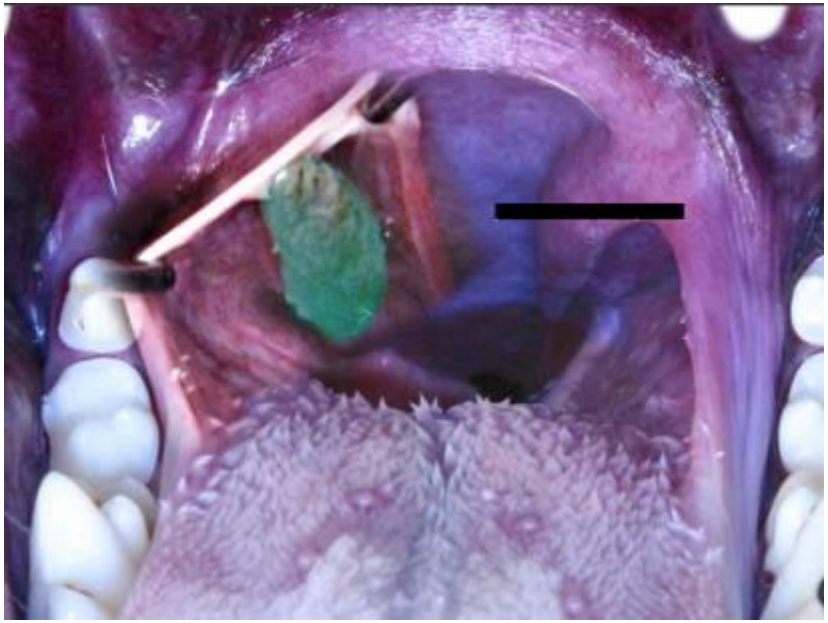


Medial view of sectioned sheep head: NP=nasopharynx, OP=oropharynx, LP=laryngopharynx

Image courtesy of C Murray

Pharynx

- lymphoid tissue (defence against infection) - both scattered and in *tonsils*
- tonsils may have smooth surface (e.g. palatine tonsil, dog) or crypts (e.g.palatine tonsil, horse)



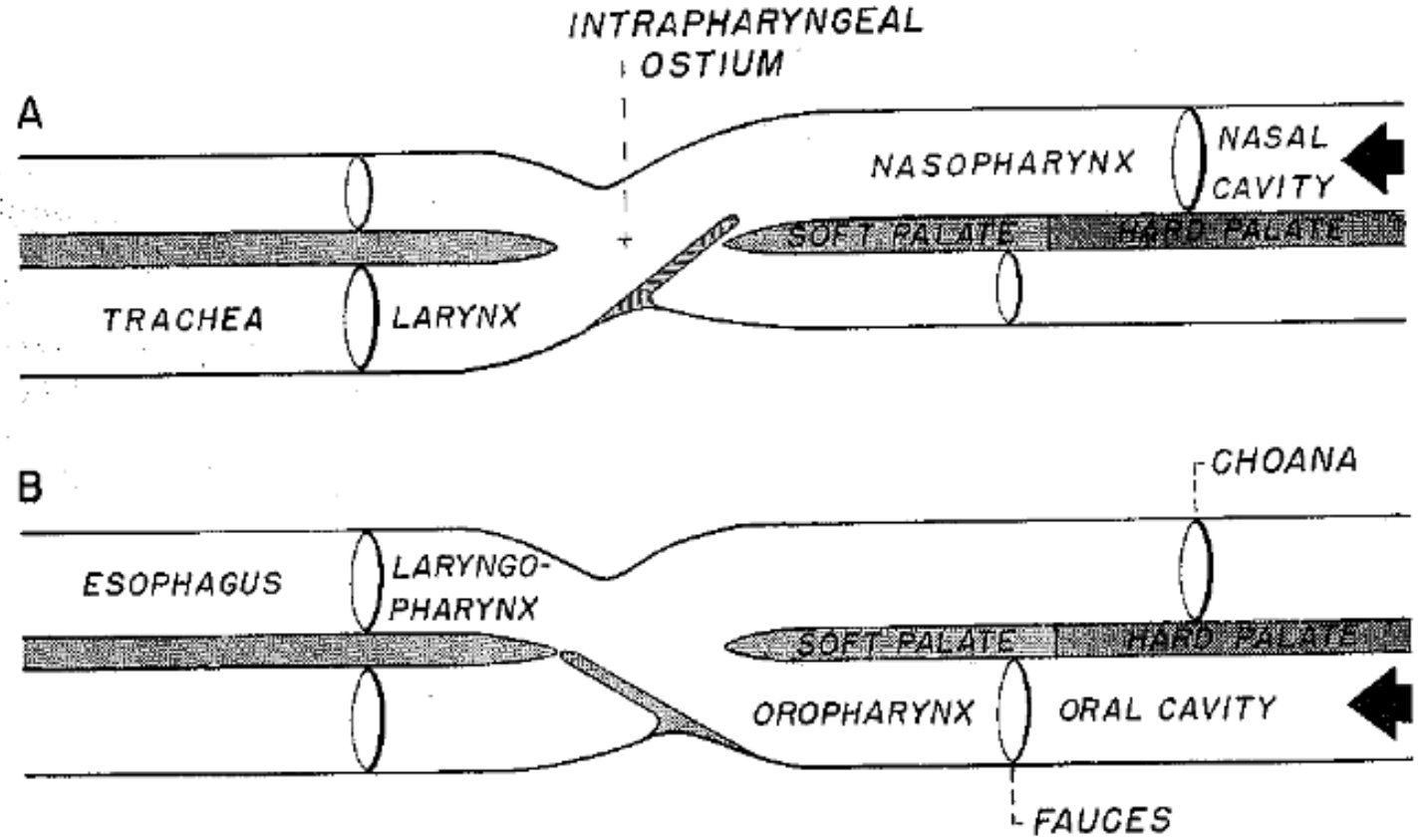
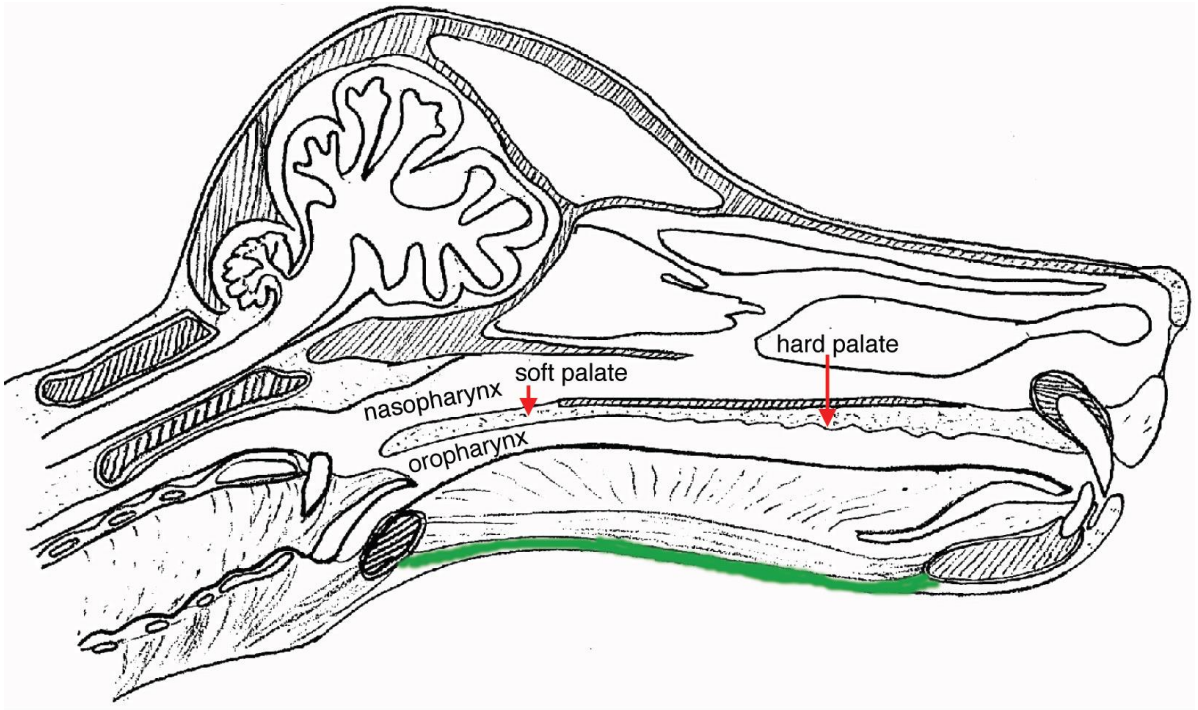


Figure 7–27. Diagram of the pharyngeal chiasma.
A. During respiration.
B. During deglutition.

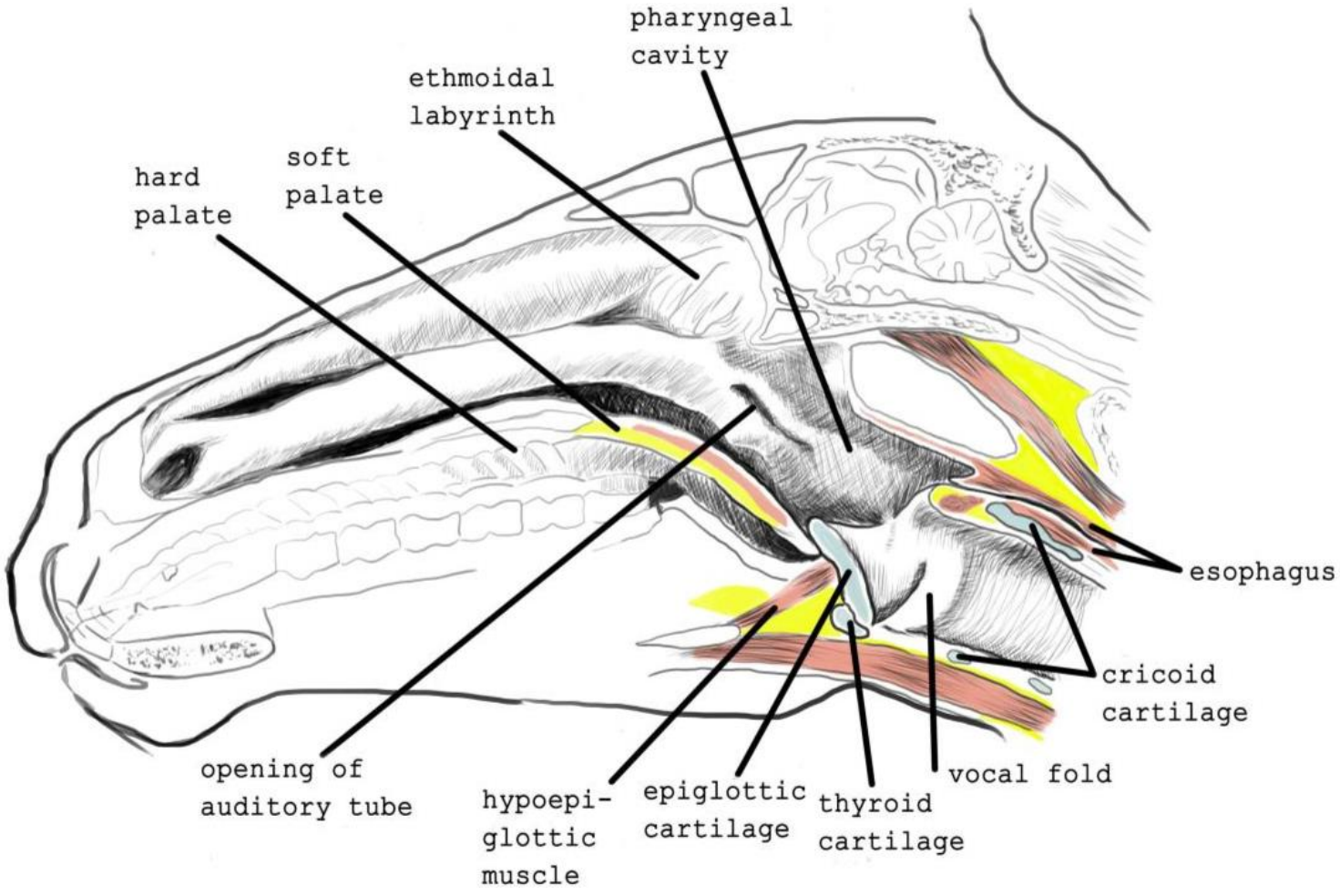
Evans and Christensen, 1979,p 452

Pharynx



Sagittal section of dog's head

Pharynx


pharyngeal cavity
ethmoidal labyrinth
soft palate
hard palate
esophagus
cricoid cartilage
vocal fold
opening of auditory tube
hypoepi-glottic muscle
epiglottic cartilage
thyroid cartilage

Deglutition (swallowing)

- initiated voluntarily, but taken over by reflexes once food reaches pharynx

Bolus of food prepared by mastication and insalivation

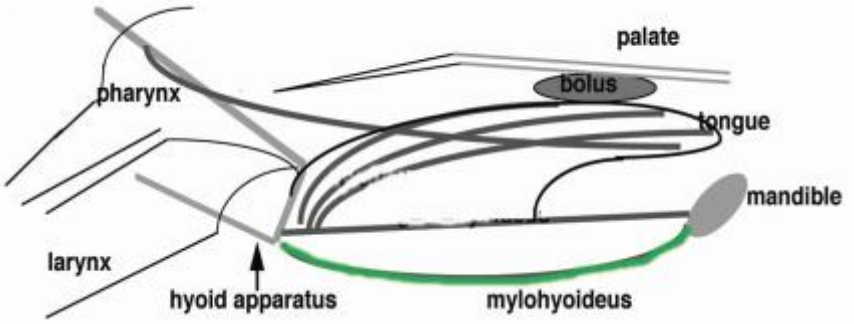
⇓

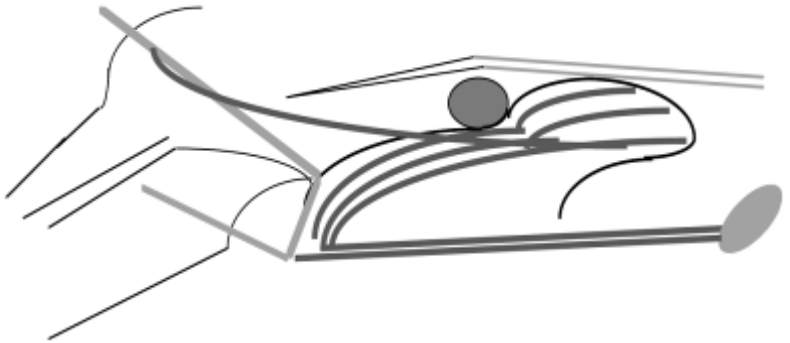
apex of tongue pressed against palate

⇓

rapid contraction of mylohyoideus and extrinsic muscles of tongue to propel food into pharynx

⇓





Deglutition (continued)

⇓

contact with pharyngeal mucosa sets off reflexes

⇓

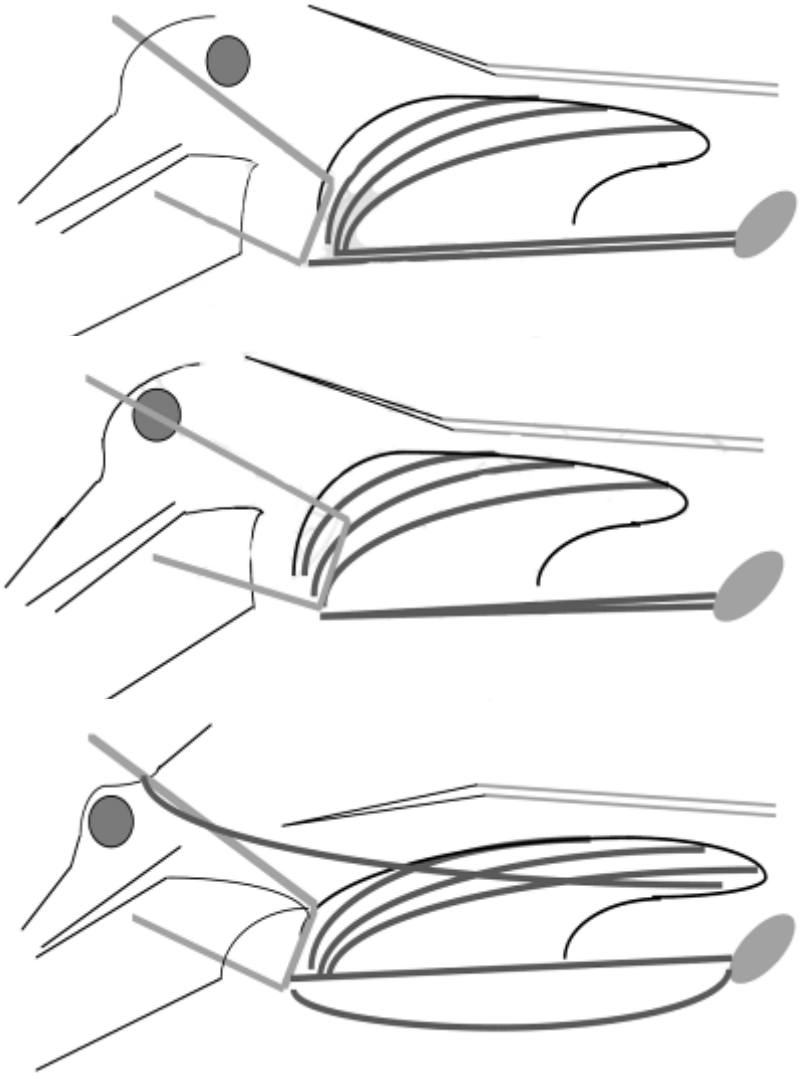
soft palate raised, glottis (narrowest part of larynx) closed, hyoid apparatus drawn rostrally, pharynx shortened (by pharyngeal shorteners)

⇓

bolus moved into oesophagus by pharyngeal constrictors

⇓

wave of peristalsis conveys bolus to stomach



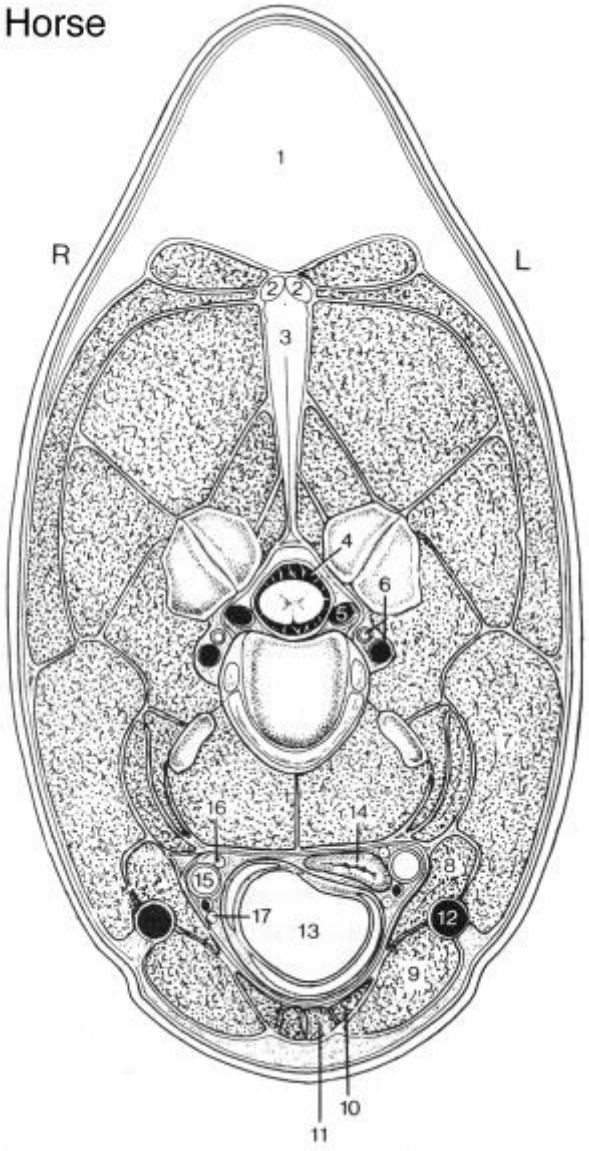
The oesophagus

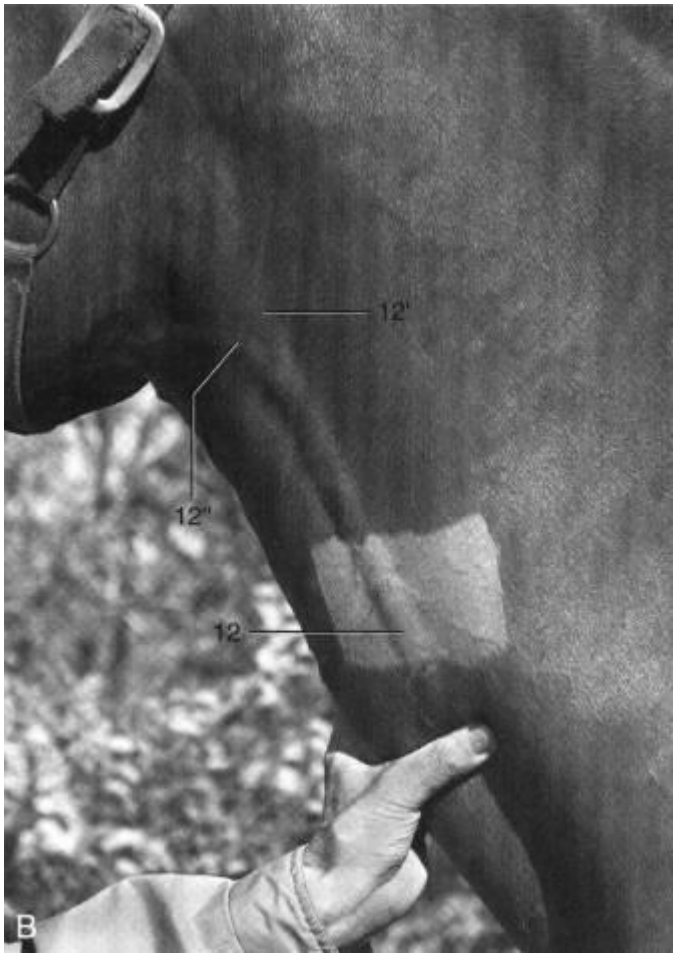
- Simple muscular tube
- Runs from the cricoid cartilage of the larynx to the cardia of the stomach
- Divided into three segments
  - Cervical
  - Thoracic
  - Abdominal

Cervical oesophagus

- Pharynx to thoracic inlet
- Ventral to subvertebral muscles (longus colli and longus capitis)
- Begins in median plane dorsal to trachea
- Inclines to the left
- Prior to thoracic inlet is left lateral to trachea

oesophagus





Stomach tubing the horse

Thoracic oesophagus

- First rib to the oesophageal hiatus
- Runs in the mediastinum between the lungs
- Passes over the base of the heart
- Crosses the right side of the aortic arch
- Runs dorsal to the tracheal bifurcation
- Runs caudally in the mediastinum ventral to the aorta

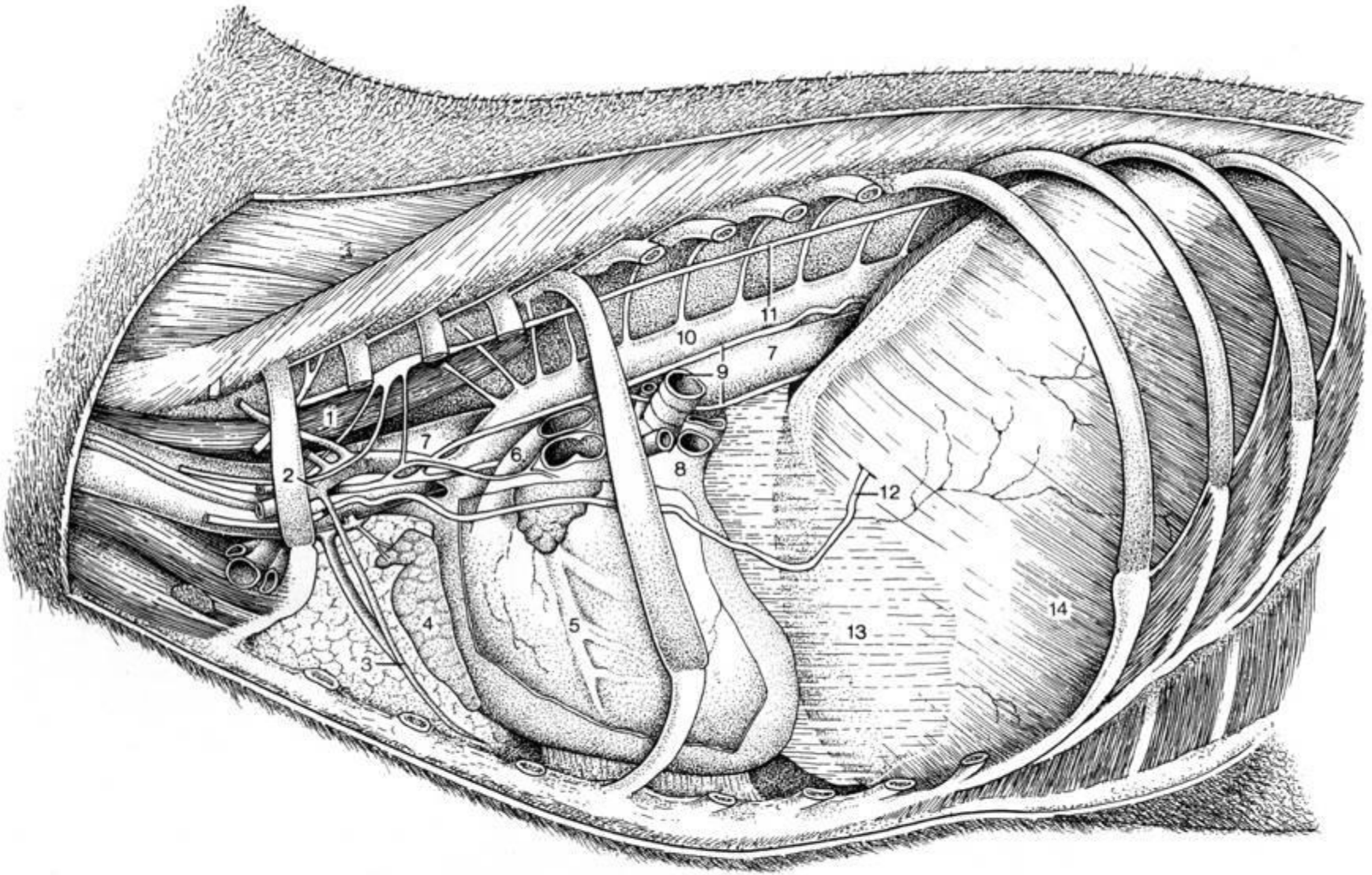


Figure 13–9. Left lateral view of the canine thoracic cavity; the lung and much of the pericardium have been removed.

1, Longus colli; 2, left subclavian artery; 3, internal thoracic vessels; 4, thymus; 5, vessels in paraconal interventricular groove; 6, pulmonary trunk; 7, esophagus; 8, pulmonary veins entering left atrium; 9, left principal bronchus and dorsal and ventral vagal trunks; 10, aorta; 11, sympathetic trunk; 12, phrenic nerve; 13, caudal mediastinum; 14, diaphragm.

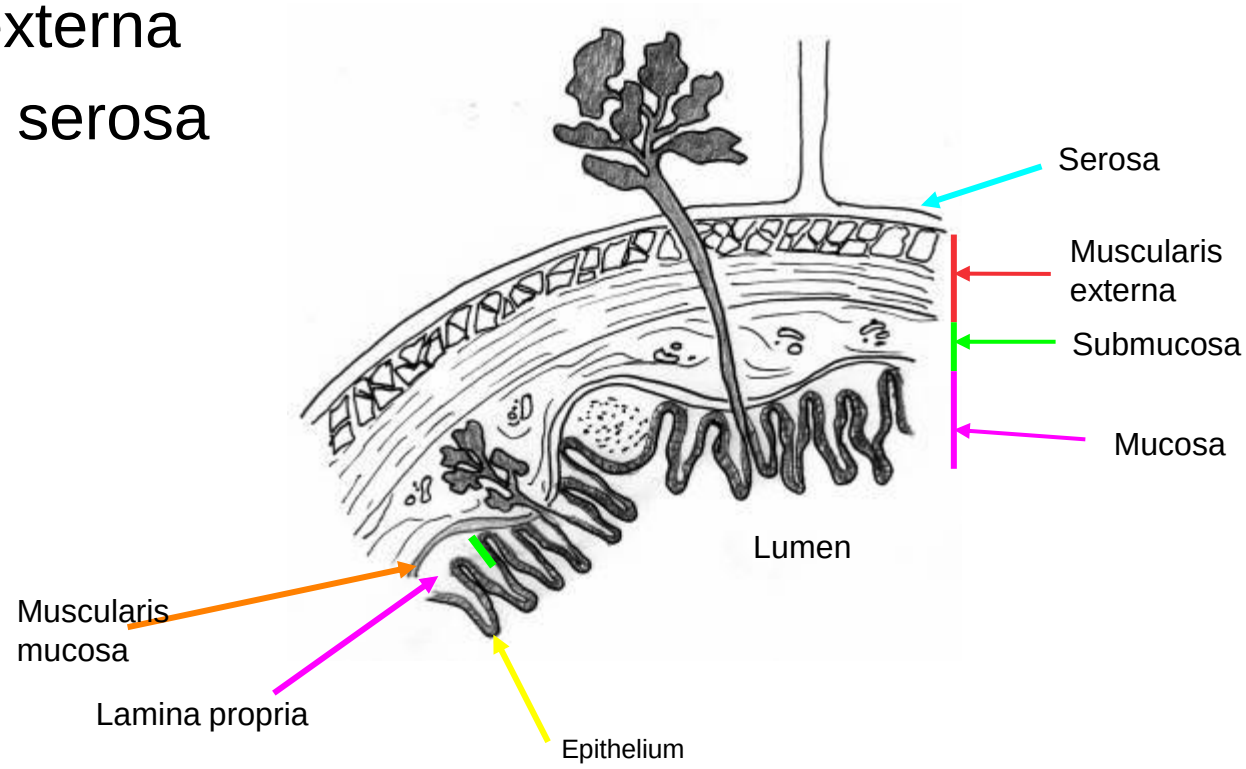
Barium contrast esophogram, right lateral view. Oesophagus pressed dorsally by mediastinal mass (lymph node).

Abdominal oesophagus

- Very short
- Ventral surface indents the dorsal border of the liver
- Joins the stomach dorsally at the cardia
- Well developed cardiac sphincter in the horse – vomiting very rare

Oesophagus - structure

- Four main layers
  - Mucosa
  - Submucosa
  - Muscularis externa
  - Adventitia or serosa



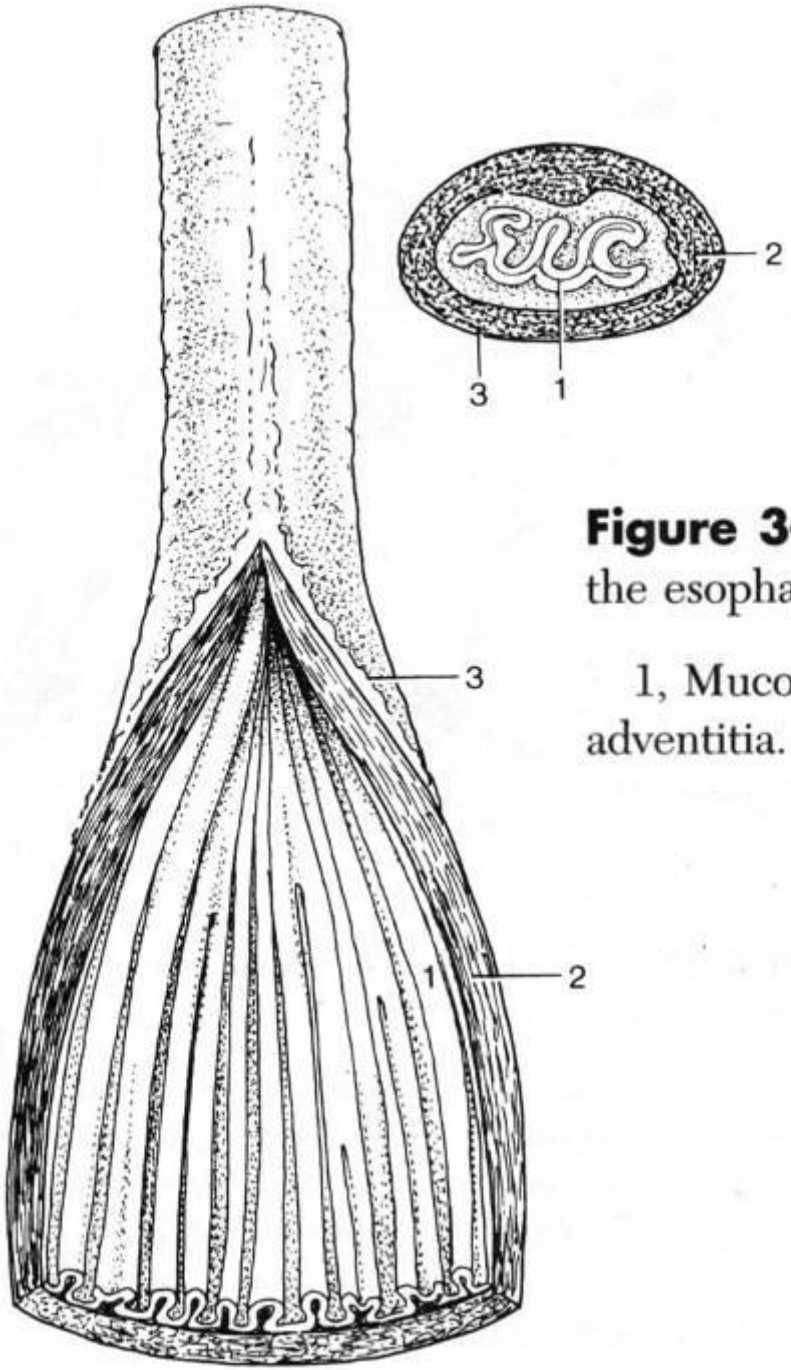


Figure 3–30. Semischematic drawing of the structure of the esophagus, sectioned longitudinally and transversely.

1, Mucosa; 2, muscular layer (longitudinal and circular); 3, adventitia.

Textbook of Veterinary Anatomy; Dyce, Sack and Wensing

Oesophagus - Muscularis externa

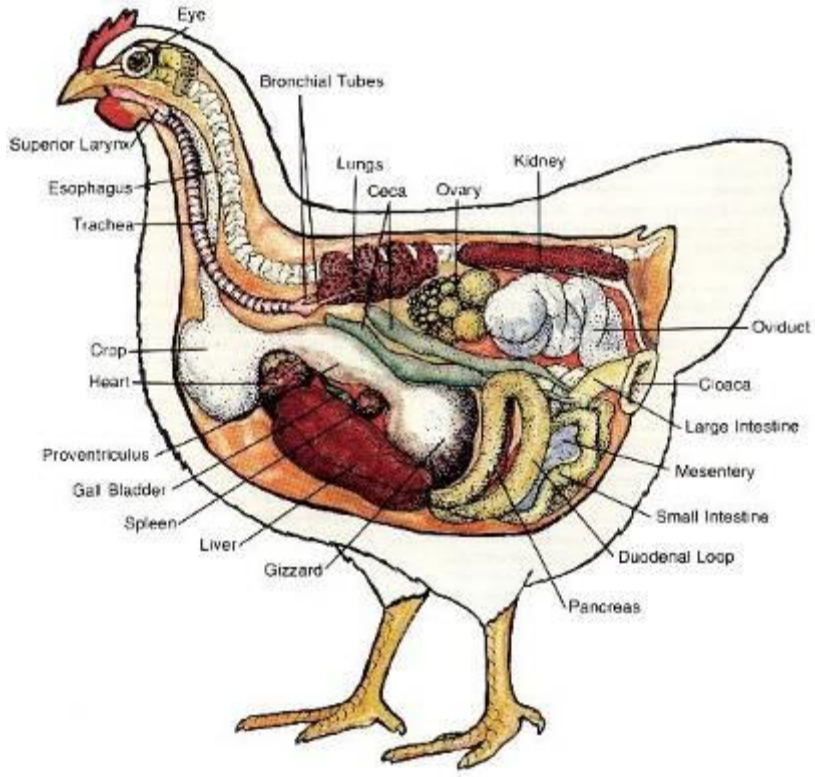
- Species variation
  - Pig, horse, cat
    - Cranially striated muscle, caudally smooth muscle
  - Dog, ruminant
    - Entirely striated muscle
- Functional cranial and caudal sphincters

Oesophagus

- Blood Supply
  - Branches of the -
    - Common carotid a.
    - Bronchoesophageal a.
    - Left gastric aa.
- Nerve Supply
  - Branches of the vagus and sympathetic nerves

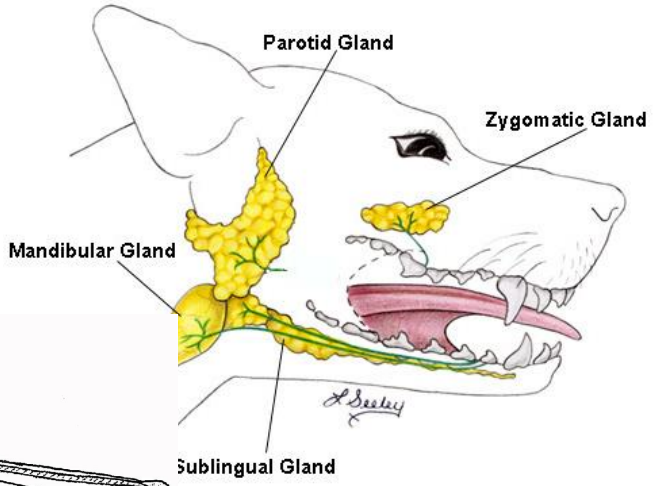
Birds

- Oesophagus on right side of neck in cervical region.
- *crop* - saccular diverticulum of oesophagus cranial to thoracic inlet.

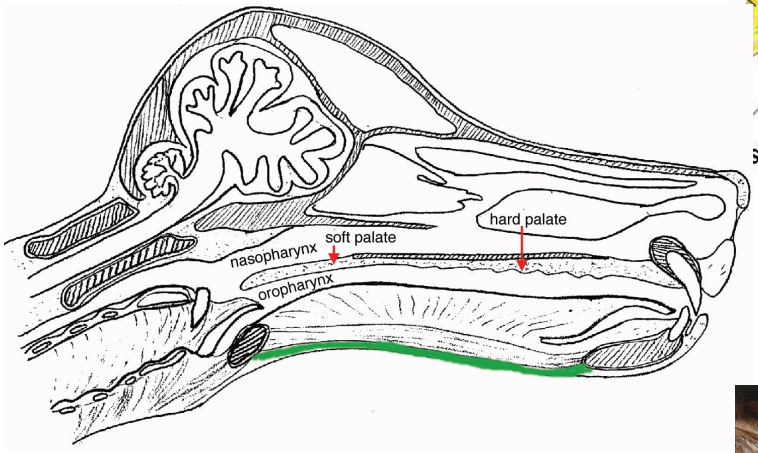


Summary

- Salivary glands



- Pharynx
- Deglutition



Sagittal section of dog's head

- Oesophagus