
In the name of Allah

طوطی سانان

Psittaciformes[1,2]

گنجشک سانان

Passeriformes[3-5]

باز سانان

Falconiformes[6]

ماکیان

Galliformes[7,8]

کبوتر سانان

Columbiformes[9-13]

غاز سانان

Anseriformes[14-16]

	 Psittaciformes[1,2]	 Passeriformes[3-5]	 Falconiformes[6]	 Galliformes[7,8]	 Columbiformes[9-13]	 Anseriformes[14-16]
Longevity Weight range	50–80 yrs (Macaws) 50 g (Budgie) - 1–1.5 kg (Scarlet Macaw)	5 yrs (Zebra Finch) - 44 yrs+ (Raven) 10 g (Zebra finch) - 1.5 kg (Raven)	10–20 yrs 120 g (Kestrel) - 14 kg (Condor)	Turkeys, Domestic Fowl - up to 10 yrs 1.2 kg (Guinea fowl) - 2.2 kg (Domestic fowl)	20–30 yrs Domestic pigeon 350–500 g (from 50 g–1200 g)	10 (Ducks) - 25 yrs (Swans/geese) 300 g (Pygmy goose) - 13.6 kg (Trumpeter swan)
Skeleton						
Type of Foot	Zygodactyl Vestigial clavicles	Anisodactyl Extra muscle for perching	Anisodactyl (osprey - semi-zygodactyl) Carpal ossicle within Lig. Propatagiale Ossified flexor tendons in some species Fused notarium	Anisodactyl Spurs often present V shaped furcula Notched sternum Heavily muscled legs Fused notarium	Anisodactyl Fused notarium	Anisodactyl/palmate Sigmoid neck Short femurs & metatarsus Long tibiotarsus Separate thoracic vertebrae
Cardiovascular						
		Highest BMR and temperature of all Largest heart for size		Well defined sinus venosus Turkey has highest BP of all	Vascular plexus on neck (*plexus venosus intracutaneus collaris*)	Lymph nodes Heat loss through legs and webbed feet
Respiratory						
Syrinx Sinuses Airsacs	Simple syrinx Right/left nasal sinus communication Well-developed infraorbital sinus	Well-developed complex syrinx No communication right/left sinus 7 airsacs (Cranial thoracics fused with clavicular)	Poorly developed syrinx	Simple syrinx 9 airsacs (except turkey with 7)		Syringeal bulla in male ducks Salt glands present Long trachea coiled in sternum (Trumpeter swan)
Digestion						
Type of Diet Cere	Omnivorous, granivorous Cere present, often feathered	Omnivorous, insectivorous, granivorous Cere absent	Carnivorous (piscivorous) Cere present	Omnivorous (granivorous) Cere present	Mainly granivores (some frugivores) Cere usually snow white	Mainly herbivorous (some omnivorous) Often fleshy cere

پر آنها را قادر می سازد که پرواز کنند

پر چند نوع است:

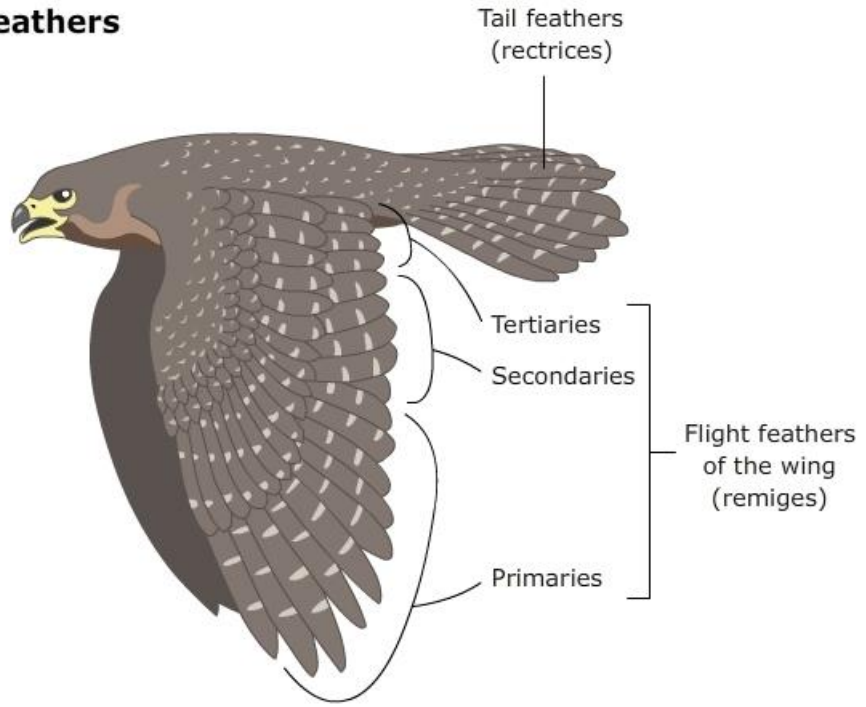
شاه پر (پرهای پروازی) (Flight feathers or Remiges) : که در ناحیه دم و بال می توانیم آنها را ببینیم .

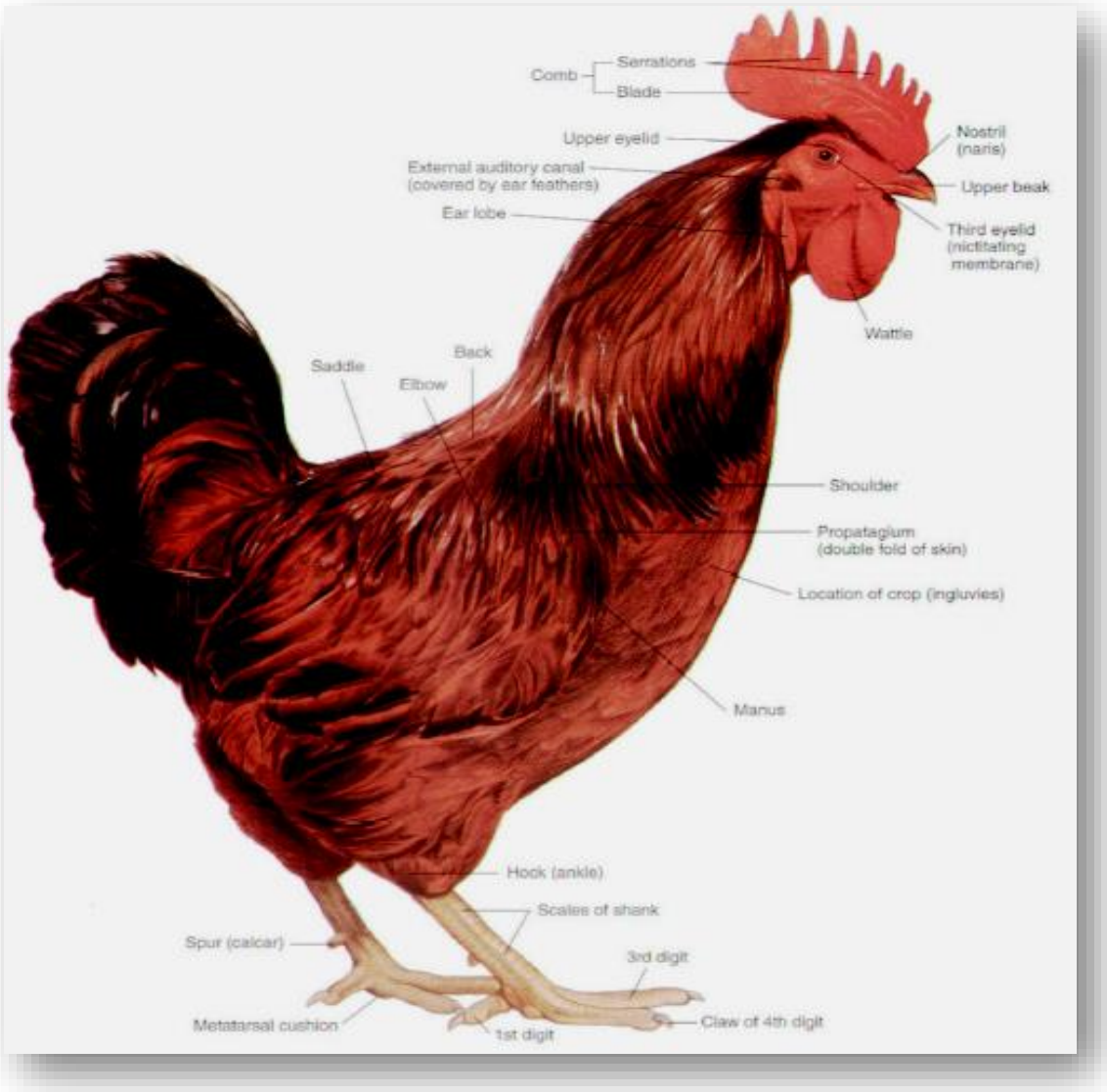
پوش پر (پرهای کوچك و انبوه) (Coverts or Tectrices): پرهایی هستند که بدن پرنده را می پوشانند

موپر (Down feathers) : پرهای خیلی ضعیفی هستند و زیر پوش پرها قرار می گیرند .

خارپر (Spine Feather): در کنار منقار قرار می گیرند .

Flight feathers



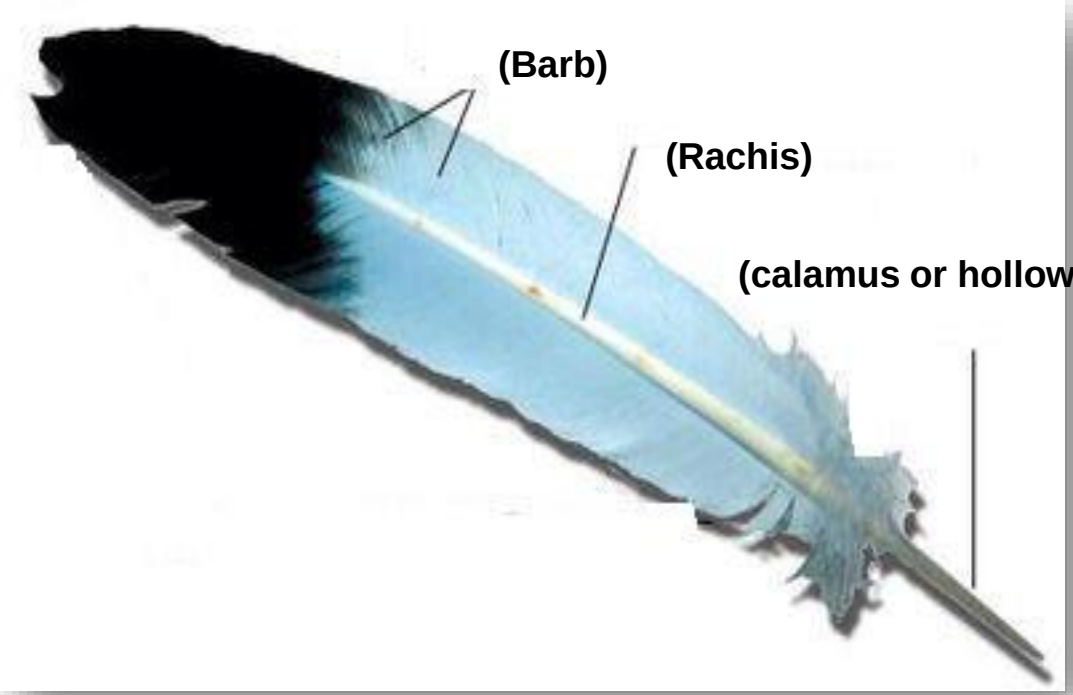


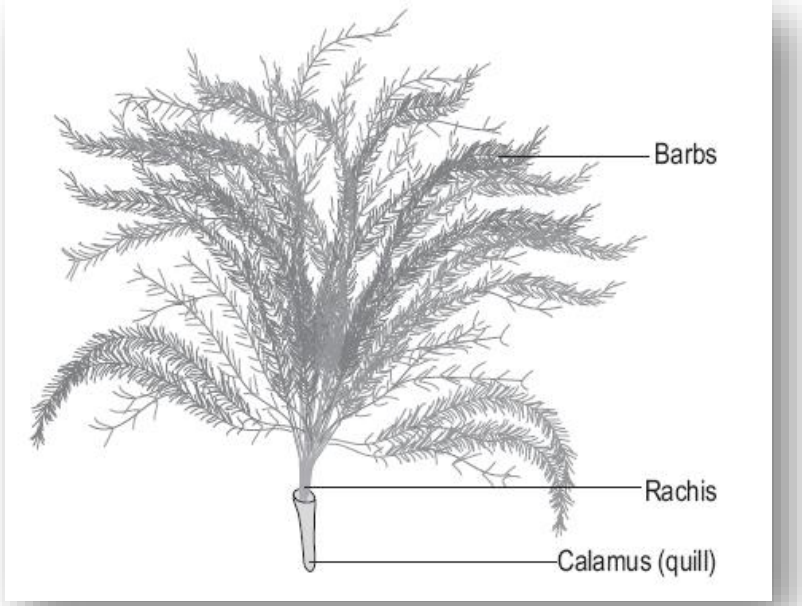
هر پر از چند بخش ساخته شده است:

دم پر(calamus or hollow shaft)

رگ پر(Rachis)

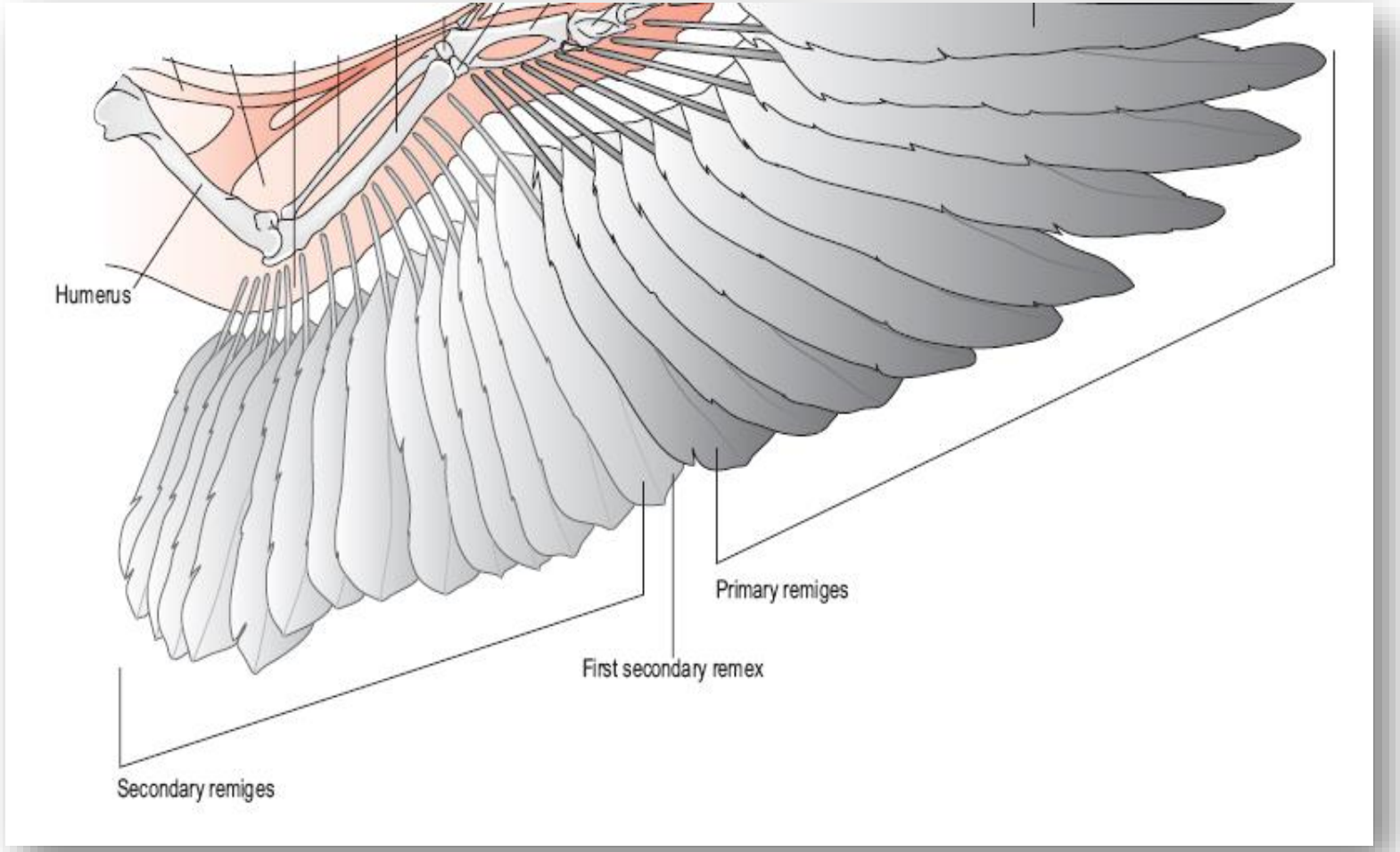
رشته های ظریف روی رگ پرها >>>>> ریش پر(Barb)





مو پر

شاه پرهای ناحیه بال دو نوع اولیه و ثانویه دارند. اولیه 10 عدد و ثانویه 10 تا 20 عدد می باشند.



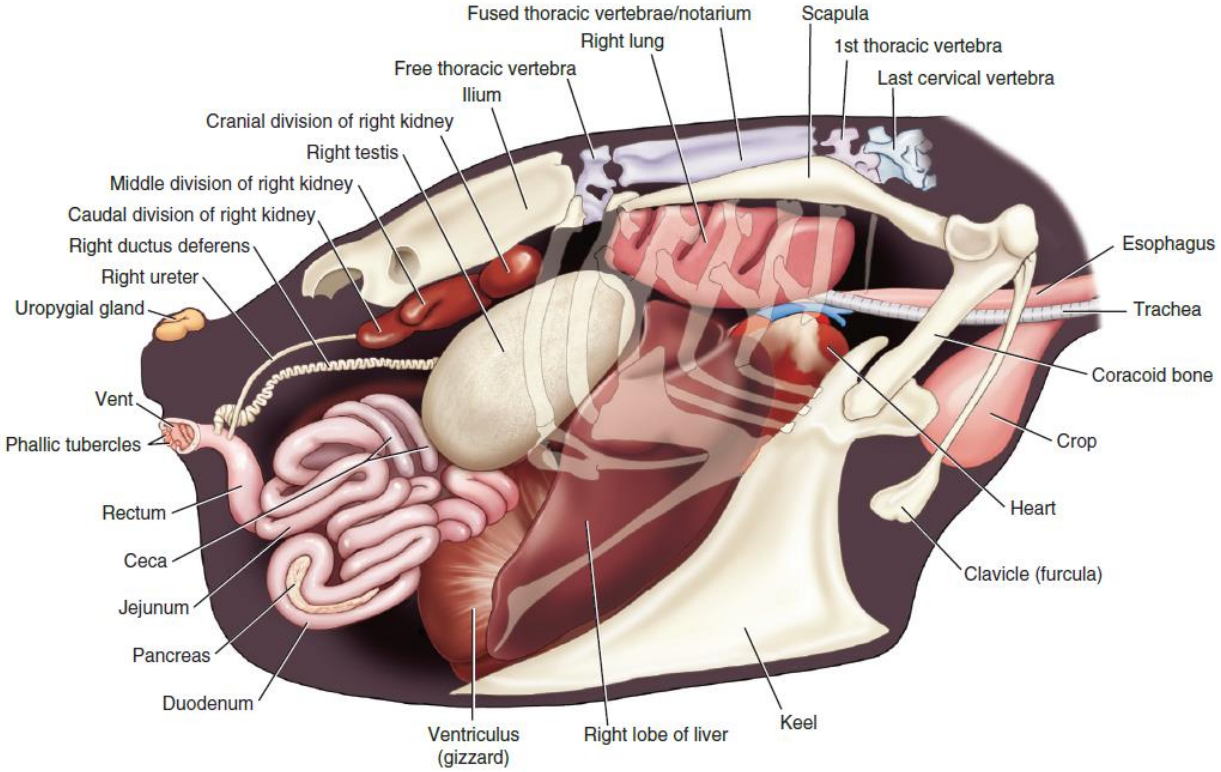
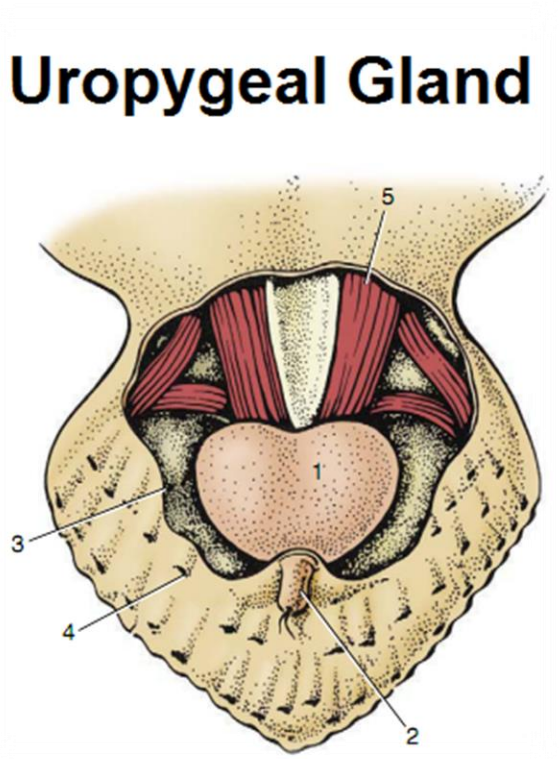


FIG. 6-6 Right view of the avian thoracic and abdominal cavities and pelvis—Male.



Uropygial gland

It lies deep to the epidermis on the dorsal midline at the base of the tail, dorsal to the levator (elevating) muscles of the tail. The uropygial gland(preen gland or the oil gland) is an exocrine gland that produces a diverse range of biochemicals. It has been hypothesized to be involved in chemical protection, water-proofing and maintenance of plumage brightness.

Impacted Uropygial (Preen) Gland

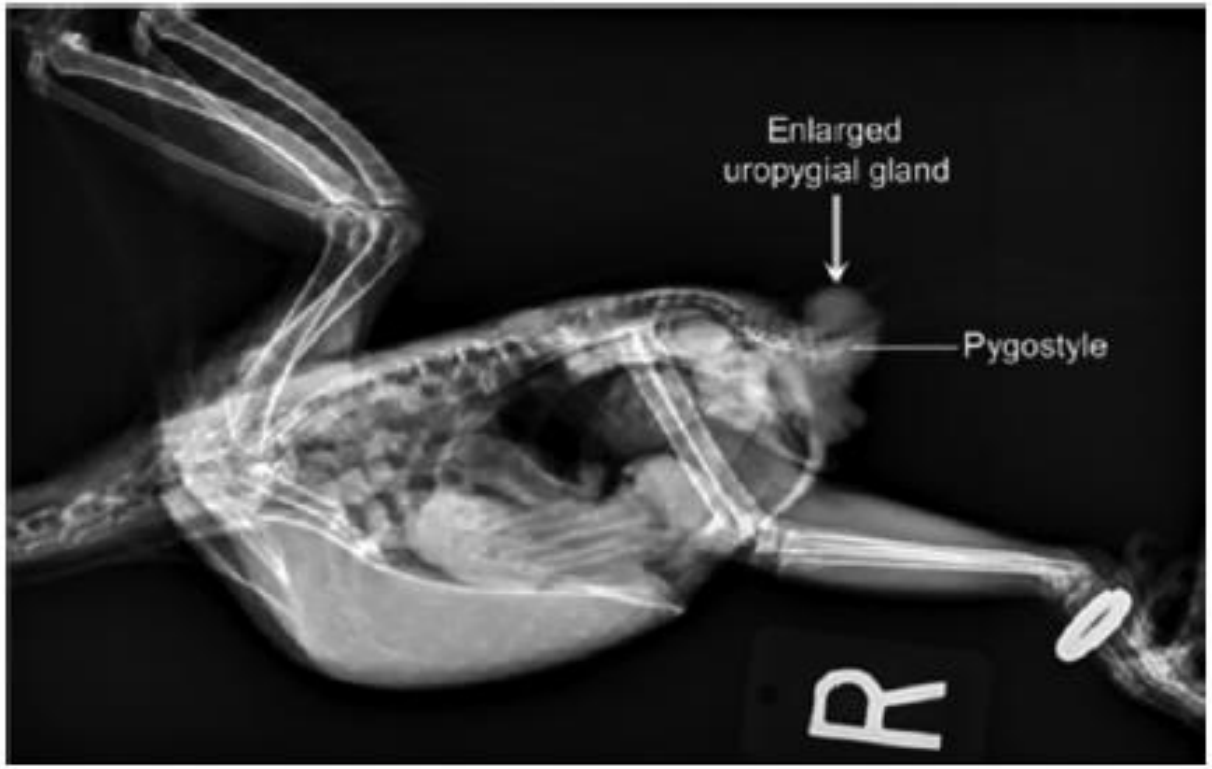
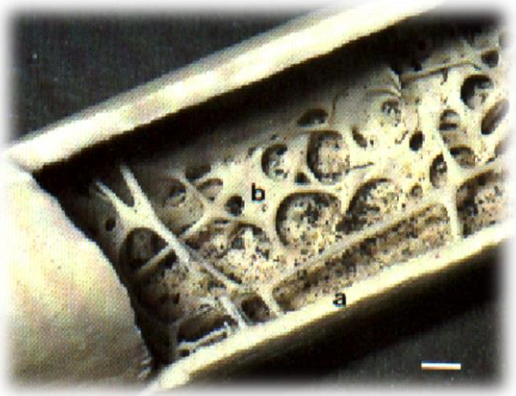


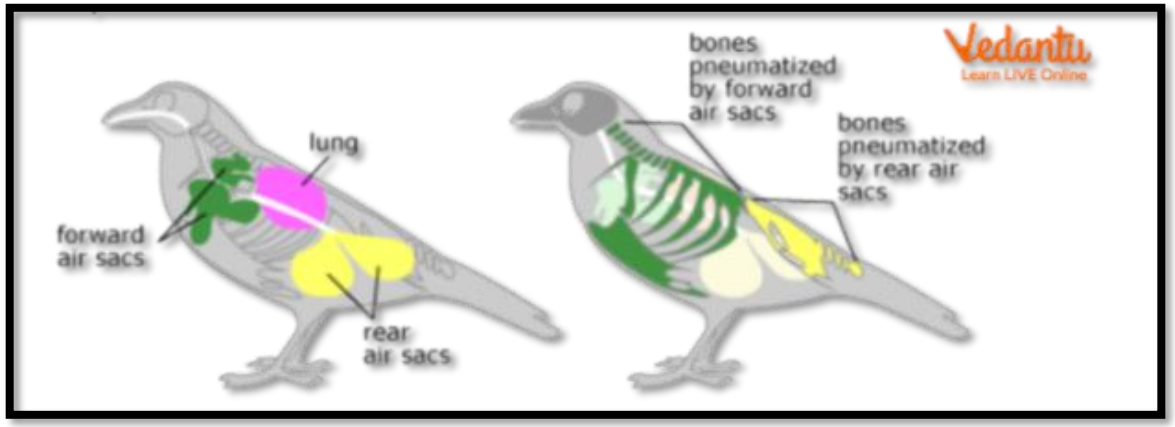
FIG. 28.1-1 Lateral radiograph of the juvenile African gray parrot in this case, showing the grossly enlarged uropygial gland overlying the pygostyle (fused caudal vertebrae) at the base of the tail. Normally, the uropygial gland is not visible radiographically in this species.

•Birds possess **pneumatic bones**, which are hollow and filled with air, contributing to their lightweight skeletons essential for flight. The primary pneumatic bones in birds include ;



• **Skull:** Contains several pneumatic structures that help reduce weight.
•**Humerus :** The upper arm bone, which is crucial for wing movement.
•**Clavicle:** Also known as the wishbone, it plays a role in flight mechanics.
•**Sternum:** The breastbone, which supports the flight muscles.
•**Vertebrae:** Part of the backbone, many vertebrae are pneumatic, aiding in respiratory efficiency.
•**Pelvic girdle:** Some components of the pelvis also exhibit pneumatic characteristics.

While most birds have pneumatic bones, certain species like penguins, ostrich, loons, and puffins typically lack these adaptations as solid bones can enhance their agilities.



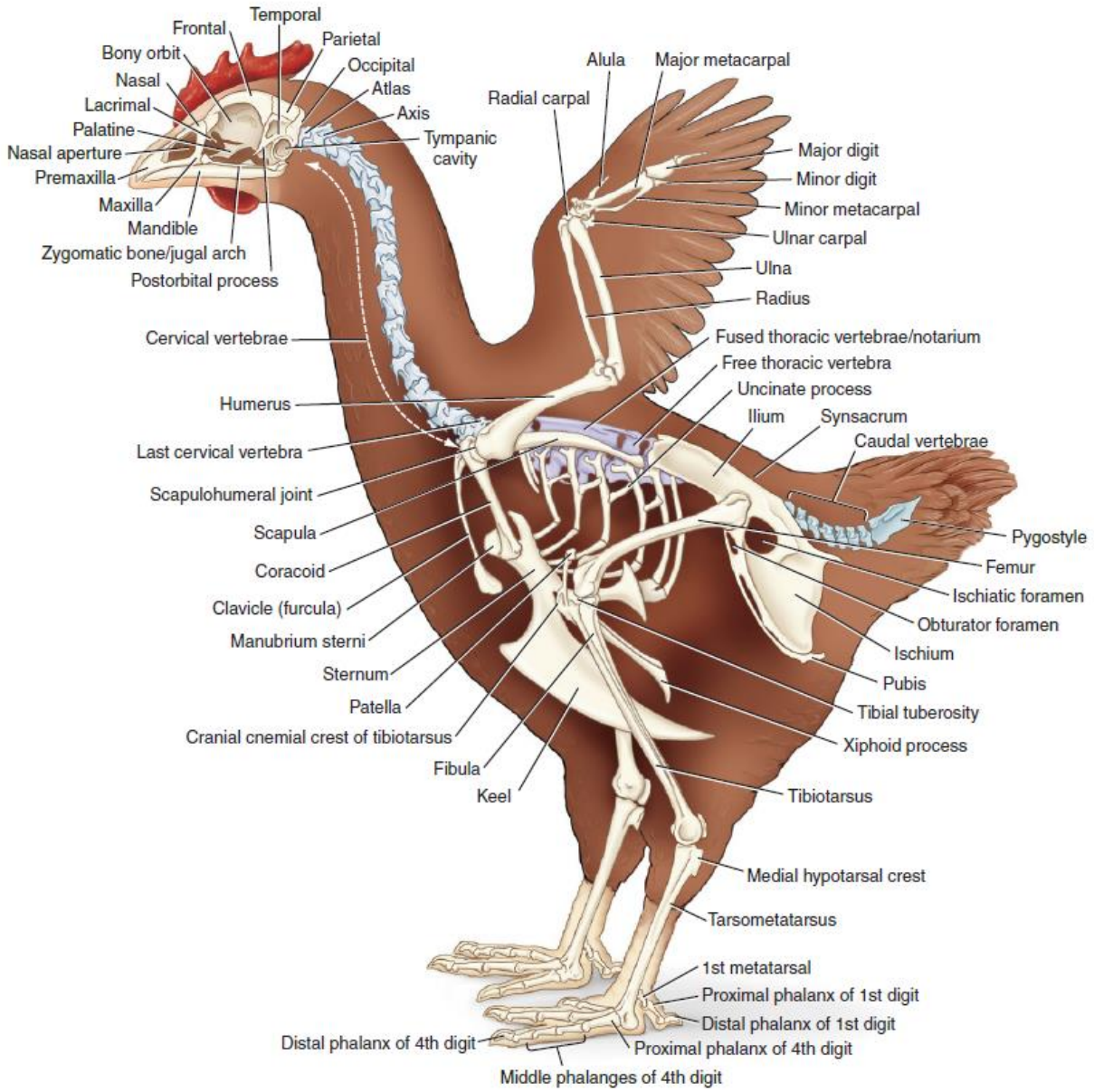


FIG. 6-7 Lateral view of the avian skeleton. Vertebral column formula: $C_{8-25}T_7L/S_1Cd_{4-9}P_1$.

The skull bone is solid and the eye cavity is large. The jaws have turned into a beak and the upper jaw can move in addition to the lower jaw.

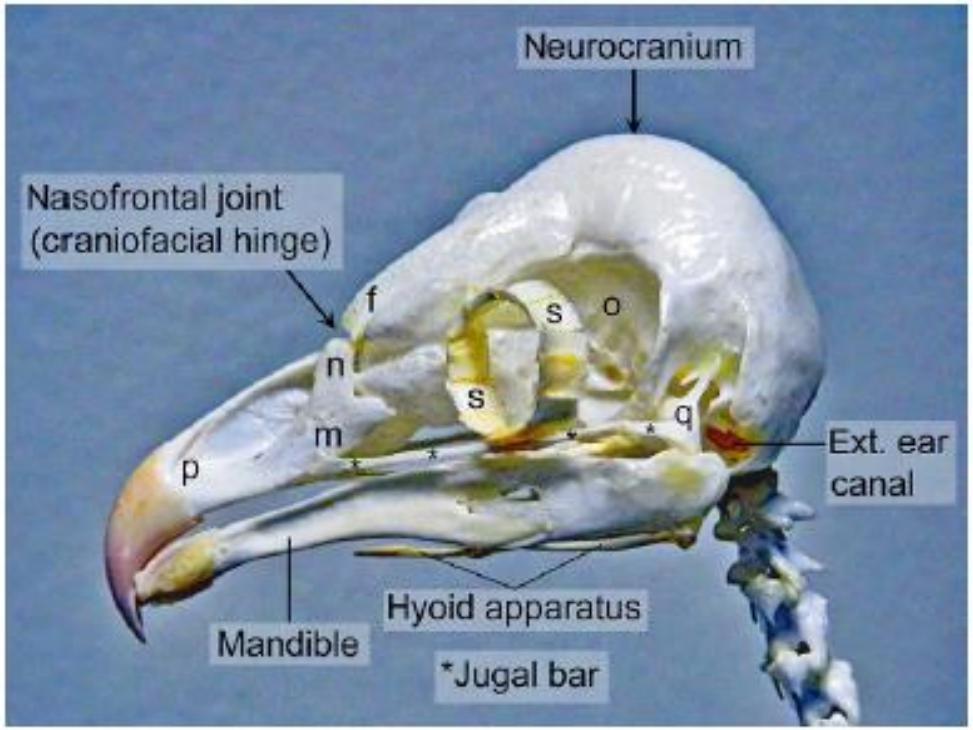
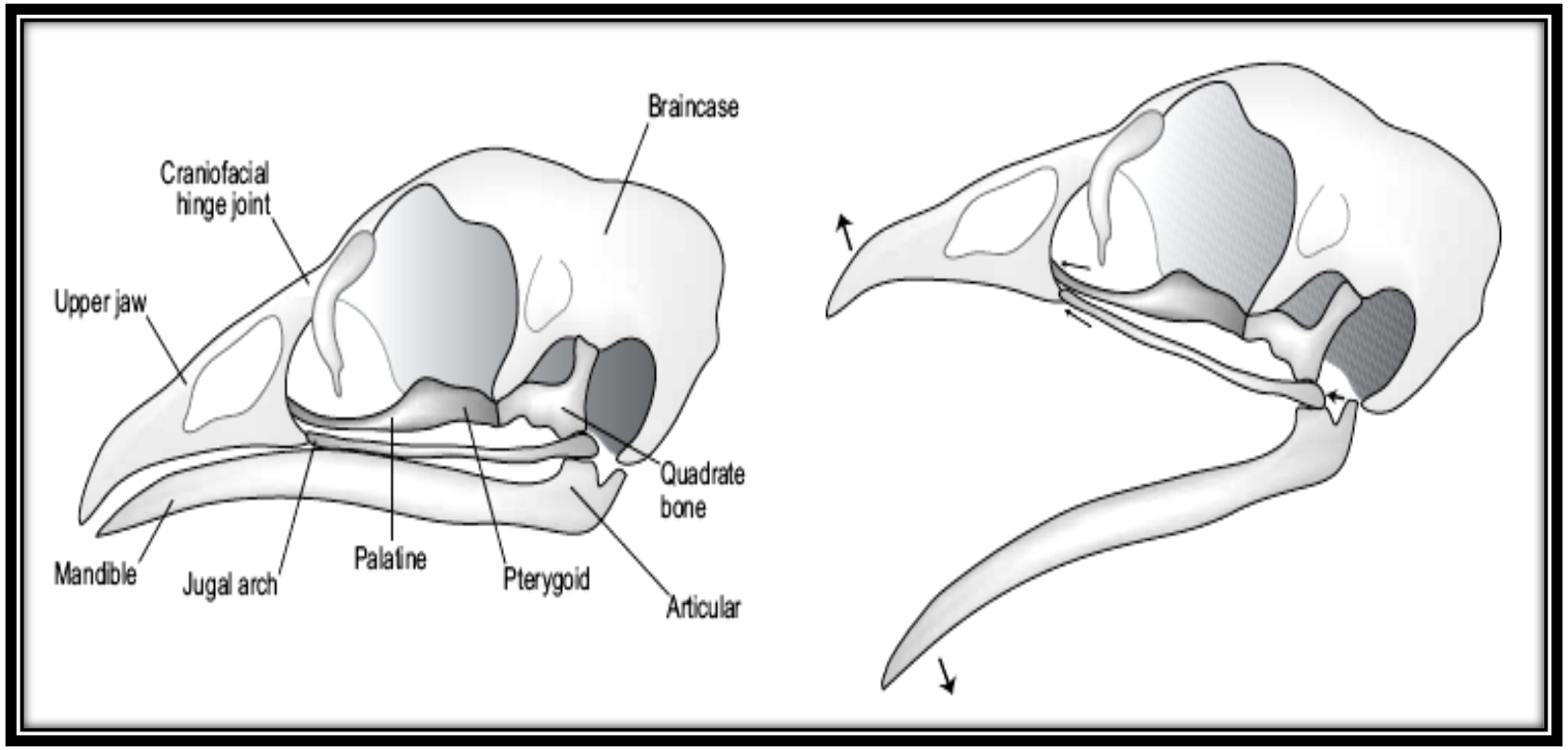


FIG. 25.4-10 Skull of a Barn owl, lateral view. Key: *ext.*, external; *f*, frontal bone; *m*, maxilla; *n*, nasal bone; *o*, bony orbit; *p*, premaxilla; *q*, quadrate bone; *s*, scleral ossicles. The jugal bar is identified by *asterisks*. Parts of the pterygoid and palatine bones are visible deep to the dorsal margin of the mandible and ventromedial to the jugal bar. These structures are better illustrated in Fig. 25.4-12B.

پایین آمدن استخوان فک باعث حرکت چرخشی استخوان مربعی می گردد. این حرکت چرخ دنده ای از دو طریق باعث حرکت منقار بالایی می شود:

1. انتقال حرکت به استخوان رجلی – کامی
2. انتقال حرکت به کمان جوگال

هر دوی این استخوان ها به استخوان ثنایا اتصال دارند و مجموع حرکت آنها باعث حرکت منقار بالا می شود. همچنین وجود مفصل لولایی مابین استخوان های بینی و پیشانی نیز به این حرکت کمک می کند .



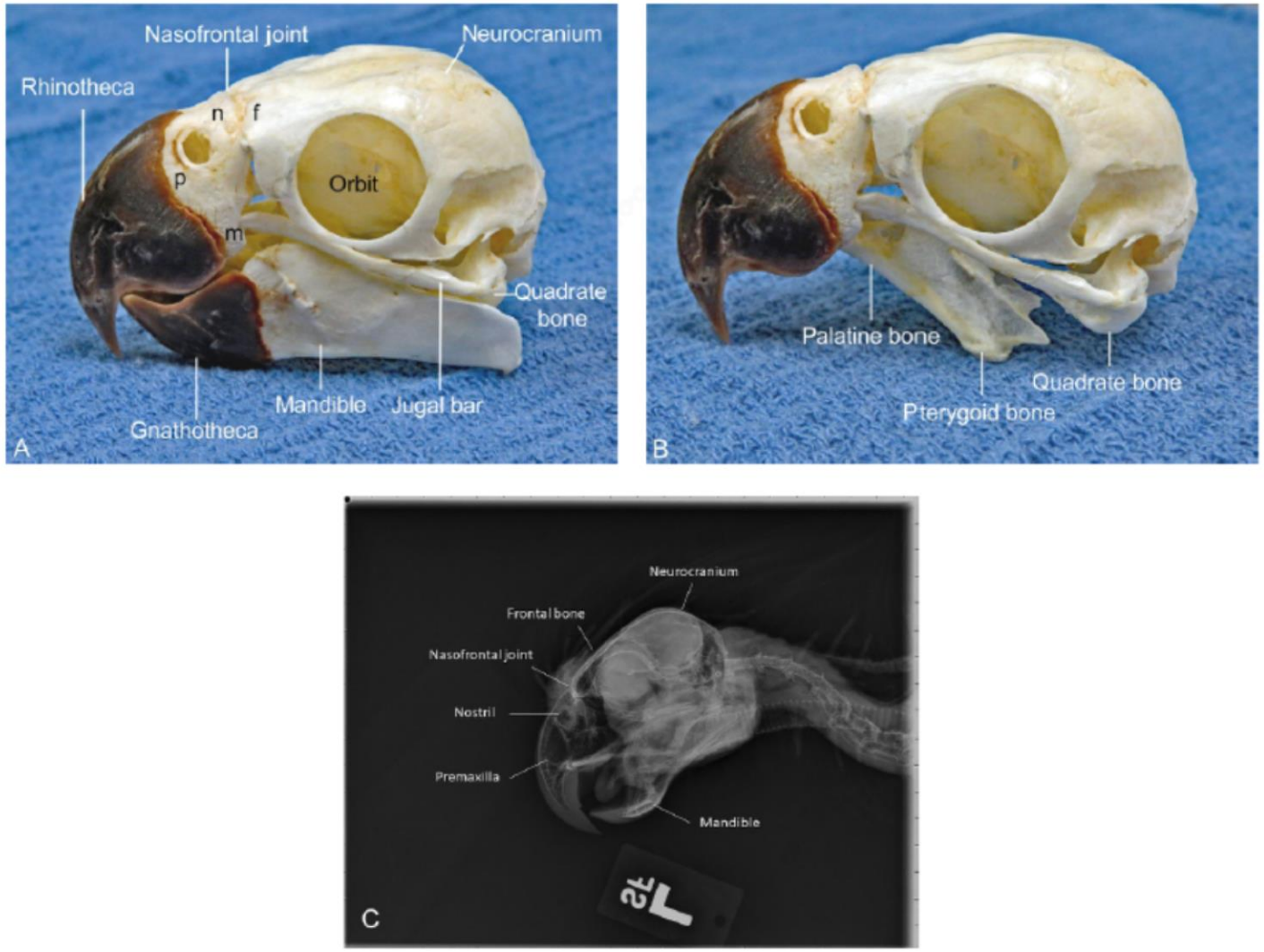


FIG. 25.4-12 Skull of a Sulfur-crested cockatoo. (A) Lateral view. Key: *f*, frontal bone; *m*, maxilla; *n*, nasal bone; *p*, premaxilla. (B) The mandible was removed to show the pterygoid and palatine bones that lie deep to it. The quadrate bone is also better seen in this image. In this preparation, the pterygoid and quadrate bones have been separated at their articulation for better depiction. (C) Lateral radiograph of a Sulfur-crested cockatoo.

Scissor Beak

Beak overgrowths and deformities such as “scissor beak” are relatively common, in pet birds, and can significantly impact the bird’s health, so it is important to evaluate the beak shape during physical examination.

FIG. 25.4-4 Top: A Green-cheeked conure (*Pyrrhura molinae*) with an acquired malocclusion of the beak (“scissor beak”), 4 weeks after sustaining an injury to its gnathotheca in a dog attack. Bottom: The same bird after a corrective beak trim. Note the permanent full thickness defect in the mandible. This bird will require maintenance beak trims for the remainder of its life, but can successfully manipulate food.

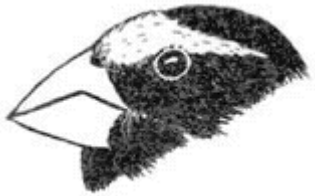
نوشیدن شهد گلها

منقار صافی مانند

برای پاره کردن گوشت

منقار براي فرو کردن در چوب

منقار برای گرفتن ماهی



منقار قوی شکننده دانه

Tearing Beak

Sharp, hooked beaks for cutting and tearing meat

Example - a Wedge-tailed eagle and Peregrine Falcon

Cracking Beak

Cone shaped beaks for cracking

Example - a Finch

Filtering Beak

Comb-like bumps on the beak catch and filter small animals and plants from the water

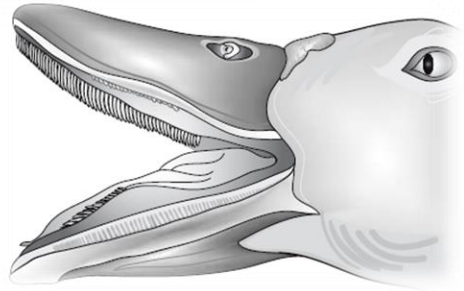
Example - a Pacific Black Duck

Cracking, squishing and pulling beak

Base of beak used to crack seeds

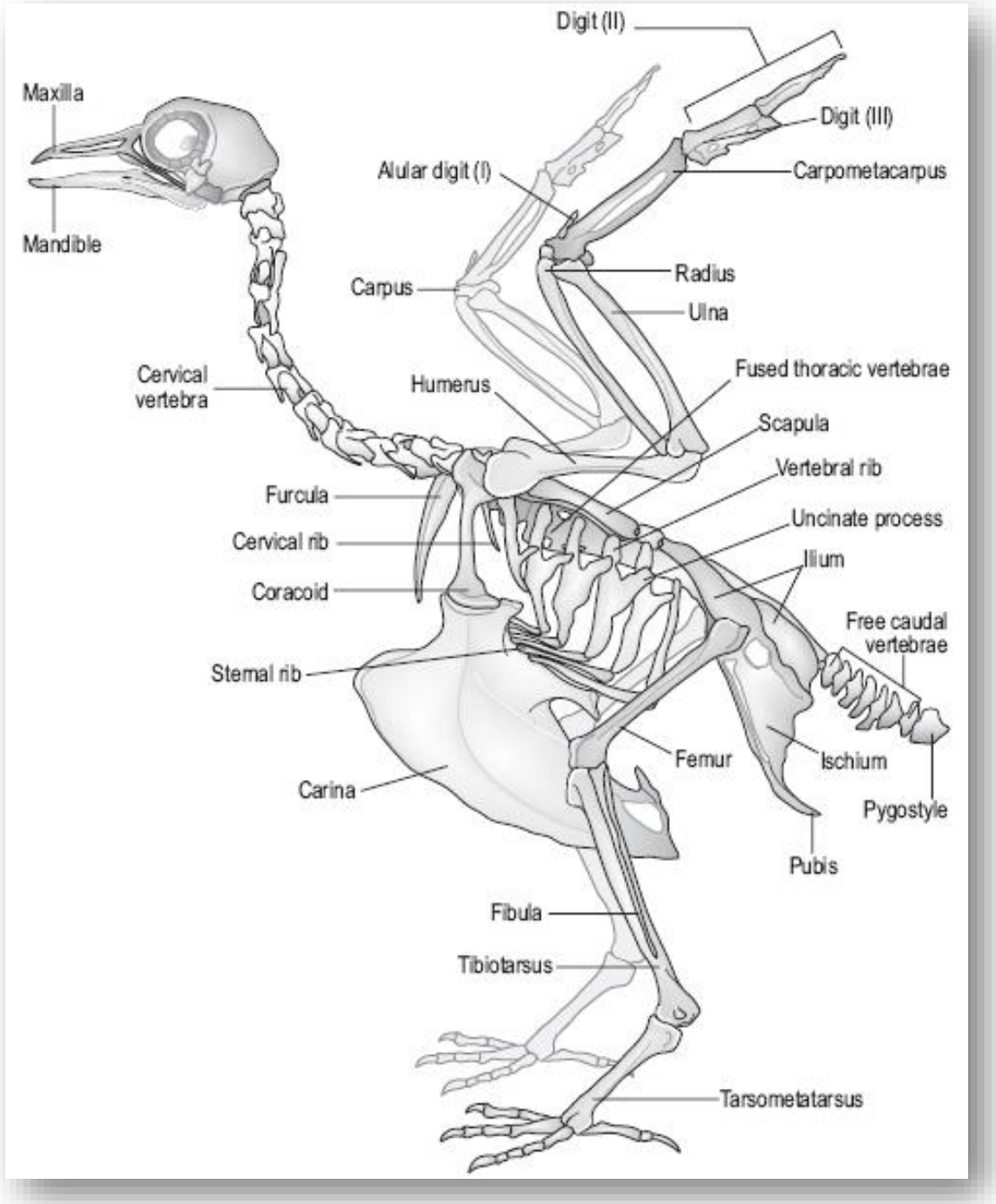
Hook part used to pull apart fruit

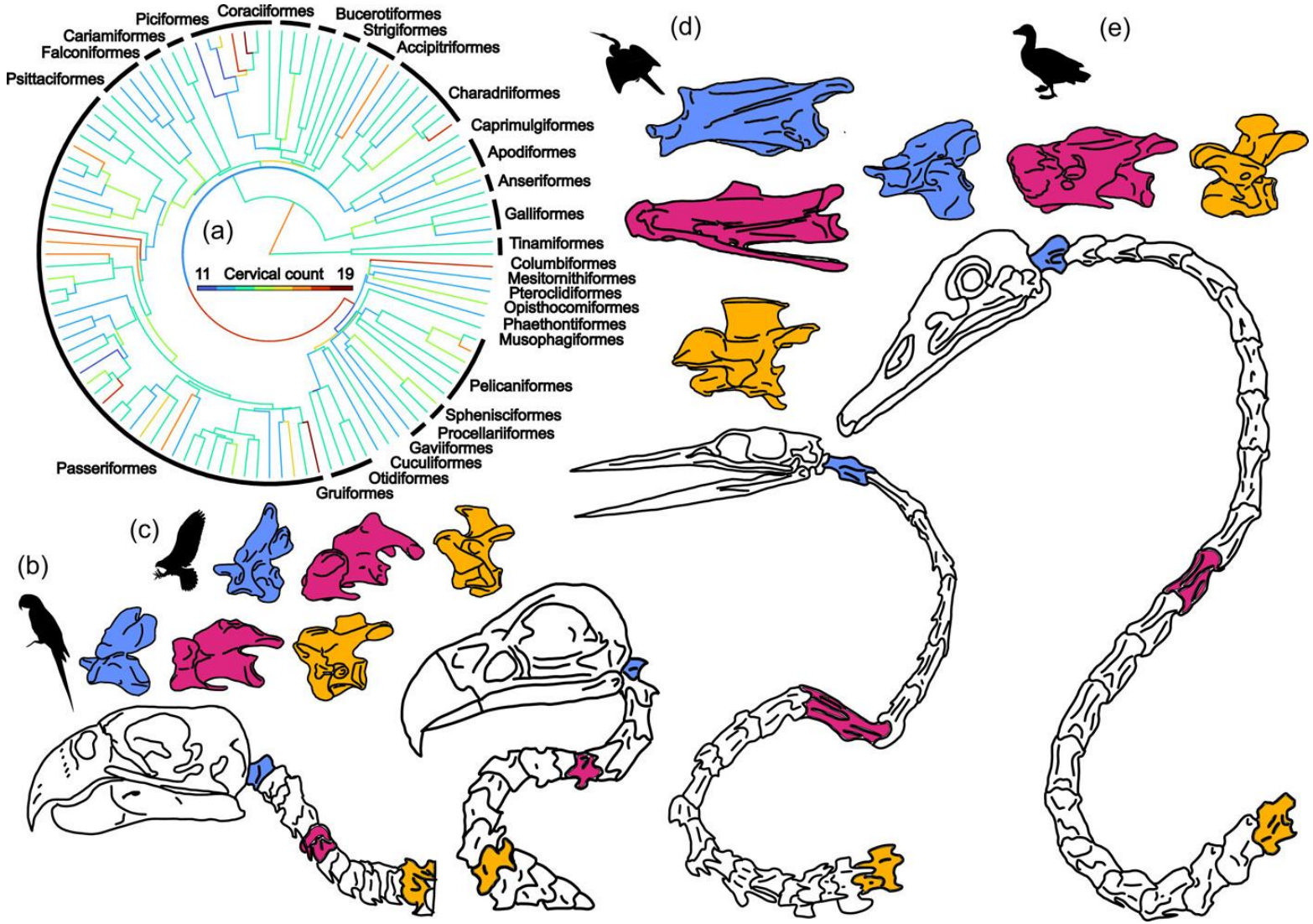
Example - a Cockatoo



Cervical vertebrae, thoracic vertebrae, syn-sacrum, free caudal vertebrae and pygostyle in the avian

Pigeon	12	7	14-15	8	1
Chicken	14-17	7	15-16	5-6	1
Goose	17-18	9	15-16	8	1
Duck	14-15	9	15-16	8	1
love bird	12	8	15-16	8	1
Ostrich	18	9	13	8	1





Strigops habroptilus (b) 9

Pandion haliaetus (c) 13

Anhinga anhinga (d) 19

Anser fabalis (e) 22

CSF FLUID ASPIRATION

The atlanto-occipital (AO) space is generally the only option for the aspiration of CSF fluid because of the fusion of much of the vertebral column; additionally, the free spaces are very narrow, making the AO space the only viable site. The spinal cord terminates as a small extension into the pygostyle after the last spinal nerve has exited.

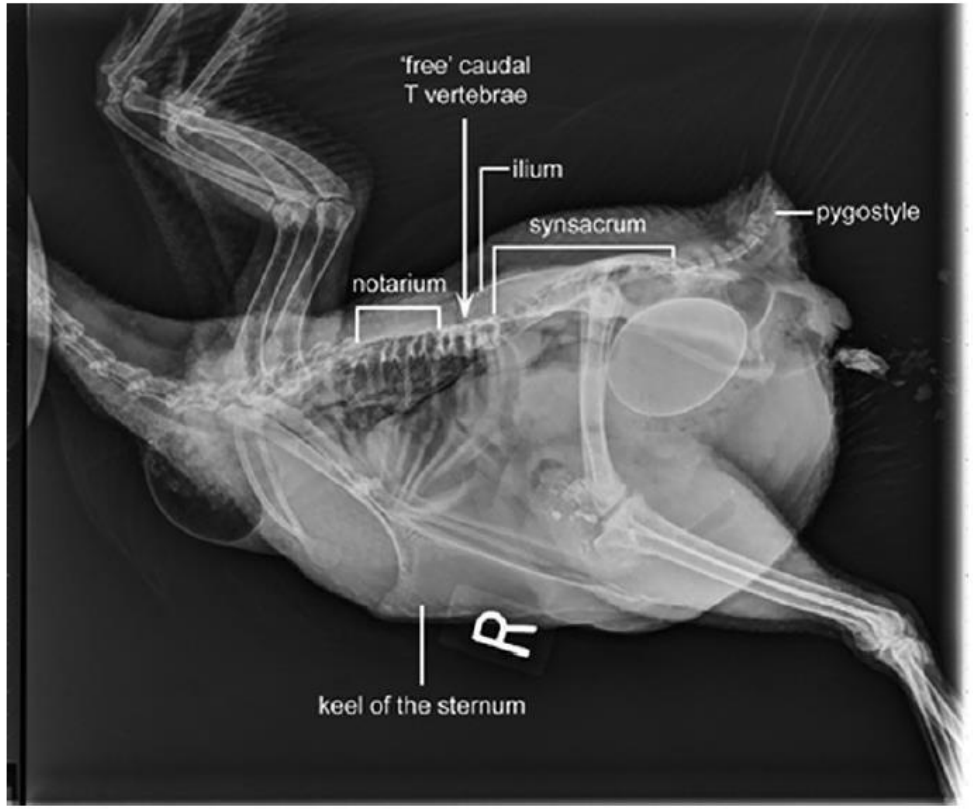
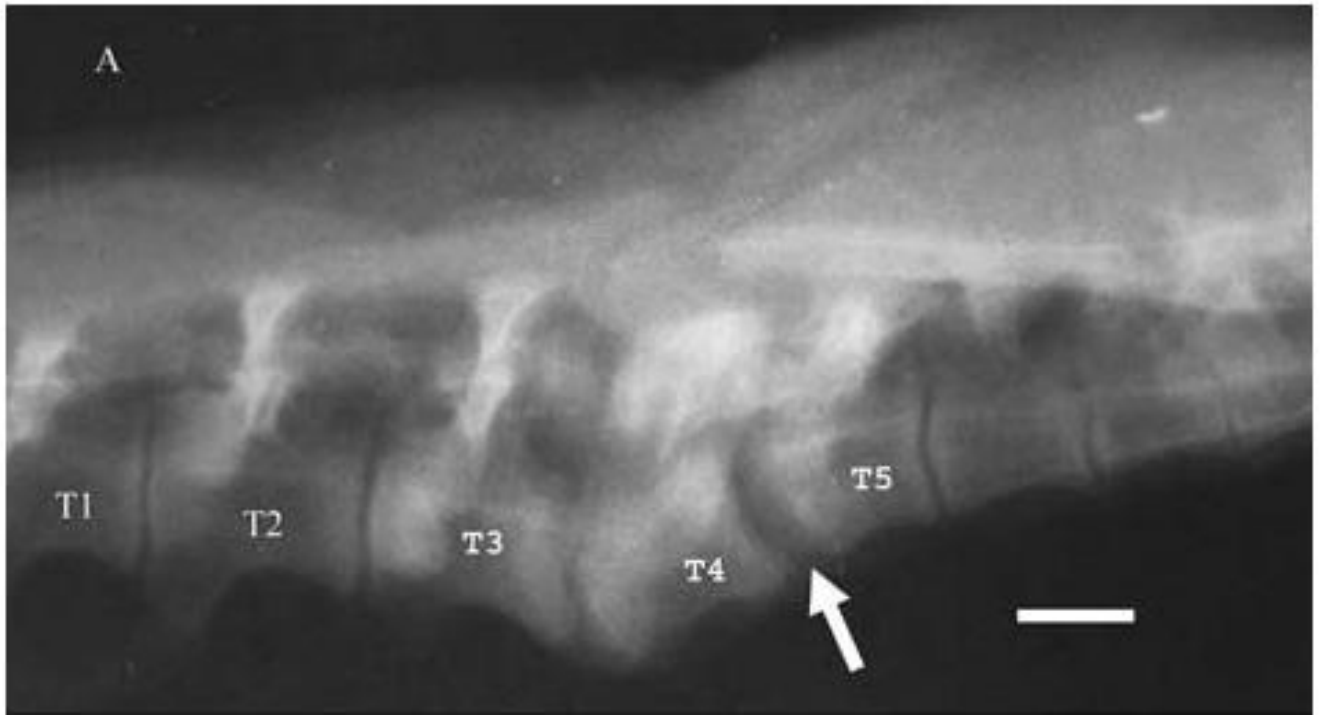


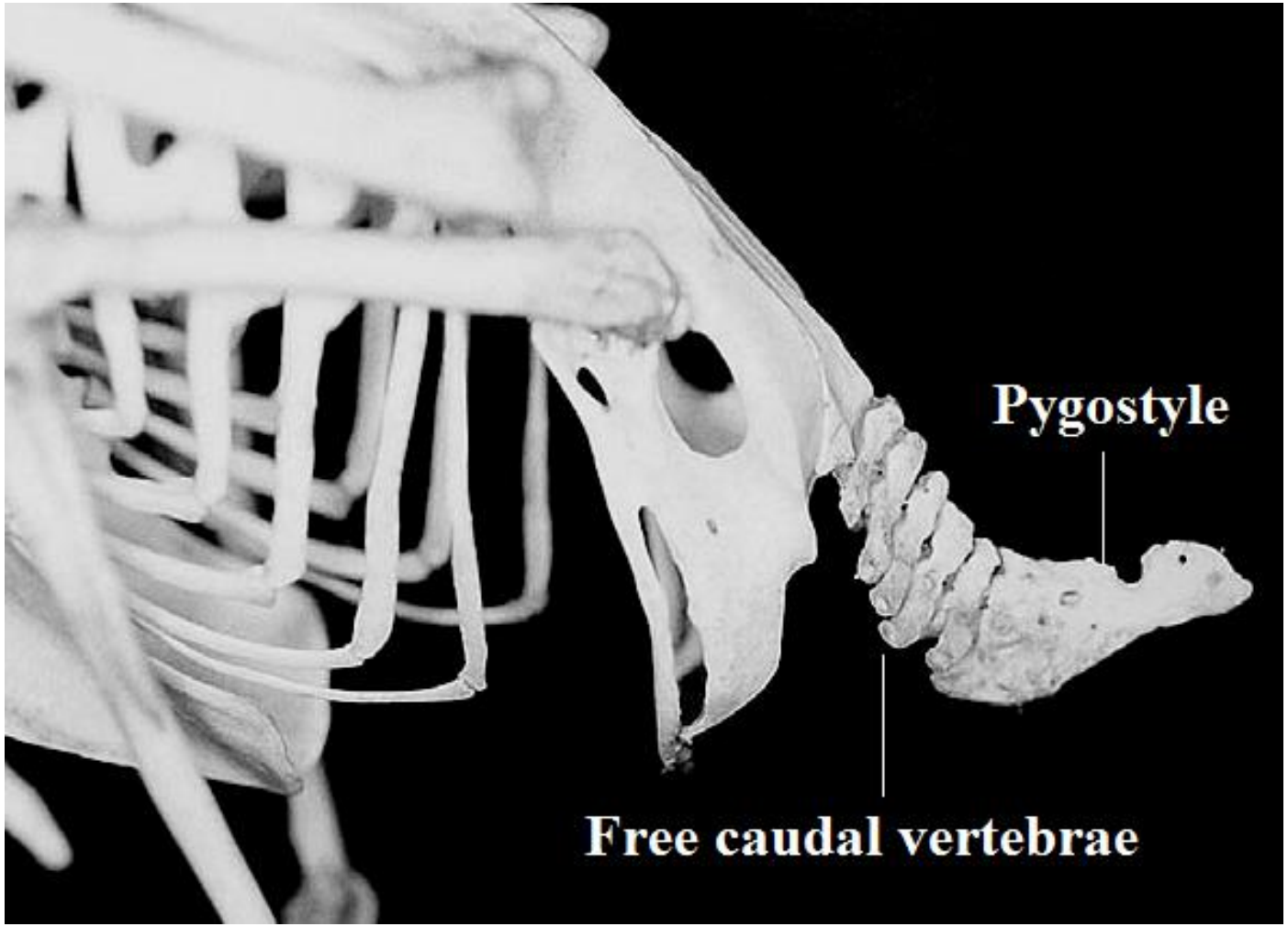
FIG. 27.2-4 Lateral radiograph of a chicken, showing the normal appearance of the notarium, synsacrum, and pygostyle in this species.

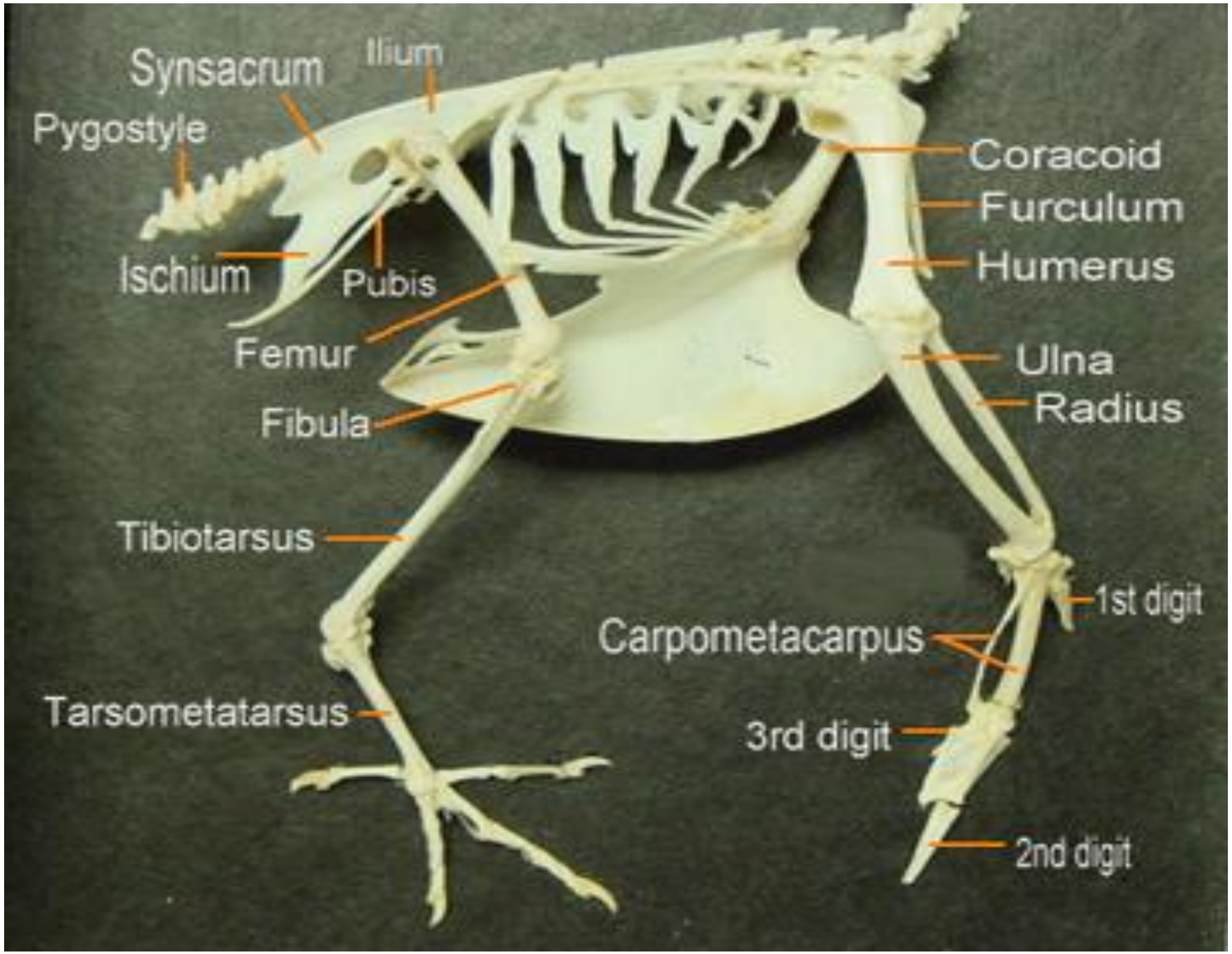
The free thoracic vertebra is the weak point of the vertebral column in poultry, and fractures in this area occur easily. In a condition called **spondylolisthesis or kinky back**, this vertebra becomes loose and slightly deviates from its natural position. Rapid growth rates lead to metabolic disturbances that exacerbate the condition in broilers.

Figure 1. Thirty-nine-day-old broiler chick sitting on its



Spondylolisthesis, lateral radiograph. Vertebral dislocation of the free T4 between not
arium


Pygostyle
Free caudal vertebrae


Synsacrum
Ilium
Pygostyle
Coracoid
Furculum
Humerus
Ischium
Pubis
Femur
Ulna
Radius
Fibula
Tibiotarsus
1st digit
Carpometacarpus
Tarsometatarsus
3rd digit
2nd digit

پرندگان از نقطه نظر پرواز به دو دسته تقسیم می شوند:

1) آنهایی که پرواز را به خوبی انجام می دهند. در ناحیه سینه اي استخواني به نام استخوان Keel (Carina) وجود دارد. در آنهایی که خوب پرواز مي کنند قوس آن بیشتر است. مانند کبوتر

2) آنهایی که خوب پرواز نمی کنند. مانند پنگوئن ، شتر مرغ و مرغ خانگی

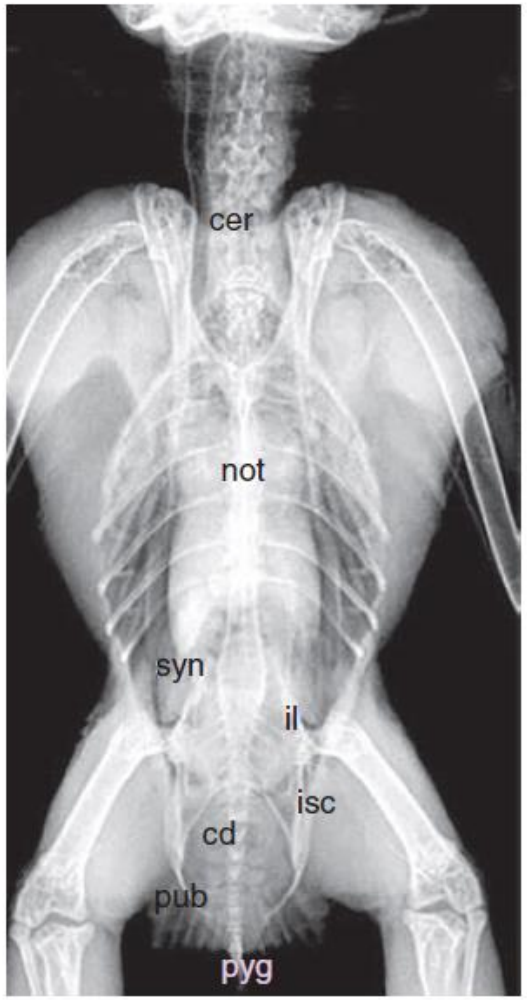


Fig. 2.3. The spine and pelvis: cervical vertebrae (cer), notarium (not), synsacrum (syn), ilium (il), ischium (isc), caudal vertebrae (cd), pubis (pub), pygostyle (pyg).

Key Points of Forelimb Anatomy in Birds

The avian forelimb is highly specialized for flight, with significant adaptations in bone structure, joint mobility, and feather attachment. Despite these modifications, the basic plan remains similar to that of other tetrapods, with homologous regions corresponding to the upper arm, forearm, and hand.

•Shoulder Girdle
- *Scapula*: Long, blade-like bone supporting the shoulder.
- *Coracoid*: Robust bone connecting the scapula and sternum, crucial for bracing the wing during flight.
- *Furcula (Wishbone)*: Fused clavicles providing spring-like action during wing beats.

•Upper Arm
- *Humerus*: The single large bone of the upper wing, pneumatic (hollow) for reduced weight, articulates with the shoulder girdle.
- The humerus is connected to the air-sac system, further reducing weight and aiding respiration.

•Forearm
- *Radius*: Slender, cranially located bone.
- *Ulna*: Larger and caudal to the radius, provides attachment for secondary flight feathers.

•Wrist and Hand
- *Carpals*: Two wrist bones (radiale and ulnare) that articulate with the forearm and hand.
- *Carpometacarpus*: Fusion of some carpals and metacarpals into a single strong structure, supporting the primary flight feathers.
- *Digits (Phalanges)*: Reduced to three digits, with the first digit (alula) supporting a small set of feathers important for slow flight.

Key Adaptations for Flight

•Bone Fusion and Reduction: Many bones are fused (e.g., carpometacarpus, furcula) to provide rigidity and reduce weight.
•Hollow Bones: Major wing bones are pneumatic, making them lightweight yet strong.
•Restricted Joint Movement: Elbow and wrist joints move mainly in one plane, optimizing the wing for efficient flapping.
•Feather Attachments: Primary feathers attach to the hand (carpometacarpus and phalanges), while secondary feathers attach to

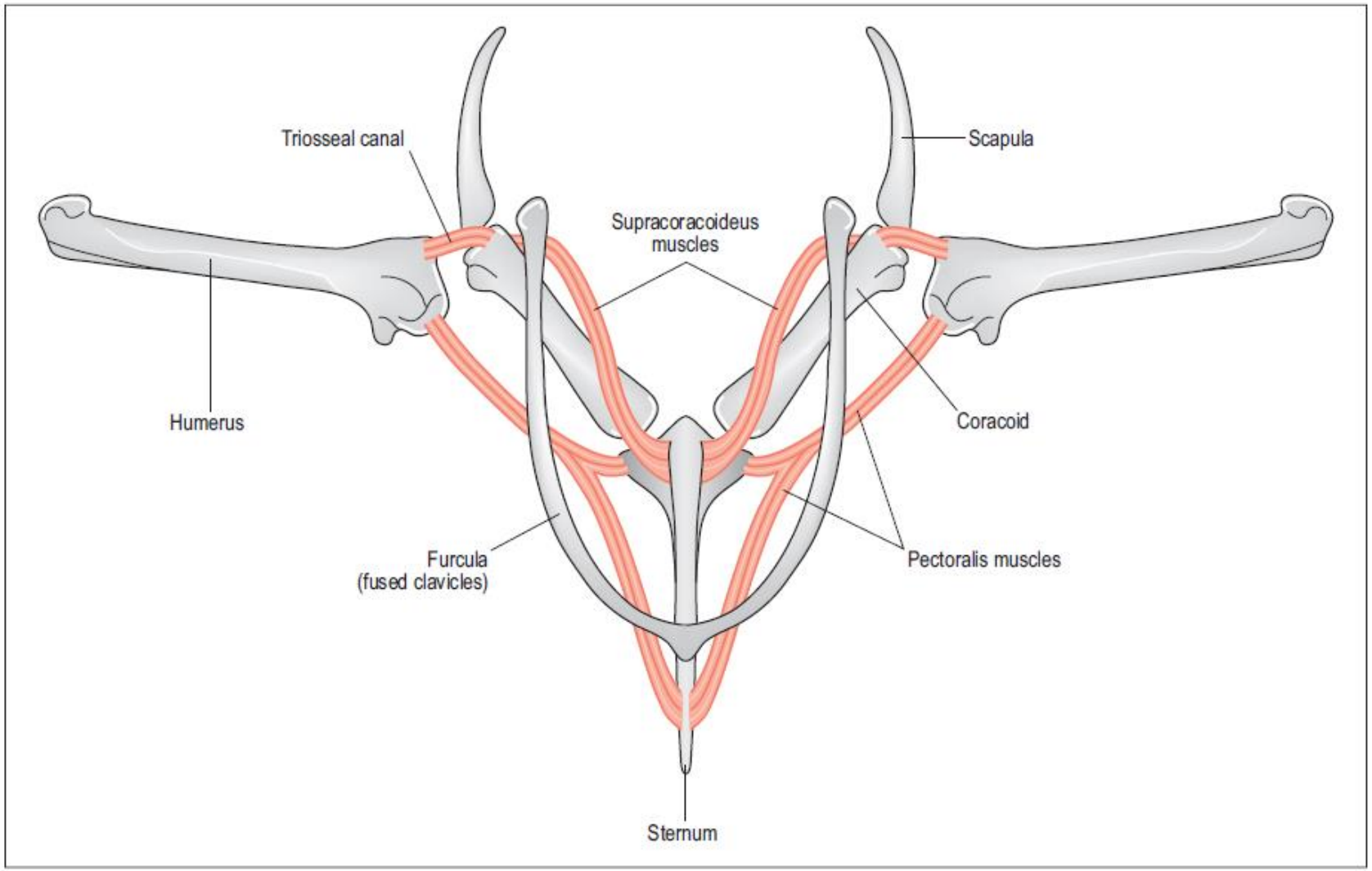


Figure 6.22 • Diagram of pectoral muscles demonstrating how both the supracoracoideus, which elevates the wing, and the pectoralis, which depresses the wing, have ventral origins. This keeps the heavy musculature close to the bird's center of gravity.

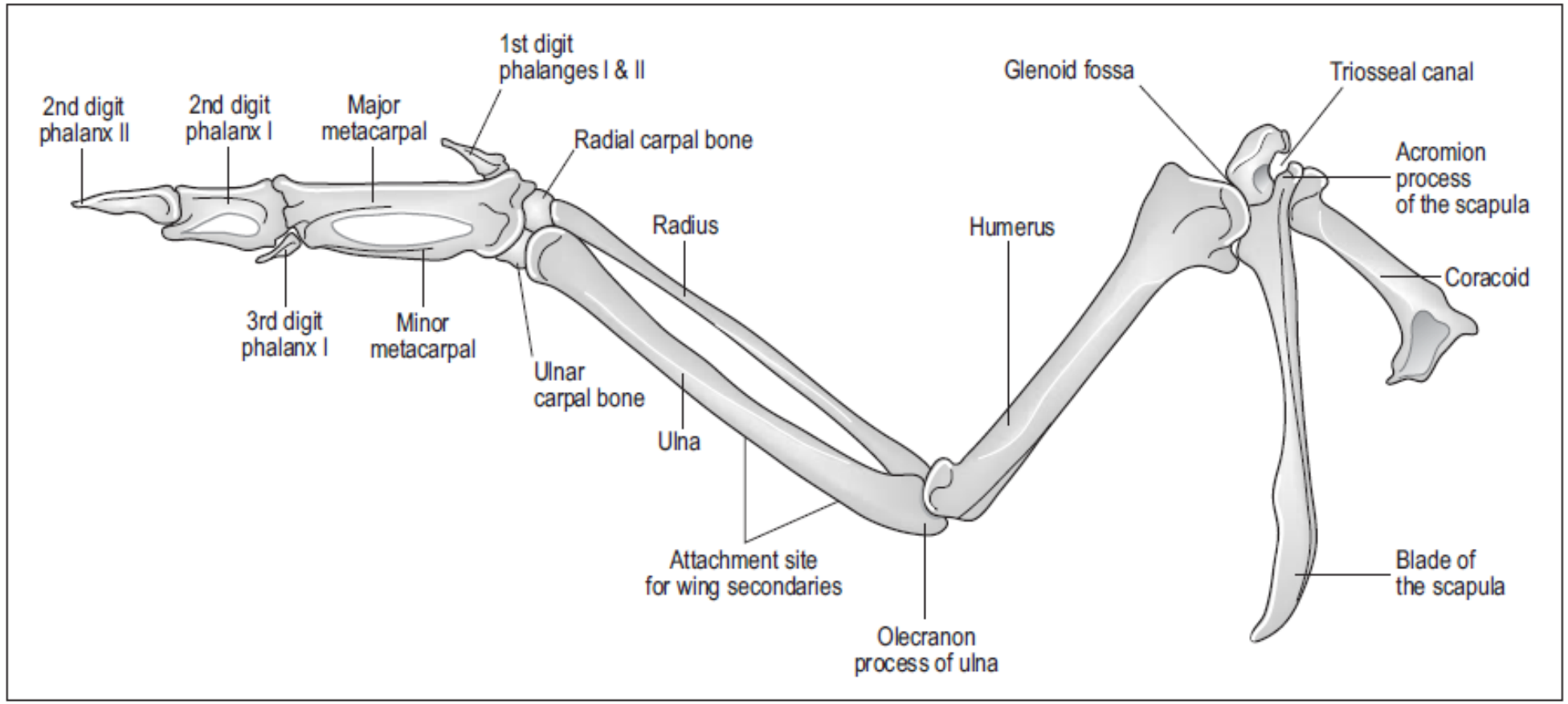
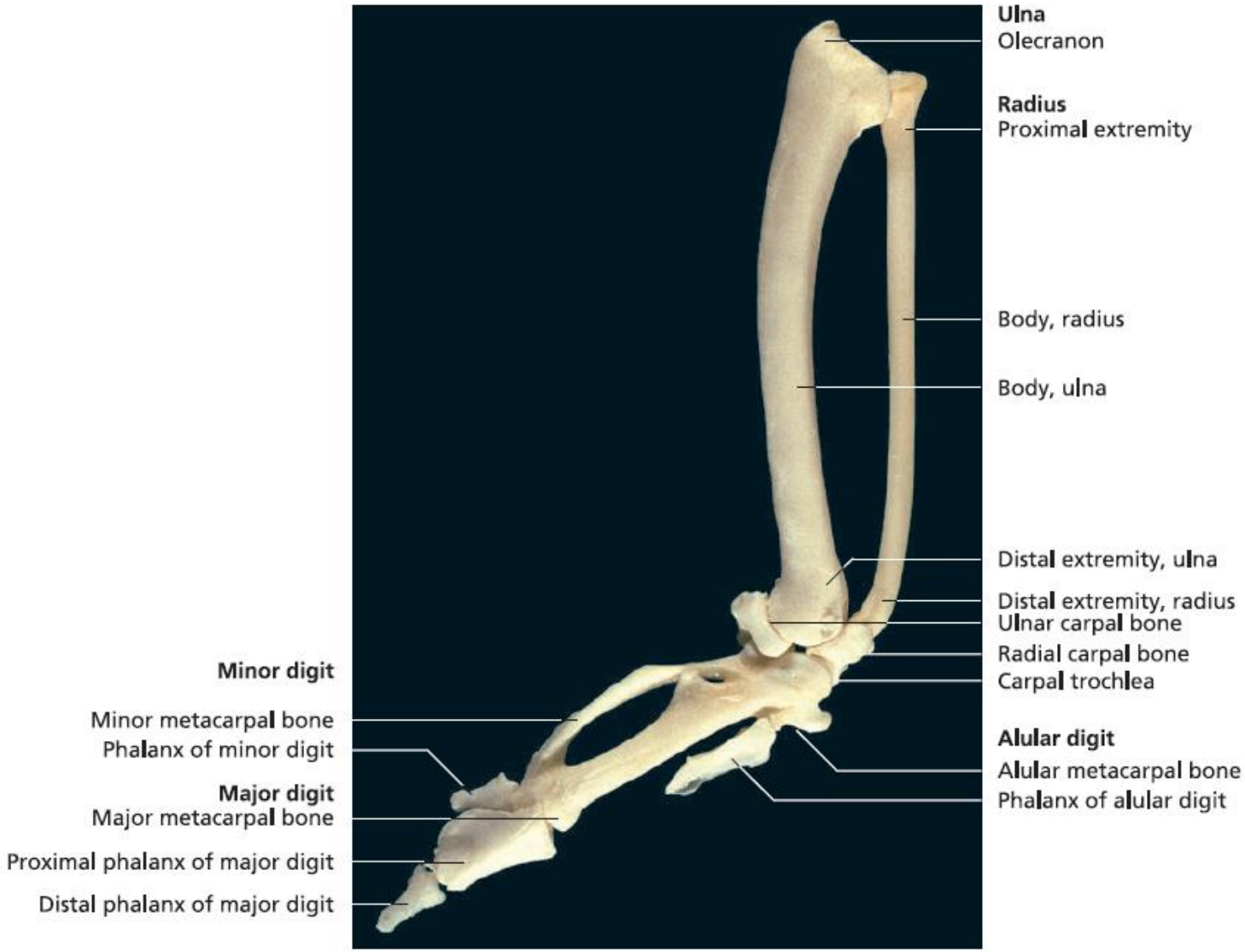
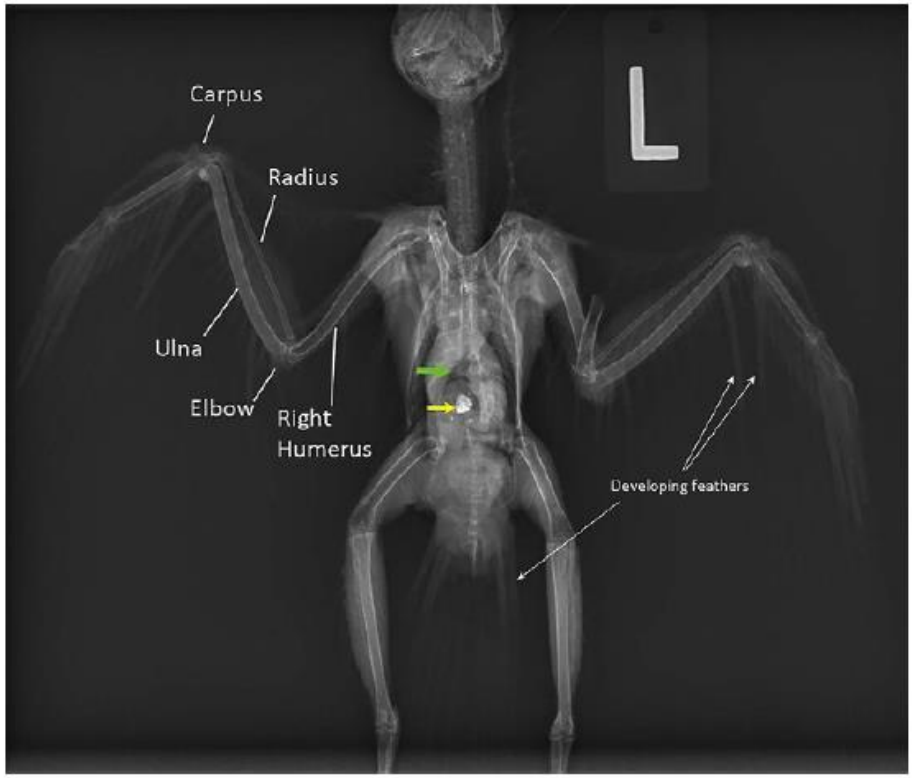


Figure 6.16 • Ventral view of pectoral girdle and left wing.



3.8 Bones of the right antebrachium and manus of a chicken (dorsal view).

The humerus is a common site for **fractures** in bird. Wild birds have a requirement for return to full function, whereas captive/pet birds may be able to manage with some degree of impairment. Pet birds, such as parrots, often have decreased bone density due to poor diet, excessive egg-laying (which depletes calcium stores), and lack of exercise, so they may not have a sufficient bone density to support orthopedic pin placement. These birds often have a poor prognosis for return to flight and are sometimes best treated conservatively with cage rest, pain management, diet correction, and calcium supplementation. Fractures may be described as “open” or “closed.” In birds, fractures of pneumatic bones such as the humerus may lead to respiratory infection, particularly with open fractures.



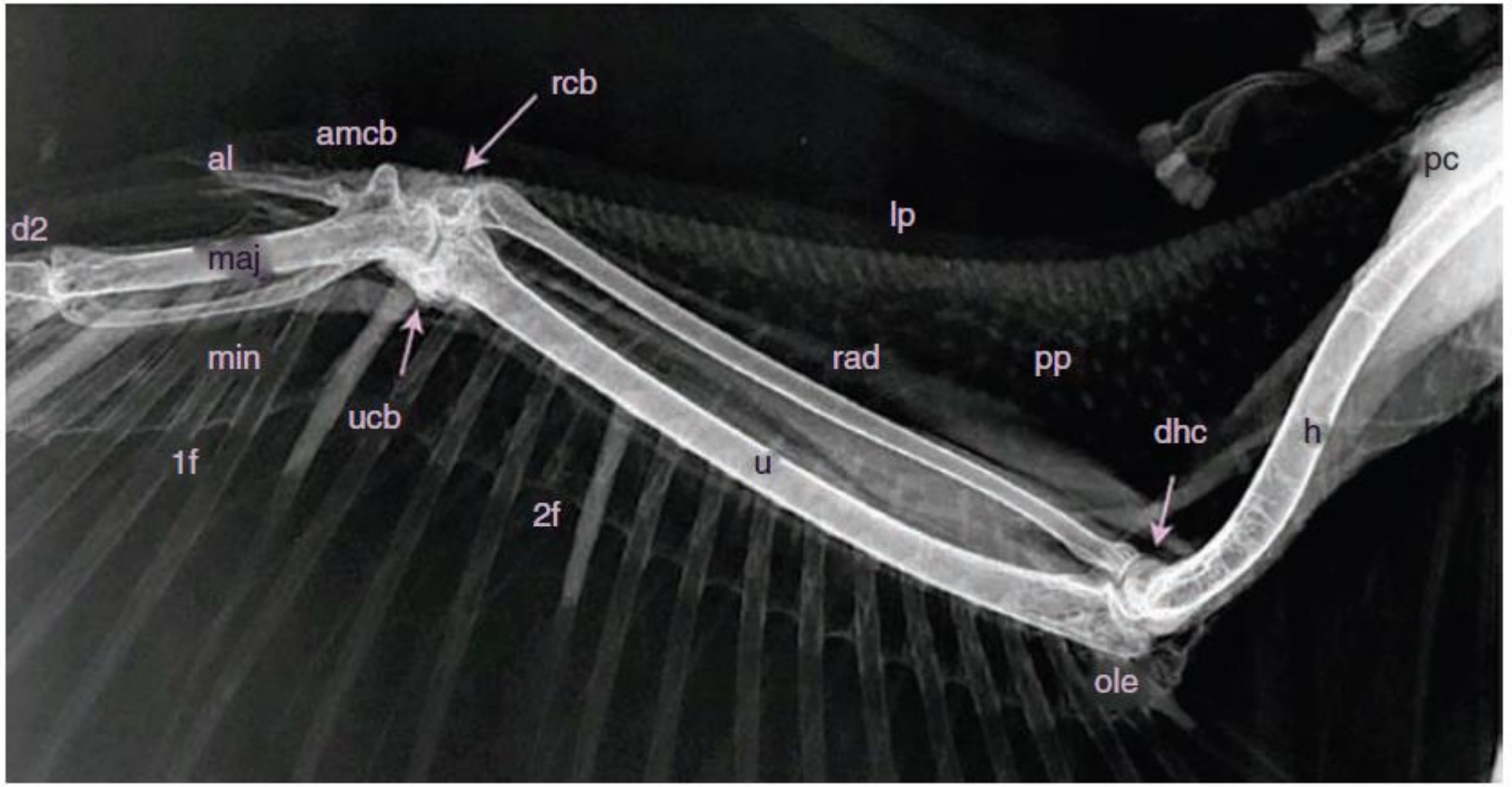


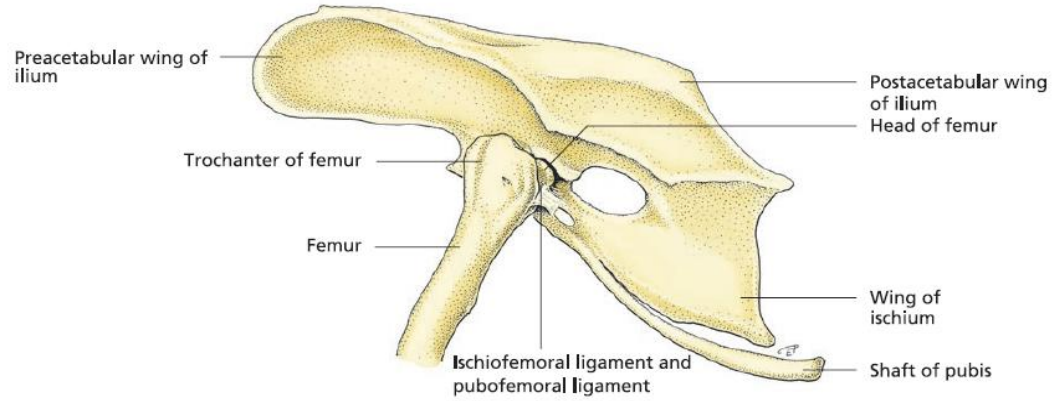
Fig. 2.2. The thoracic limb: alula (al), alular metacarpal bone (amcb), radial carpal bone (rcb), ulnar carpal bone (ucb), major metacarpal bone (maj), minor metacarpal bone (min), second digit (d2), primary feathers (1f), secondary feathers (2f), radius (rad), ulna (u), ligamentum propatagialis pars longus (lp), propatagium (pp), dorsal humeral condyle (dhc), olecranon (ole), humerus (h), pectoral crest (pc).

Structure of the Avian Pelvis
The avian pelvis is composed of three primary bones:

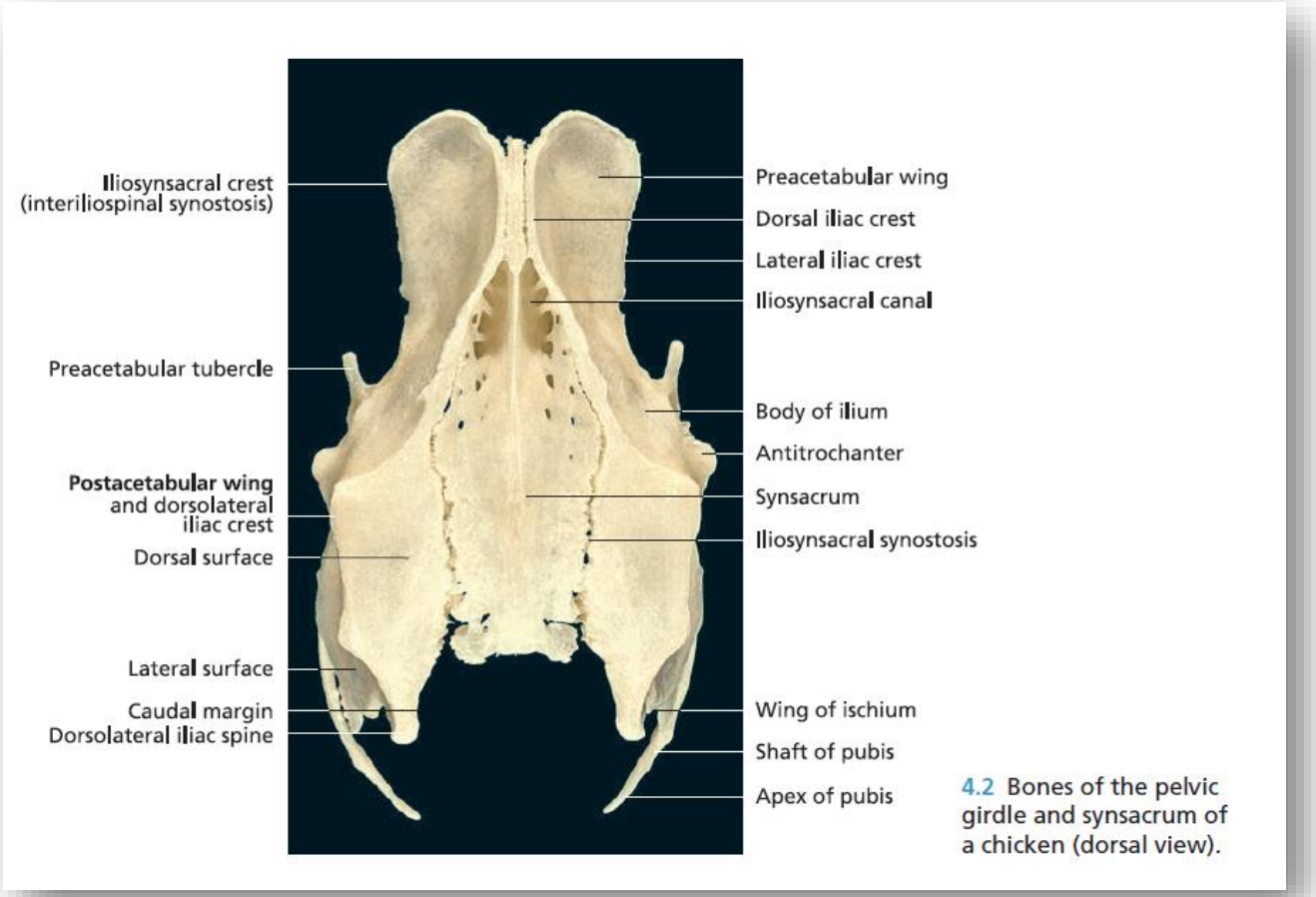
•Ilium: The largest bone, which connects to the and provides attachment points for muscles.

•Ischium: This bone forms a significant part of the lateral wall of the pelvis and is proportionally larger than in mammals.

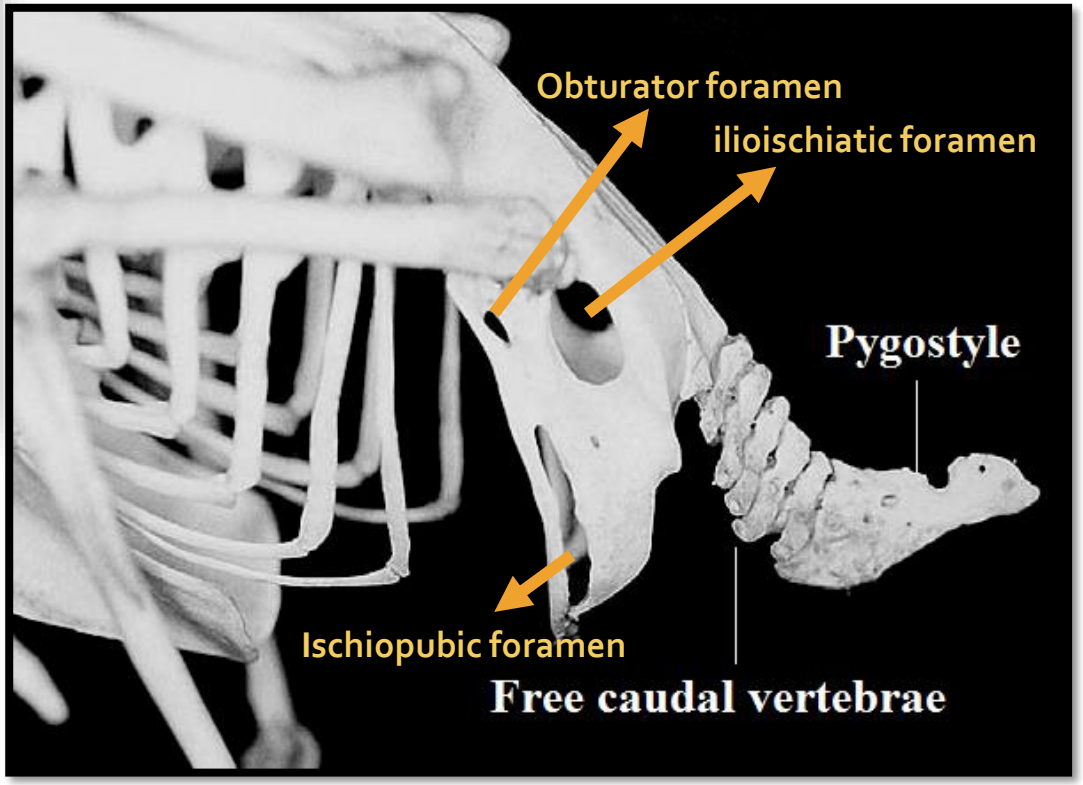
•Pubis: A long and thin bone that remains separate from its counterpart on the opposite side, allowing flexibility and mobility. In many birds the ventral part of the pelvic girdle is incomplete, providing a passage for the eggs. In the ostrich this part is filled by the pubic symphysis, thus enabling it to support the bird's heavy viscera.



4.12 Left hip joint of the chicken (schematic; lateral view).



4.2 Bones of the pelvic girdle and synsacrum of a chicken (dorsal view).



Key Bones of the Avian Pelvic Limb :

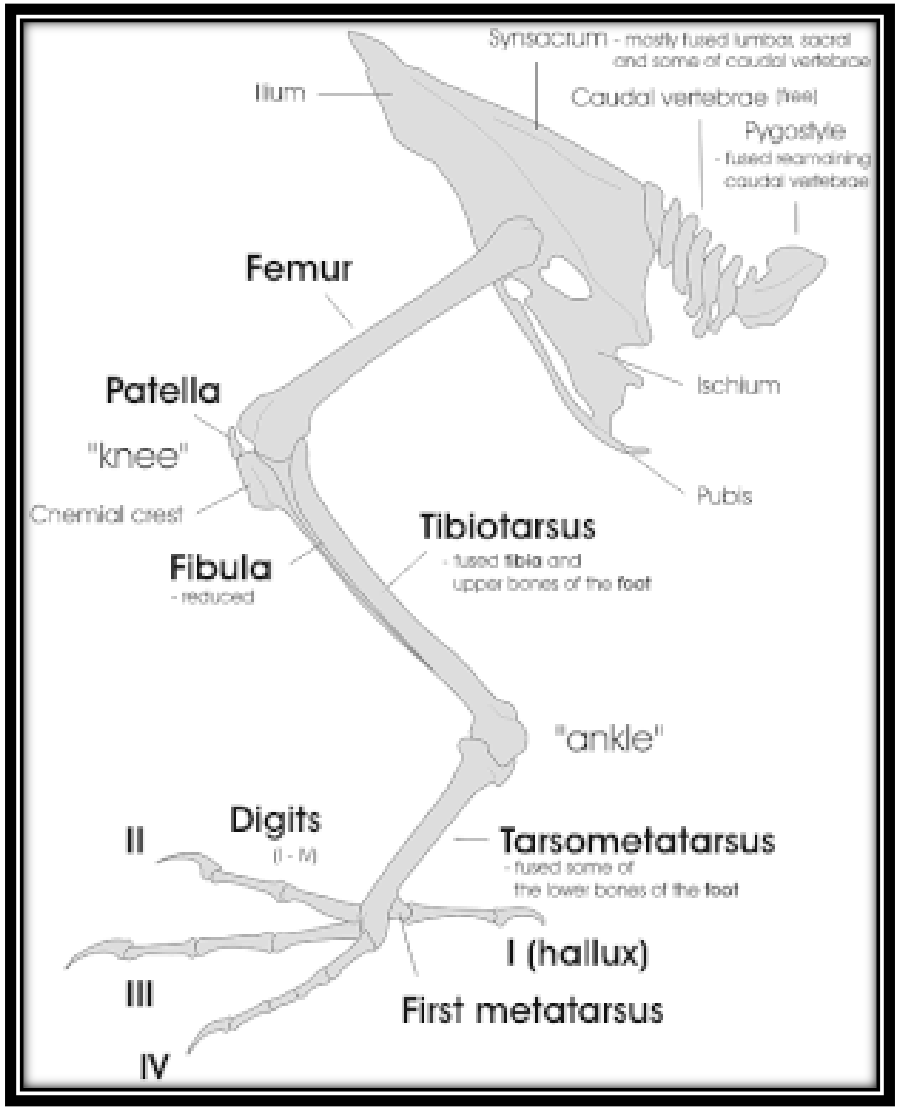
1.Femur: The femur is the primary bone of the upper leg and connects to the pelvis at the hip joint. In larger birds, the femur constitutes a smaller percentage of total limb length compared to smaller birds.

2.Tibiotarsus(Drum stick) :This bone is a fusion of the tibia and some tarsal bones, forming a long structure that connects to the tarsometatarsus. It plays a significant role in locomotion, with its length scaling positively with body size, which enhances stability and support during movement.

3.Tarsometatarsus: The tarsometatarsus is formed by the fusion of the distal row of tarsal bones with metatarsal bones. This bone structure allows for efficient weight distribution and is essential for bipedal locomotion.

4.Patella:The patella serves as a kneecap, providing protection and support to the knee joint, although it is less prominent in birds compared to mammals.

5.Fibula:The fibula runs alongside the tibiotarsus but is much thinner and contributes less to weight-bearing compared to its counterpart in



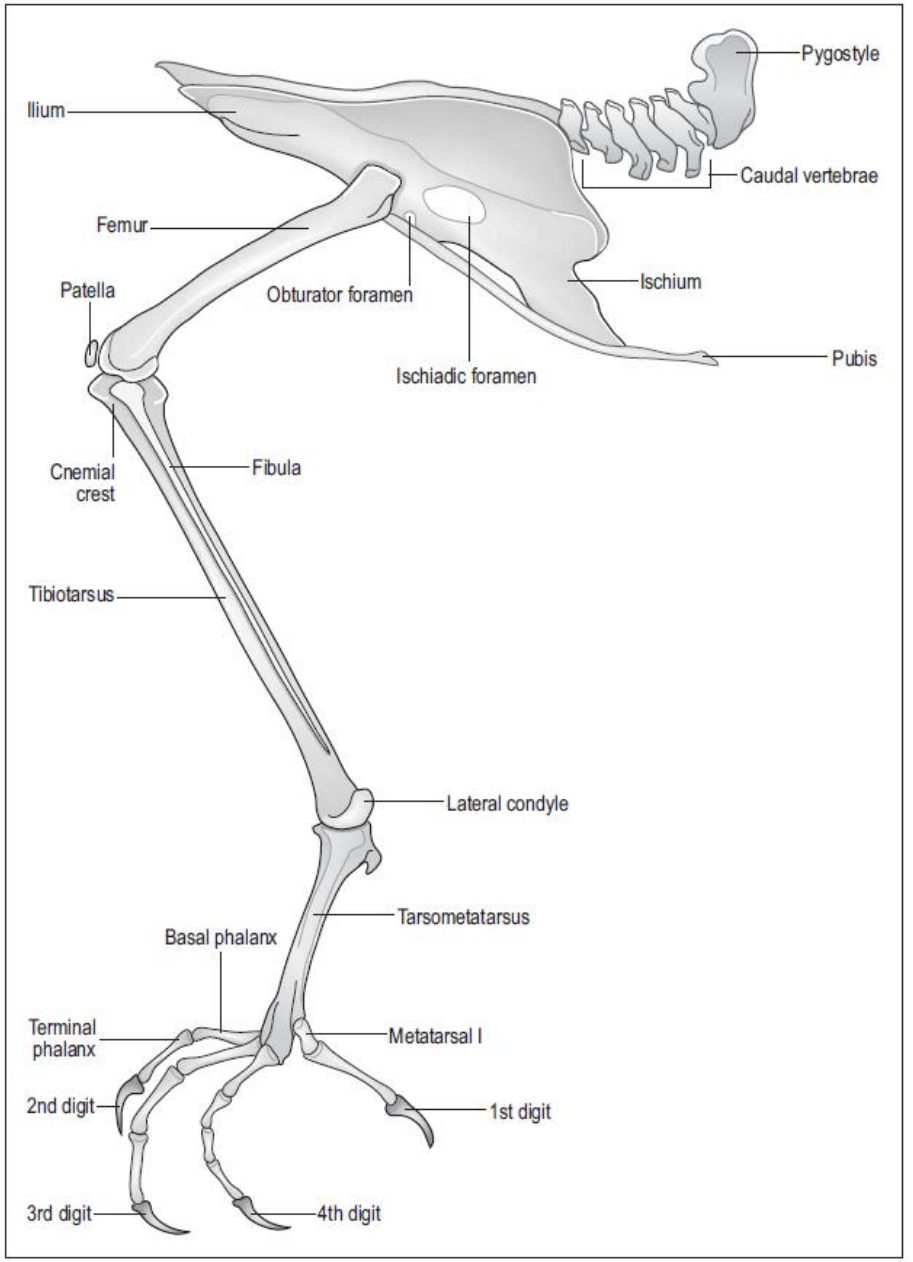
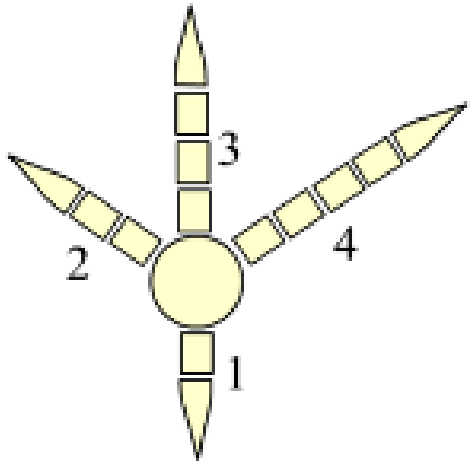

Pygostyle
Ilium
Caudal vertebrae
Femur
Patella
Obturator foramen
Ischium
Pubis
Ischiadic foramen
Cnemial crest
Fibula
Tibiotarsus
Lateral condyle
Tarsometatarsus
Basal phalanx
Terminal phalanx
Metatarsal I
2nd digit
1st digit
3rd digit
4th digit

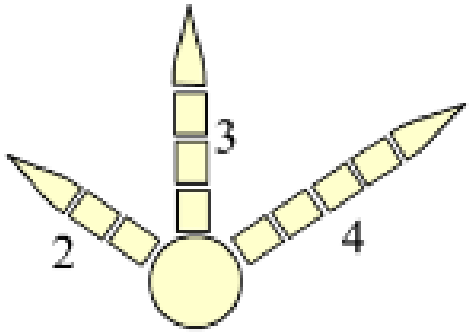
Fig. 2.4. The leg: femur (f), fibula (fi), tibiotarsus (tt), hock joint (h), tarsometatarsus (tmt), metatarsal 1 (mt1), digit 1 (d1), digit 4 (d4).

The number of toes in birds varies. Birds are divided into :

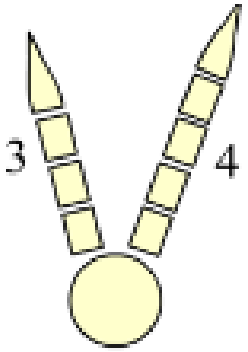
two-toed (Didactyl), three-toed (Tridactyl), and four-toed (Tetradactyl).Most birds have four toes, the ostrich has two toes, and the Australian ostrich (Emu) and Japanese quail have three toes.



Tetradactyl



Tridactyl

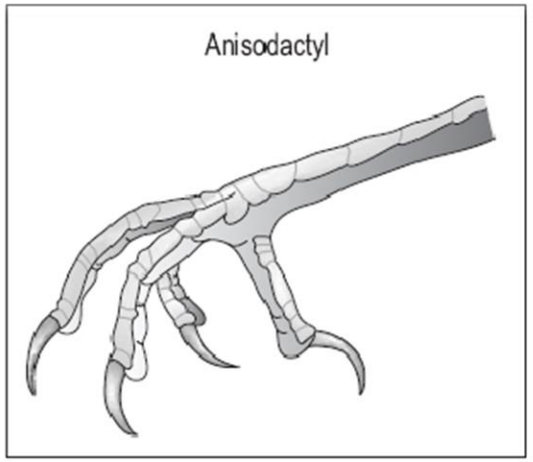


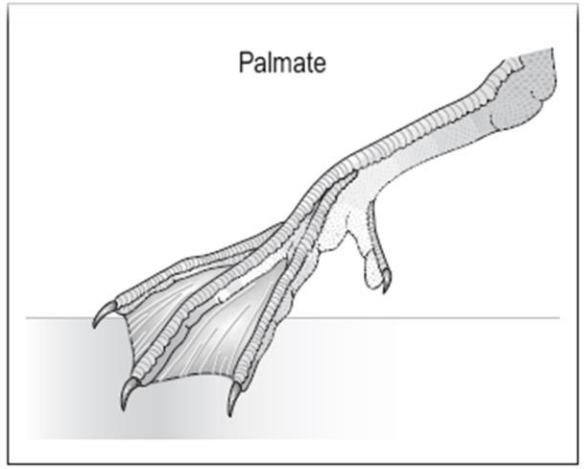
Didactyl

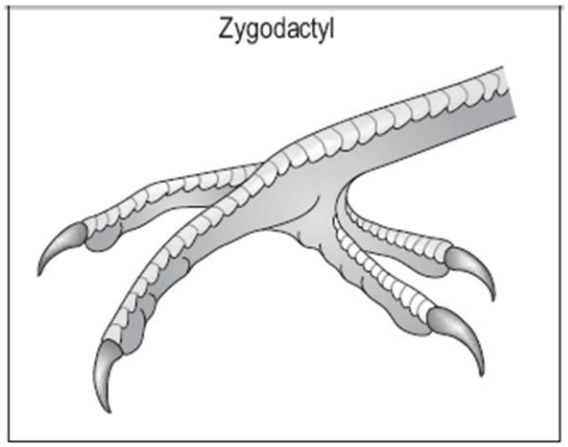
Ostrich

Emu

Birds with 4 fingers are divided into three groups based on the arrangement of the fingers: zygodactyl, anisodactyl, and palmate. The former is seen in parrots and palmate in aquatic birds, and most birds have the anisodactyl form.







Palmate

zygodactyl

The **spur** is only present on the back of the rooster's leg, which it uses for fighting.

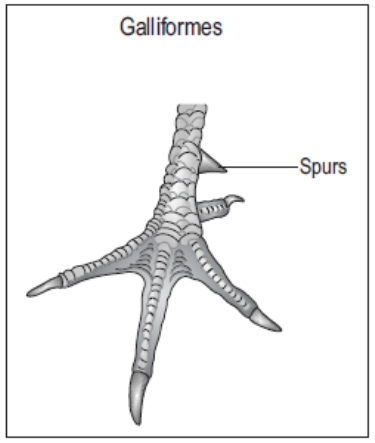
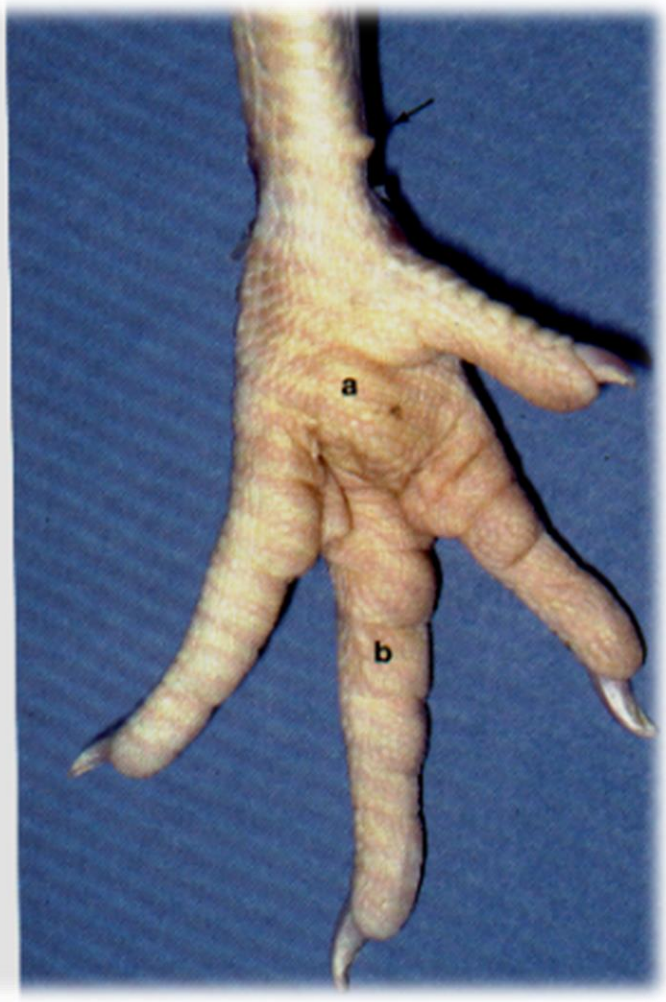
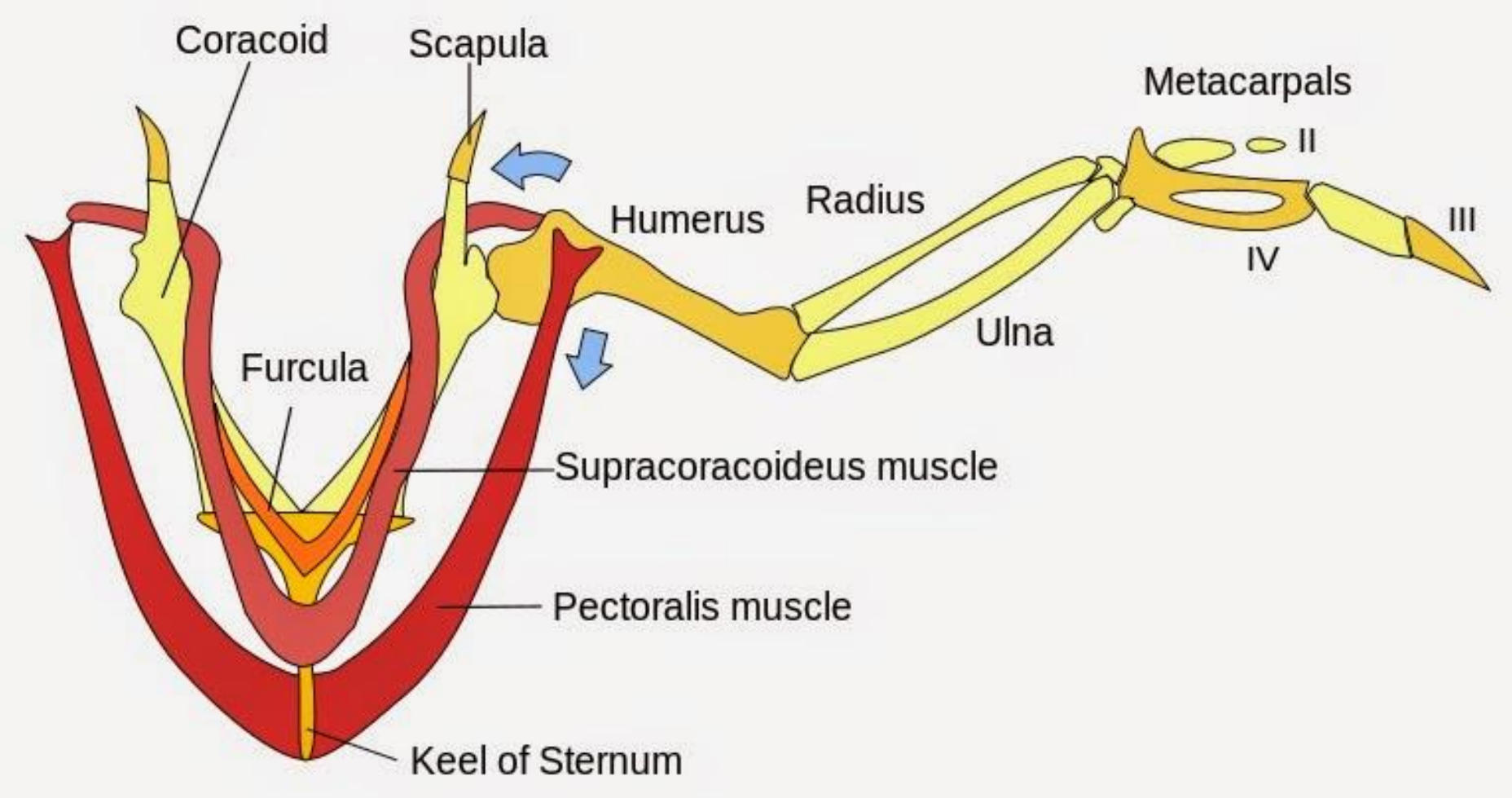


Figure 6.27 • Anisodactyl – Galliformes.
Galliforme foot showing spurs on the caudomedial aspect of the tarsometatarsus.




Coracoid
Scapula
Metacarpals
II
Humerus
Radius
III
IV
Ulna
Furcula
Supracoracoideus muscle
Pectoralis muscle
Keel of Sternum

Key Muscles Involved in Bird Flight

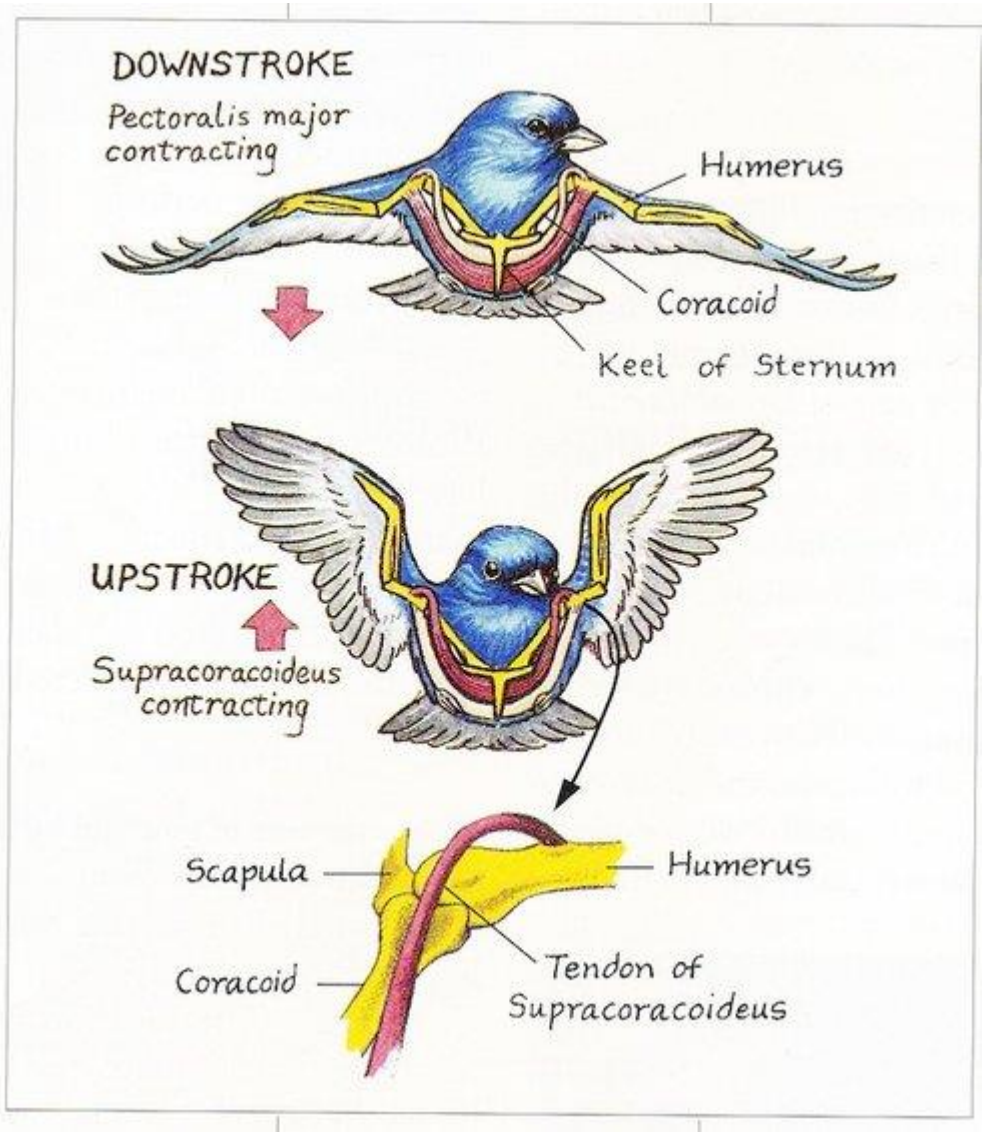
1. Pectoralis Major

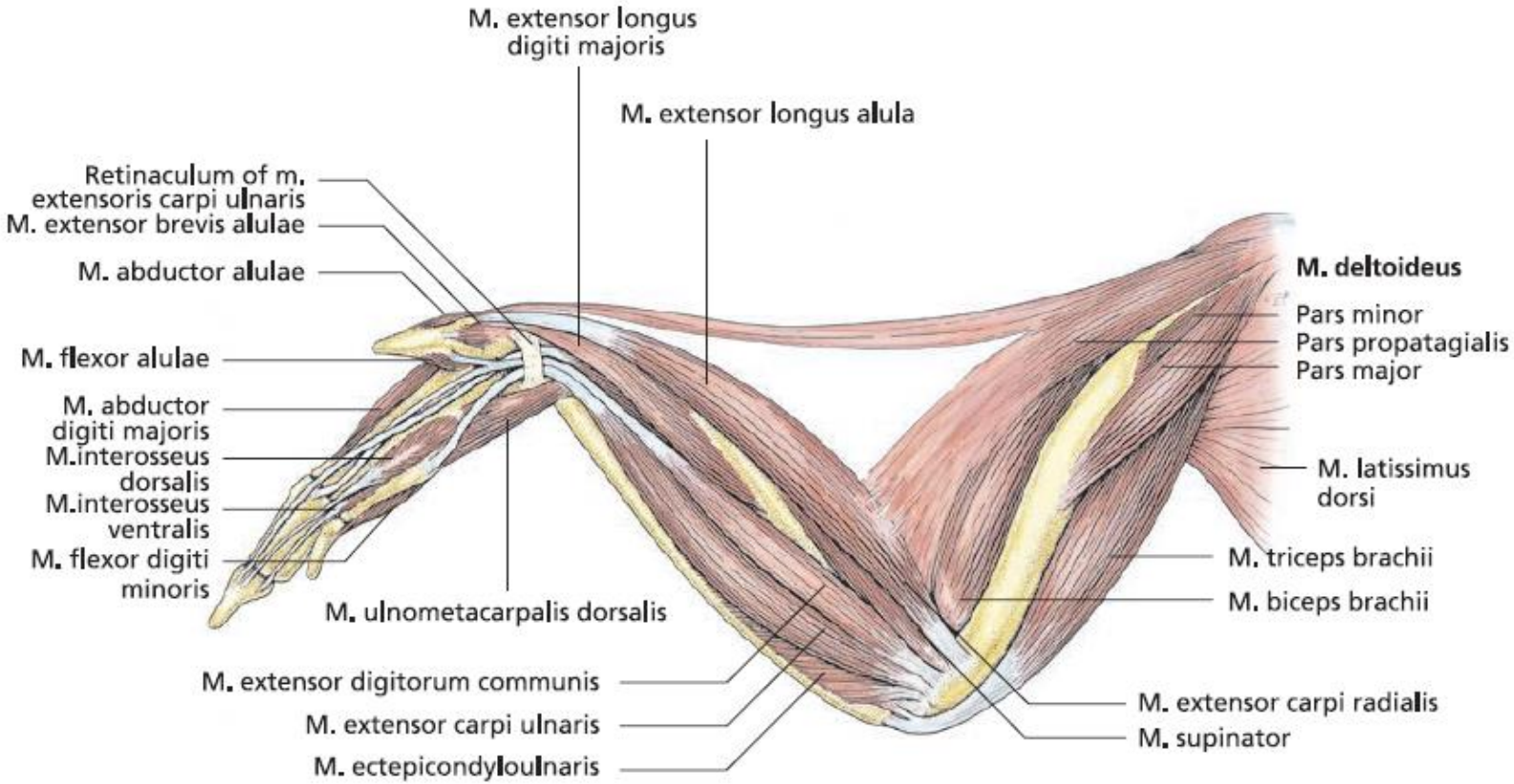
•The pectoralis major is responsible for the downstroke of the wing, which generates thrust and lift during flight. When this muscle contracts, it pulls the humerus (the upper arm bone) downwards, enabling the bird to push against the air.

•This muscle is one of the largest in birds, often accounting for about 17% of their body mass. Its substantial size provides the necessary power for sustained flight.

2. Supracoracoideus

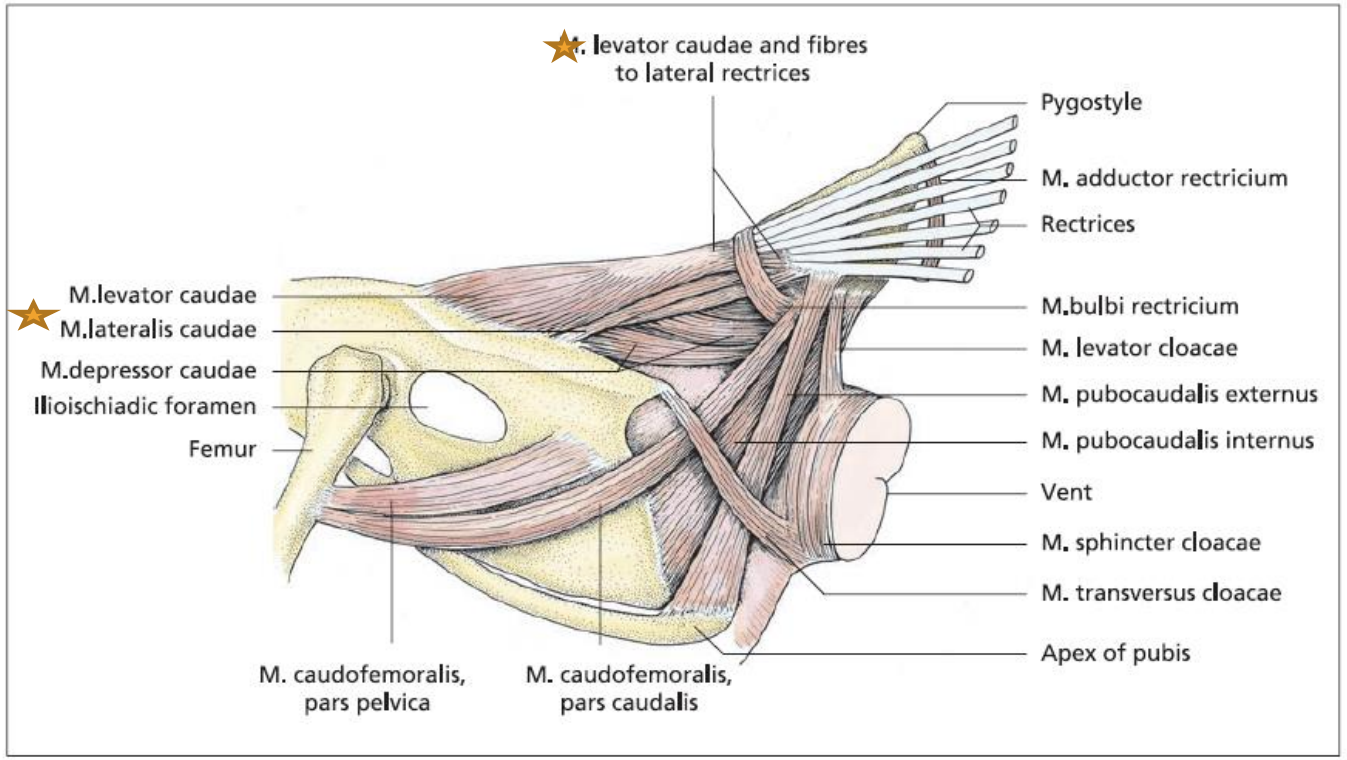
The supracoracoideus muscle is crucial for the upstroke of the wing. It works through a unique pulley system that allows it to lift the wing by contracting beneath it, rather than above, which is a distinctive adaptation among vertebrates.





3.17 Muscles of the left wing in the chicken (schematic; dorsal view).

While the pectoralis and supracoracoideus muscles produce the main power for flapping flight, the biceps and triceps provide finer control over wing shape and orientation during different phases of the wingbeat cycle.



2.33 Muscles of the tail of the chicken (schematic; lateral view).

The levator muscles associated with the tail are categorized into two main parts:

- **Levator Caudae Pars Vertebralis: This part is responsible for elevating the vertebral segments of the tail.**
- **Levator Caudae Pars Rectricalis: This section aids in controlling the rectrices (tail feathers), which are vital for aerodynamic functions during flight. The muscle can also assist in tail rotation when acting unilaterally, contributing to turning movements during flight or while walking.**

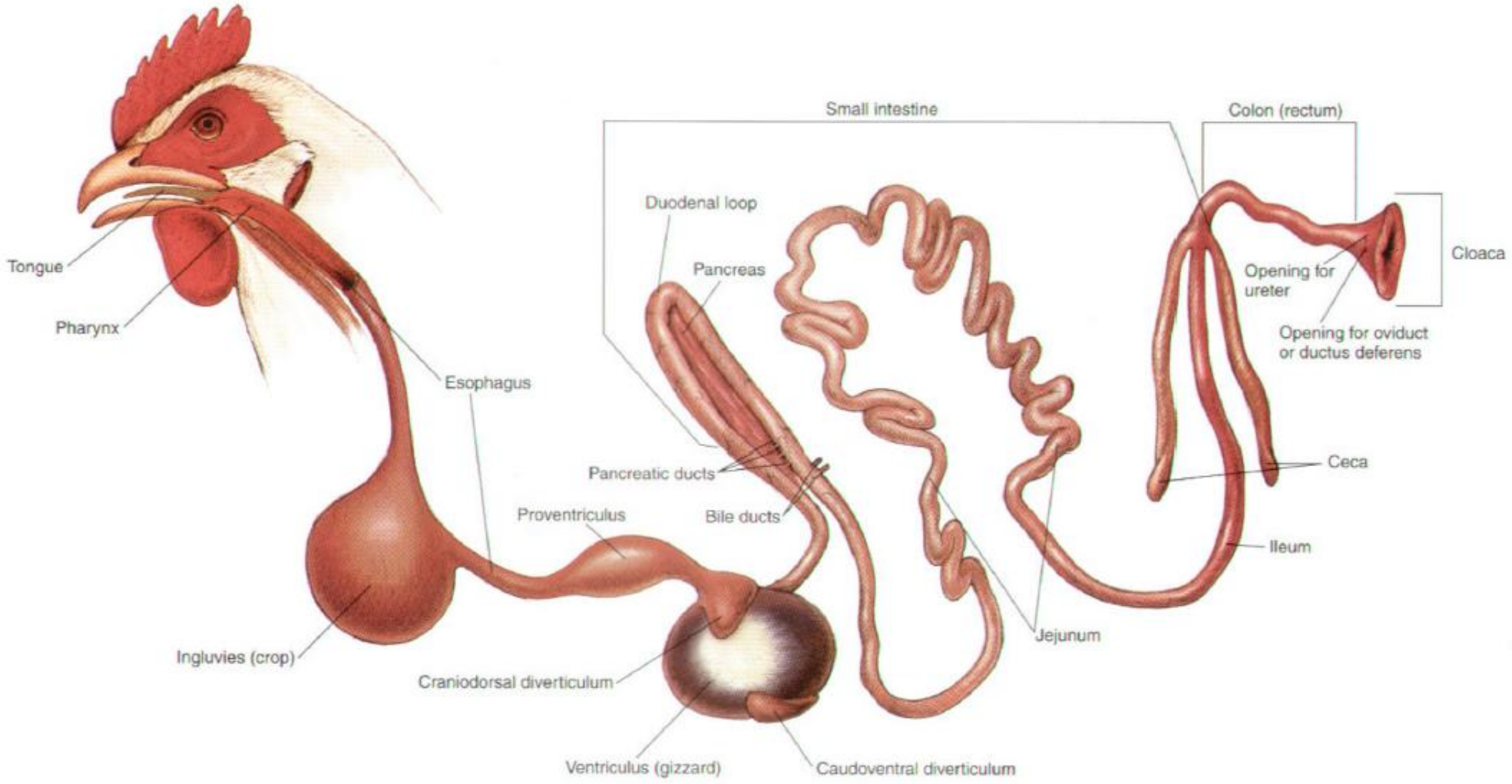


PLATE 7.9 Isolated gastrointestinal tract of the chicken.

digestion time

- **Nectarivores: 15–60 minutes.**
- **Granivores: 40–100 minutes.**
- **Domestic chickens: 4–12 hours (varies by age and activity).**

6.25 Gastrointestinal tract of a chicken with proventriculus, ventriculus and intestinal loops (separated). Courtesy of Dr Annette Kaiser, Munich.

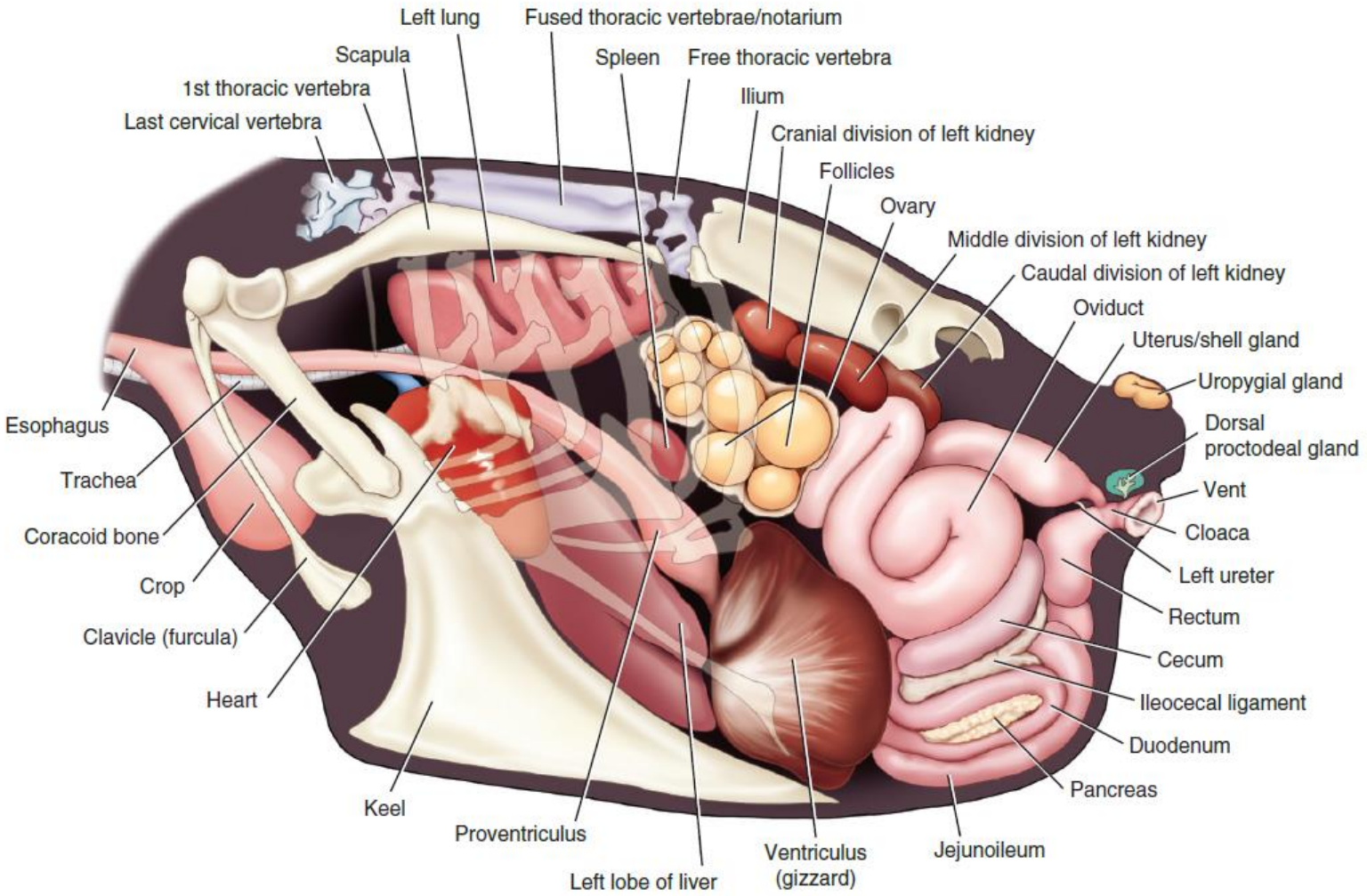


FIG. 6-5 Left view of the avian thoracic and abdominal cavities and pelvis—Female.

Birds have a unique oral cavity anatomy that differs significantly from mammals:

1.The oral and pharyngeal cavities form a common cavity called the oropharynx

2.Birds lack teeth, lips, and a soft palate

3.The beak, formed by the upper and lower jaw, is covered with a horny layer and serves as the functional tooth structure

4.The palate has a medial fissure called the choana, which connects the oral and nasal cavities

5.Caudally-projecting papillae are present along the oral margins of the choana and on the roof of the oropharynx

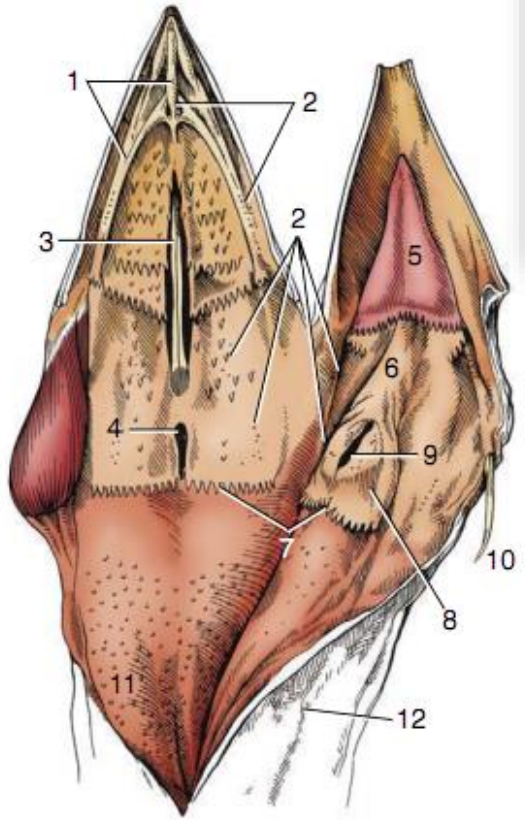
6.The infundibular cleft, located caudal to the choana, connects the oral cavity with the middle ear

7.The tongue is typically triangular, muscular, and non-protrusible in most birds, with variations among species

8.The laryngeal mound is located at the base of the tongue, opening into the glottis. Birds lack an epiglottis

9.Salivary glands are poorly developed, forming a diffuse layer beneath the oropharyngeal epithelium

10.Taste receptors are limited in number and located on the palate and posterior tongue



1, Median and lateral palatine ridges; *2,* openings of salivary glands; *3,* choana; *4,* infundibular cleft; *5,* body of tongue; *6,* root of tongue; *7,* "mechanical" papillae; *8,* laryngeal mound; *9,* glottis; *10,* branchial cornu of hyobranchial apparatus; *11,* esophagus; *12,* position of trachea.

In parrots and pigeons, the muscular layer of the **crop** may function similarly to esophageal sphincters in mammals, thereby controlling the flow of food into the stomach.

•Galliformes (chickens, turkeys): Typically possess a well-developed, bilobed crop that is round-shaped and capable of significant storage

•Columbiformes (pigeons): Have a double diverticulum (two pouches) in their crop, which can produce crop milk to feed their youngs.

•Psittaciformes (parrots): Feature a crop that may have two distinct pouches, one larger than the other, aiding in their feeding habits.

•Raptors (hawks, eagles): Generally have a functional crop, although it may be less pronounced than in seed-eating birds

•Waterfowl (ducks, swans) and owls: Often have either a rudimentary or absent crop

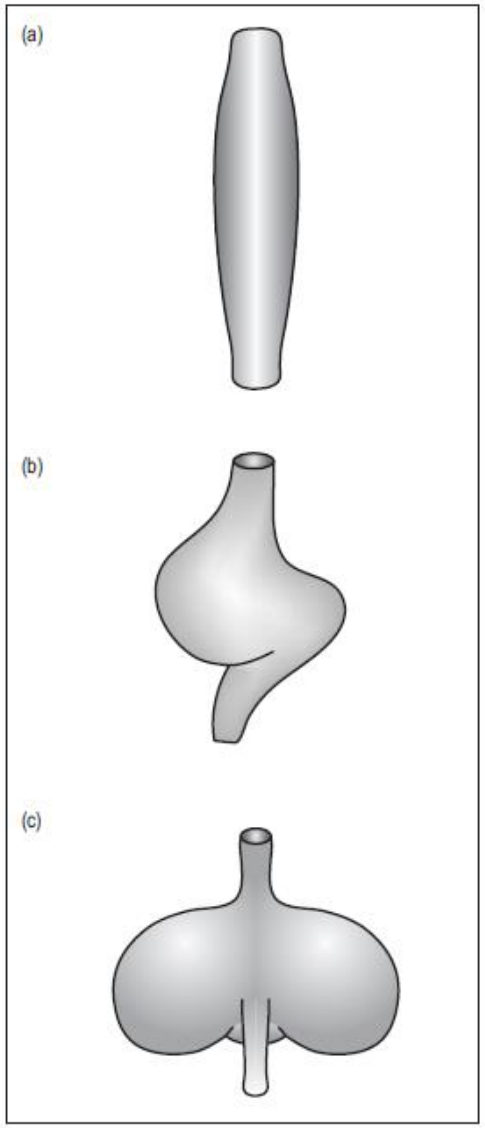


Figure 6.55 • The shape of the crop depends on the bird's diet.
(a) Waterfowl – simple and fusiform
(b) Parrots – seed can be softened here prior to passing into the ventriculus
(c) Pigeons – well developed and bilobed for softening grain and production of crop milk

Impaction of the crop

•Overeating: Birds that are allowed to eat excessively may fill their crops beyond capacity, leading to blockages.
•Inappropriate Diet: Feeding birds dry or sticky foods can contribute to impaction since these foods may not break down properly.
•Obstructive Foreign Bodies: Sometimes, foreign objects ingested by birds can cause blockages.

Impaction of the crop is most common in young parrots that have not developed the ability to differentiate between food and nonfood components. Often, it is nest material that causes an impaction. The size and shape of the crop is species-specific and reflects each species' adaptation to diet, environment, and feeding behavior.
Crop impaction can be caused by ingesting large amounts of dry food. In raptors it can be blocked by the fur and feathers of prey if there is inadequate moisture in the diet.

FIG. 25.2-4 A Eurasian collared dove (*Streptopelia decaocto*) nestling, following gavage (forced feeding via a "stomach" tube) feeding. The enormous crop occupies the entire cranial aspect of this young bird's body, from just beneath her beak to her feet, expanding on both sides of midline to create a "cleavage." This nestling weighed 110 g and her crop easily accommodated 28 mL of liquid food by gavage. (The normal gavage rate in young birds is 3 mL per 100 g bodyweight.)

The avian digestive system differs from mammals, with a unique stomach anatomy consisting of two main parts:

Proventriculus (True Stomach):

Located before the ventriculus in the digestive tract
Glandular stomach where digestion primarily begins
Secretes hydrochloric acid and digestive enzymes like pepsin

Ventriculus (Gizzard)

Often called the mechanical stomach
Made up of two sets of strong muscles that act as the bird's teeth. It has a thick lining (Koilin) that protects the muscles
Grinds, mixes, and mashes consumed feed and digestive juices

This two-part stomach structure allows birds to efficiently process food without teeth. The proventriculus initiates chemical digestion, while the gizzard performs mechanical breakdown of food particle.

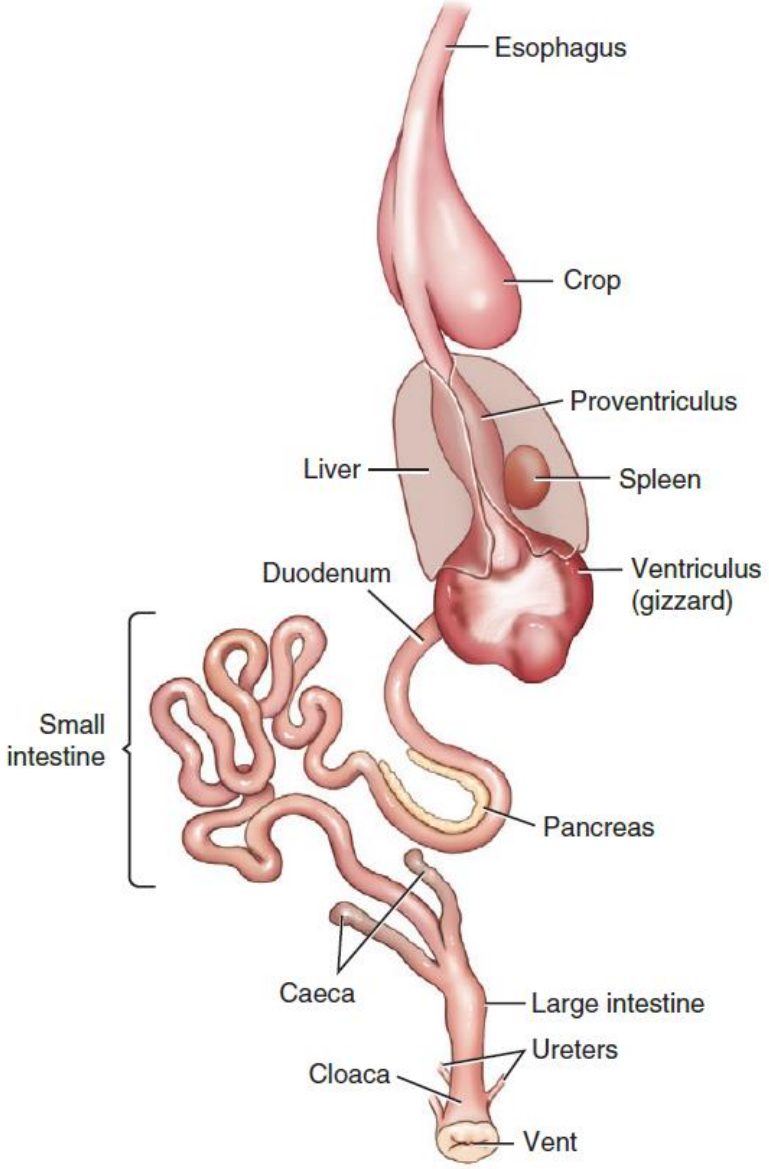


FIGURE 26.4-4 Gastrointestinal tract of a parrot.

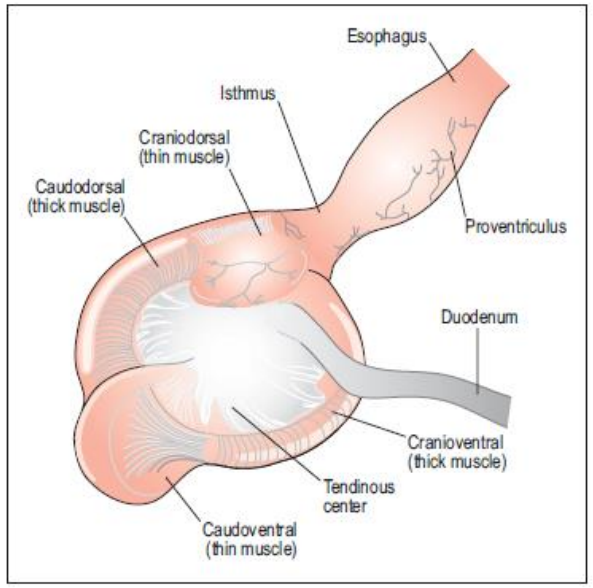


Figure 6.56 • External appearance of ventriculus (gizzard) in granivorous bird showing well-developed grinding muscles.

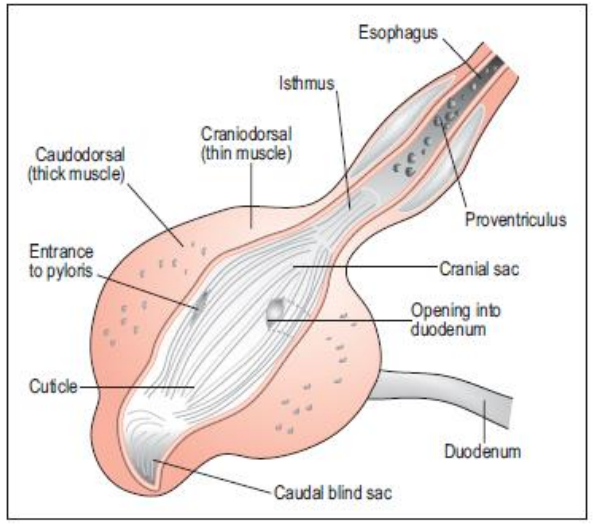
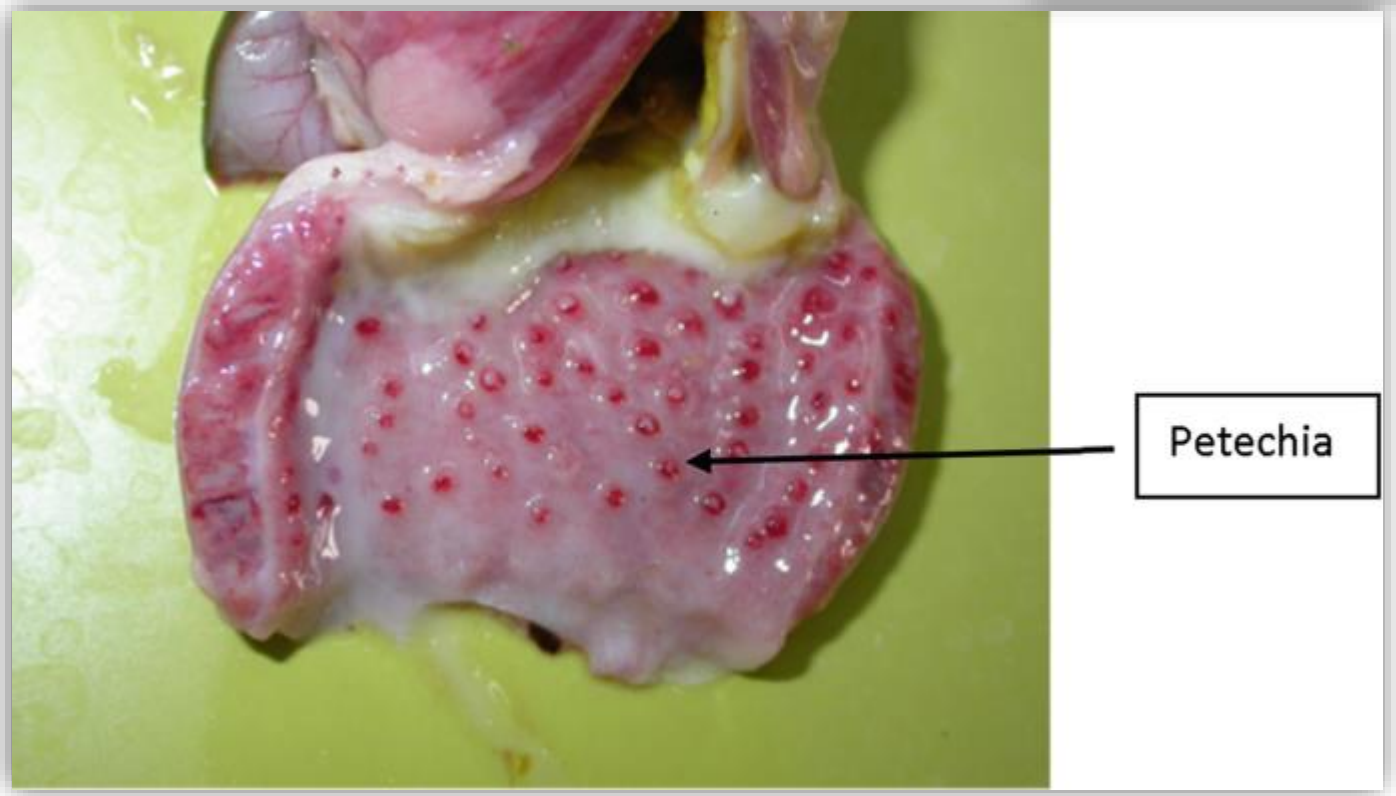
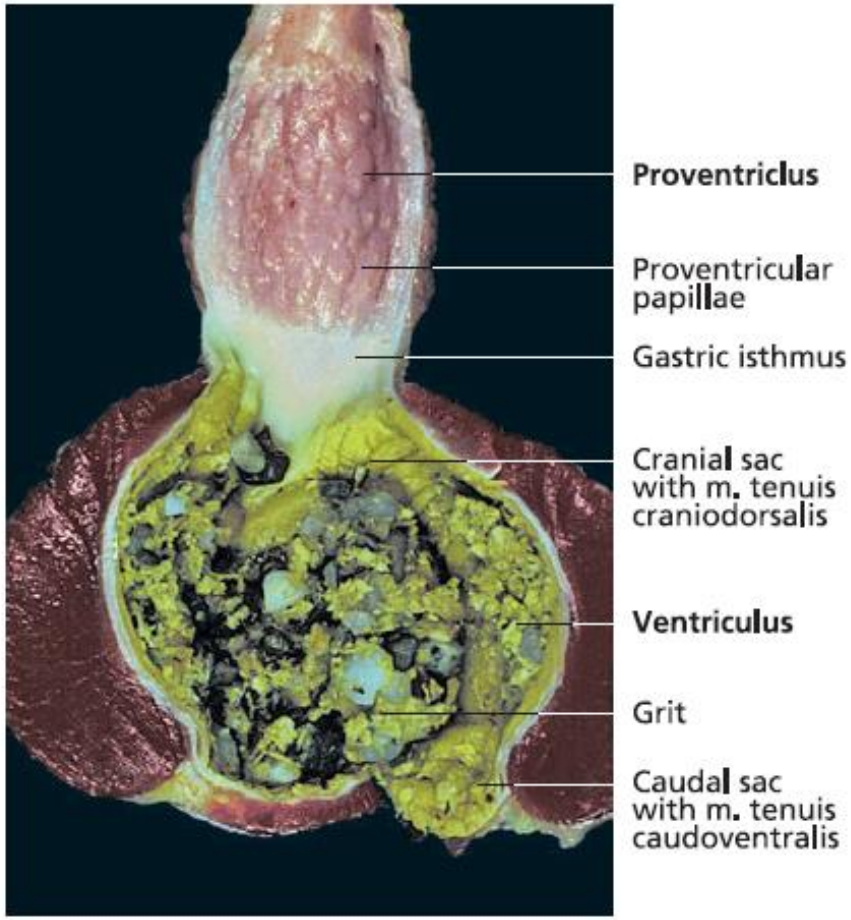


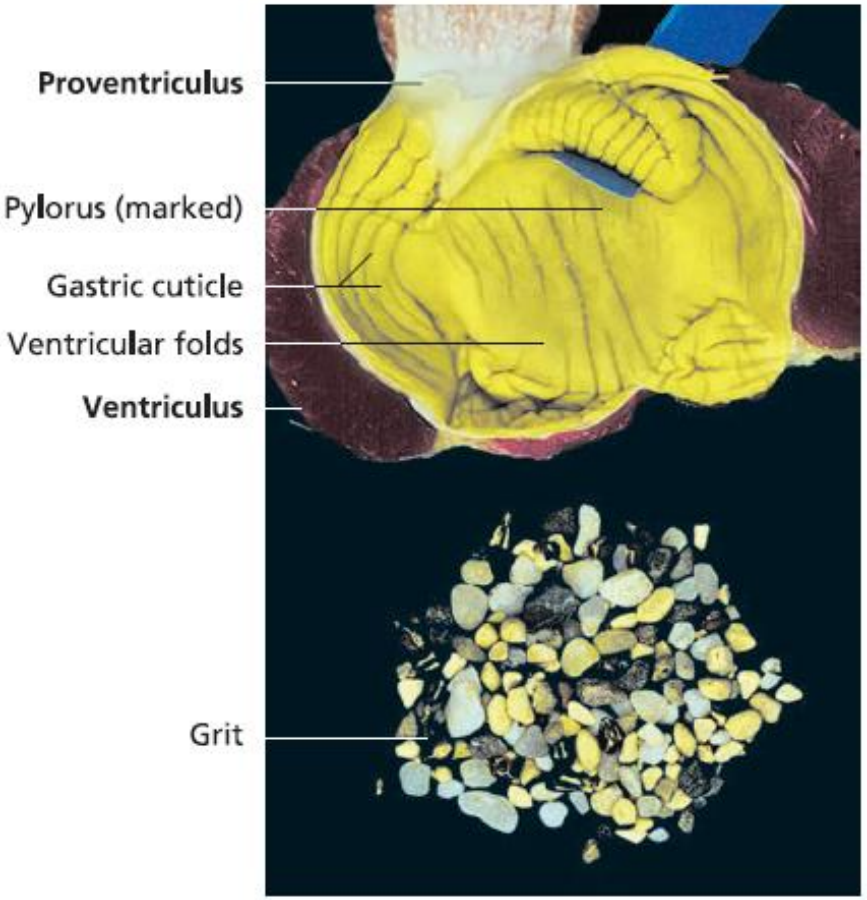
Figure 6.57 • Cross-section of ventriculus of granivorous bird.



proventriculus papillae in Newcastle disease



6.18 Proventriculus and ventriculus of a chicken (opened).



6.19 Ventriculus of a chicken (opened and grit removed).

Proventricular Dilatation Disease (PDD)

PDD is a fatal inflammatory disease affecting mainly psittacine birds, characterized by significant clinical signs that can be neurological or gastrointestinal in nature. The pathogenesis of PDD involves damage to the autonomic nervous system, particularly affecting the vagus nerve. This disruption leads to impaired peristalsis and gastrointestinal motility, resulting in the dilation and atony of the proventriculus.

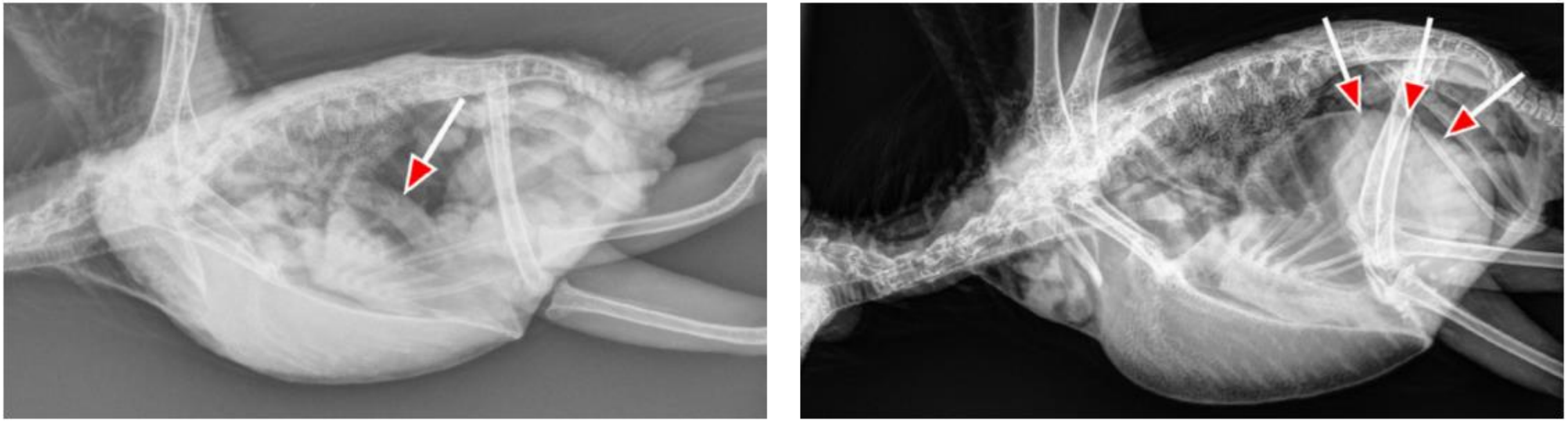


Fig. 3. Proventricular dilatation disease (PDD) gets its name from the common clinical sign of a dilated proventriculus (the glandular stomach of the bird); these radiographs compare the proventriculus of a normal bird (left) to one with PDD (right). Please note that PDD is not the ONLY cause for a dilated proventriculus.

Gizzard Erosions:

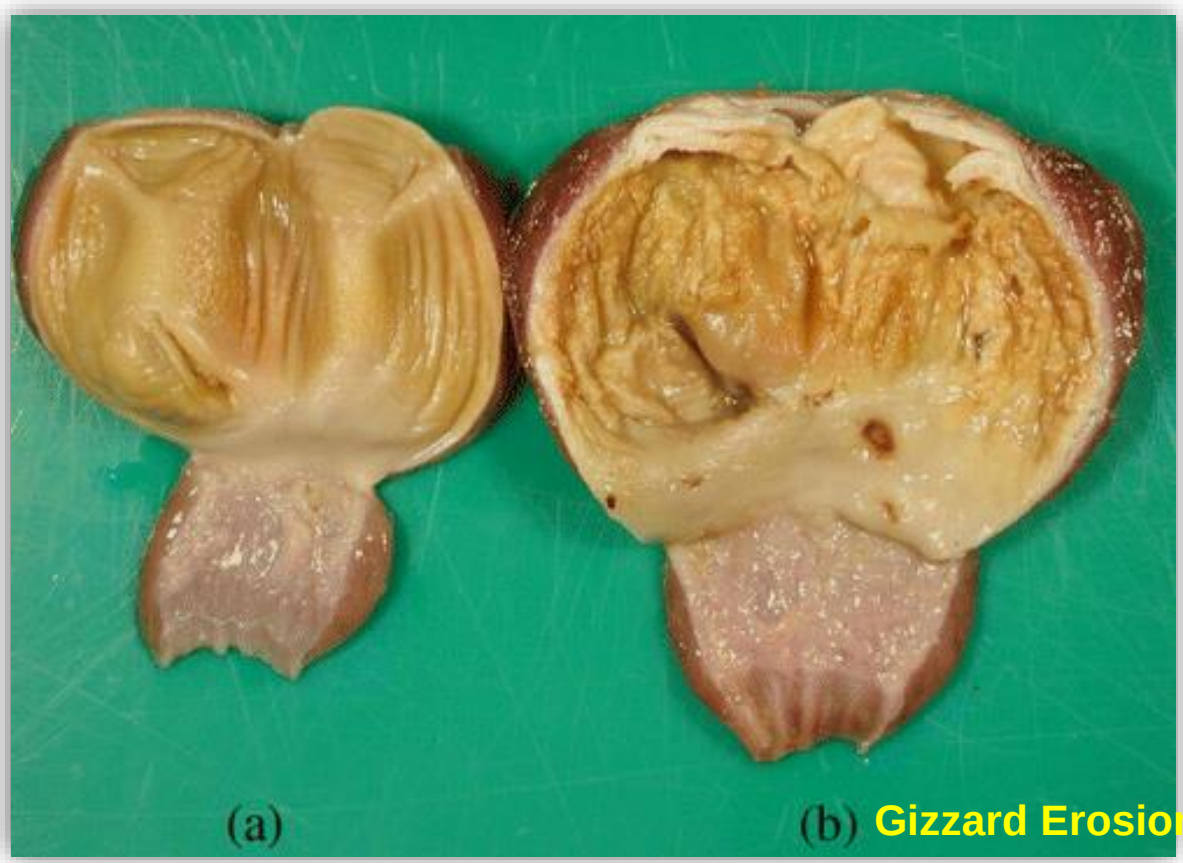
Gizzard erosions are a significant health concern in poultry, characterized by defects in the koilin layer and inflammation of the underlying mucosa. These erosions can lead to decreased feed intake and overall poor growth performance in affected birds. A study reported that 15-25% of birds examined during health surveys showed signs of gizzard erosions or related conditions.

Adenoviral Gizzard Erosion (AGE):

AGE is an emerging infectious disease linked to fowl adenovirus that causes severe lesions in the gizzard, resulting in necrotizing ventriculitis and significant production losses. Symptoms include black discoloration and inflammation within the gizzard, which can be identified through necropsy and histopathological examination.

Impactions:

Blockages within the gizzard can occur due to poor-quality food or foreign materials, leading to serious health issues or even death in birds.



Gizzard Erosions

Small Intestine
It is relatively shorter compared to mammals, with 51% less nominal surface area and 32% less volume.

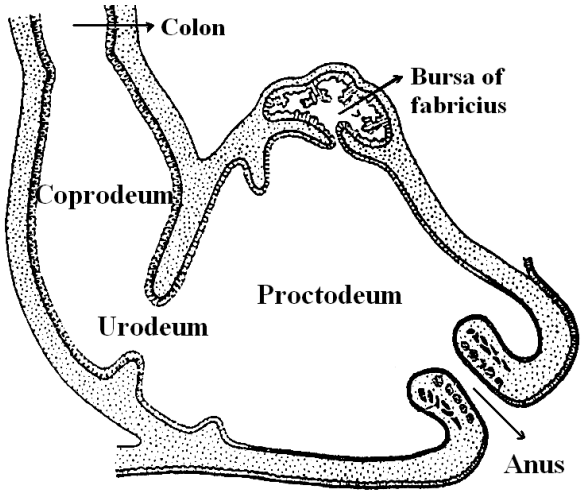
Duodenum: Forms a loop surrounding the pancreas and is the main site for carbohydrate absorption
Jejunum: Extends to the yolk stalk (Meckel's diverticulum) and is the major site for enzymatic digestion and absorption of amino acids, calcium, and phosphorus
Ileum: Shorter than the jejunum with similar but slightly reduced function

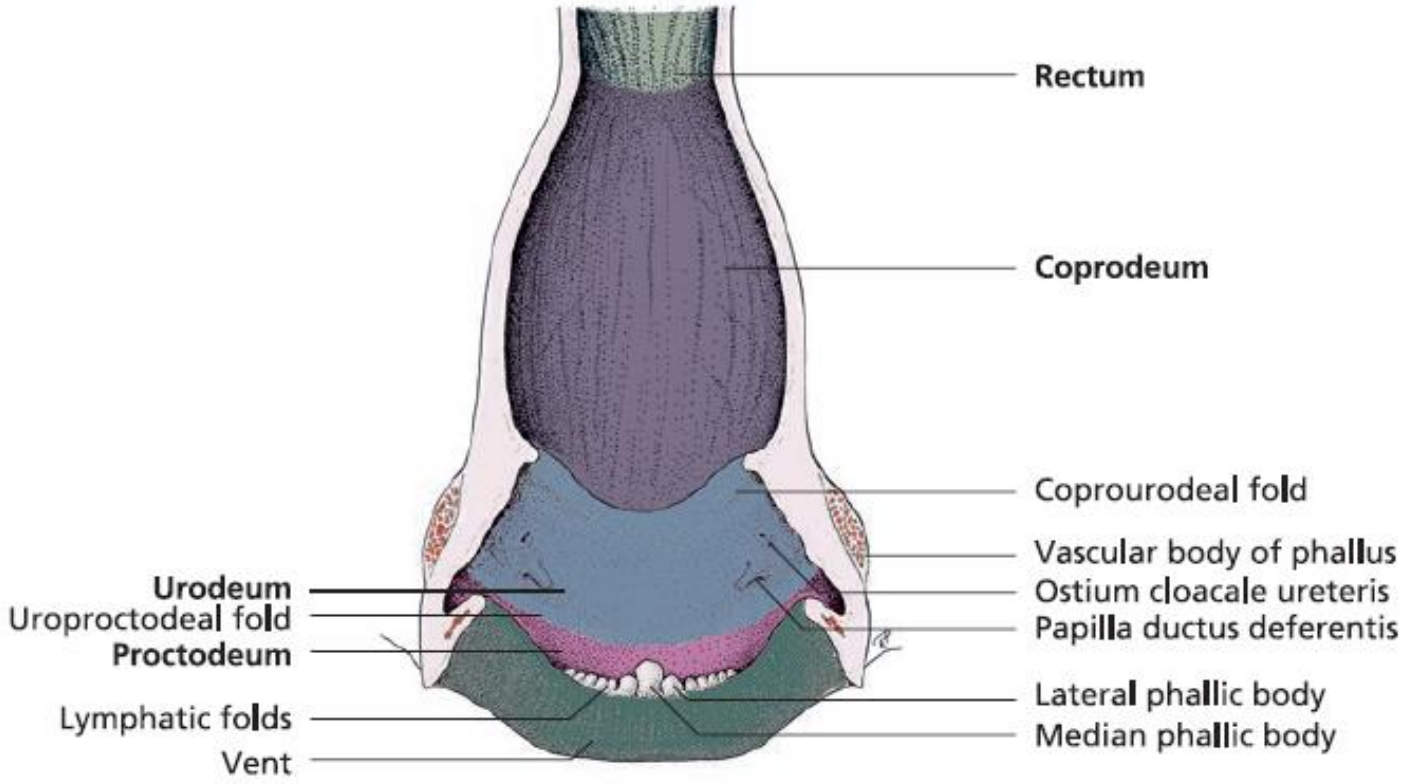
Large Intestine
The avian large intestine is significantly shorter than that of mammals and consists of:
Ceca: A pair of blind-ended sacs at the junction of the small and large intestines. In some species like chickens, they are well-developed and serve as sites for cellulose breakdown and volatile fatty acid formation
Colon: A short, nearly straight tube that runs below the vertebrae
Rectum: The terminal section of the large intestine

Key Differences from Mammals
1.Birds lack a distinct separation between jejunum and ileum
2.The avian intestinal tract is generally shorter than that of mammals on a body weight basis
3.Birds have a cloaca, a single opening for digestive, urinary, and reproductive tracts, instead of separate openings

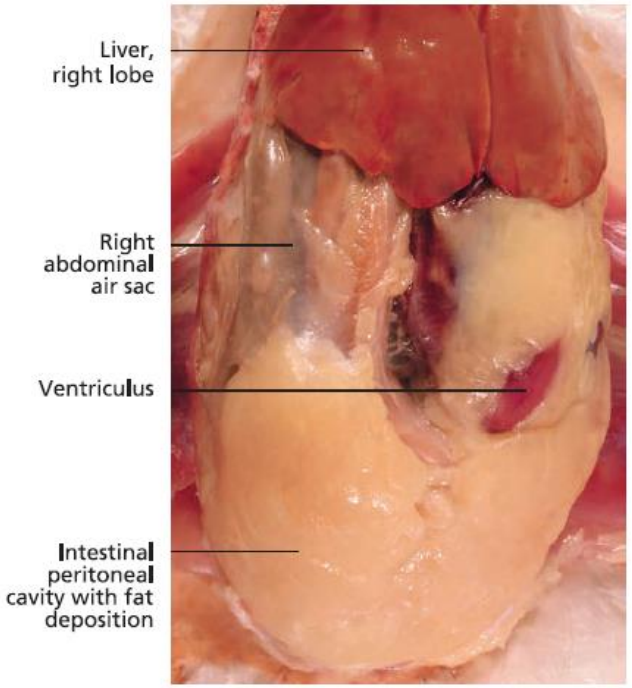
6.25 Gastrointestinal tract of a chicken with proventriculus, ventriculus and intestinal loops (separated). Courtesy of Dr Annette Kaiser, Munich.

Ceca in arboreal birds such as sparrows, eagles, and pigeons, this organ is atrophied or very small, and in birds such as parrots, it is completely absent. In poultry and waterfowl, however, this organ is well developed.

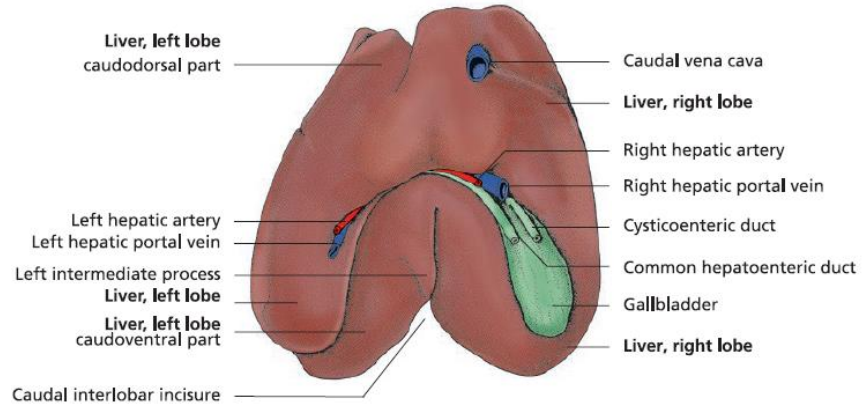




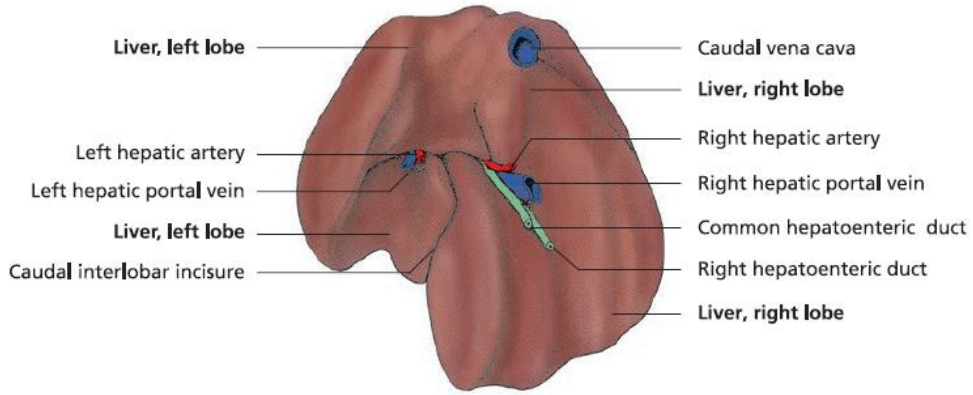
9.7 Cloaca of the male chicken (schematic), adapted from Waibl and Sinowatz, 2004.



6.33 Organs of the peritoneal cavity of a chicken, with fat accumulation in the intestinal peritoneal cavity (ventral view). Courtesy of Dr Annette Kaiser, Munich.



6.46 Visceral surface of the liver with hepatic porta in the chicken (schematic), adapted from Vollmerhaus and Sinowatz, 2004.



6.47 Visceral surface of the liver with hepatic porta in the pigeon (schematic), adapted from Vollmerhaus and Sinowatz, 2004.

The most common liver disease in birds is fatty liver disease (hepatic lipidosis), especially in pet birds with high-fat diets.

Birds such as parrots, passerines, ostriches, and pigeons lack a gallbladder. The gallbladder is located in the ventral part of the right lobe. It receives the secretions of the right lobe of the liver through the hepatocystic duct and empties them into the terminal part of the ascending duodenum through the cysticoenteric duct. The bile secretions of the left lobe also enter the ascending duodenum directly through the hepatoenteric duct. Therefore, there are two bile ducts in total in birds.

Birds possess a highly specialized and efficient respiratory system, fundamentally different from mammals. The main components include:

Nares (nostrils)

Nasal cavity

Larynx (not used for sound production)

Trachea

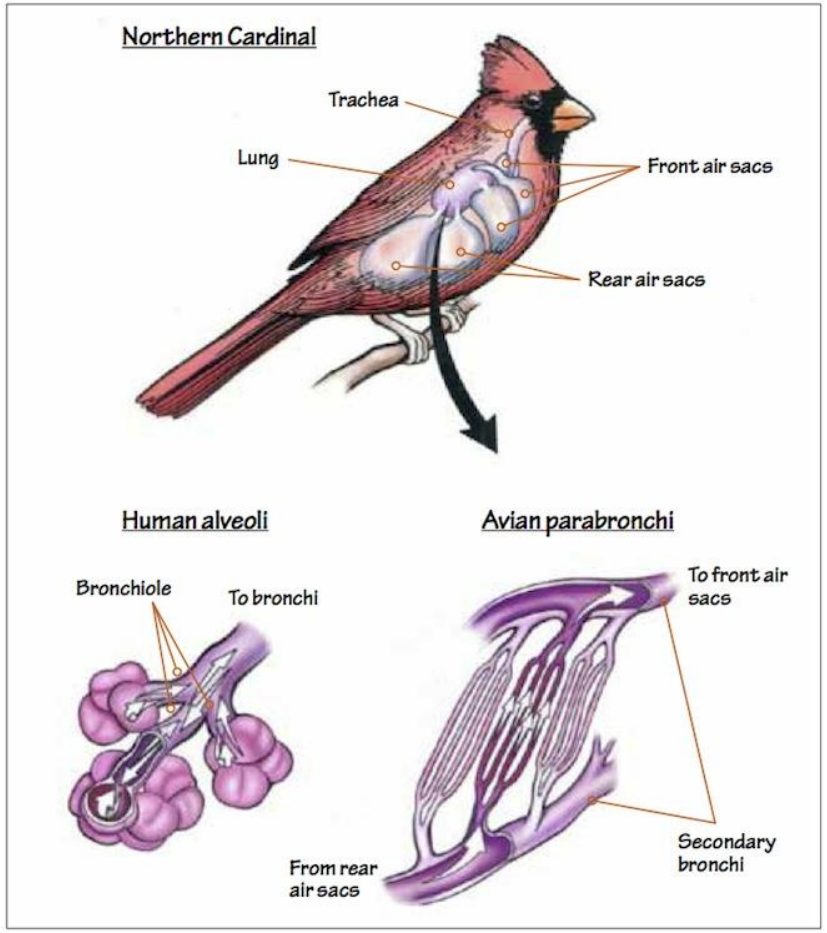
Primary bronchi, mesobronchi , parabronchi

Syrinx (the vocal organ, unique to birds)

Small, rigid lungs

Typically nine large, thin-walled air sacs

Birds lack a diaphragm. Respiration is driven by the movement of intercostal and abdominal muscles, expanding and contracting the thoraco-abdominal cavity and thus the air sacs. The active phase of respiration in birds is exhalation, requiring muscle contraction, while inhalation occurs as these muscles relax.
The unidirectional airflow and separation of ventilation (air sacs) from gas exchange (lungs) make the avian respiratory system the most efficient among vertebrates, supporting the high oxygen demands of flight.



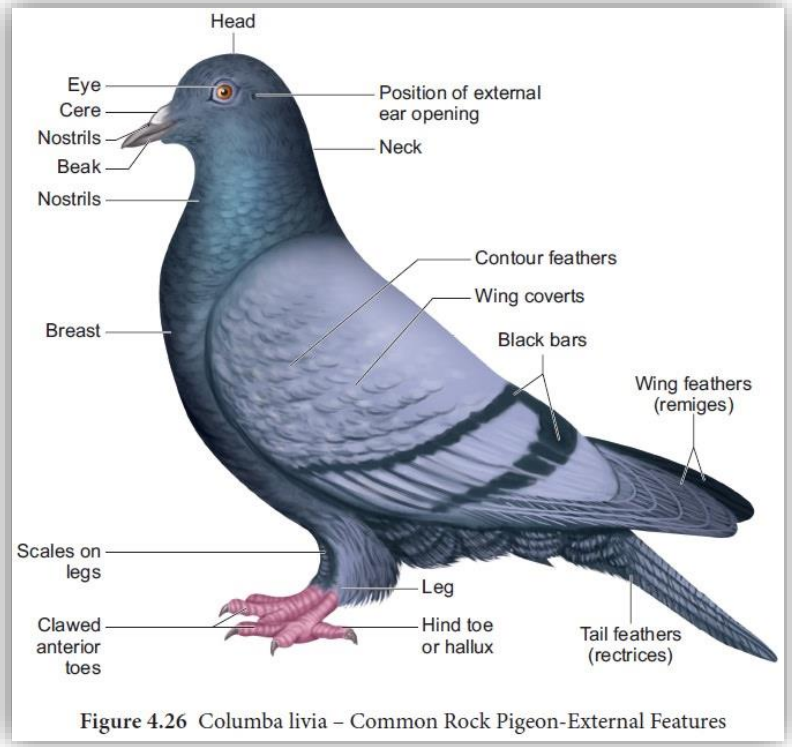
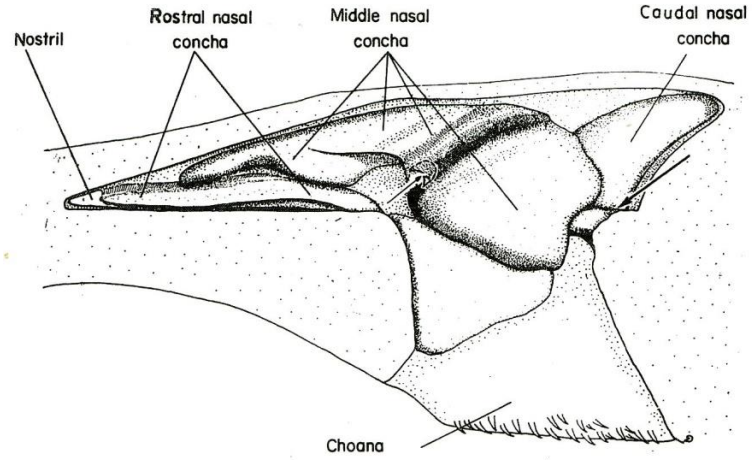
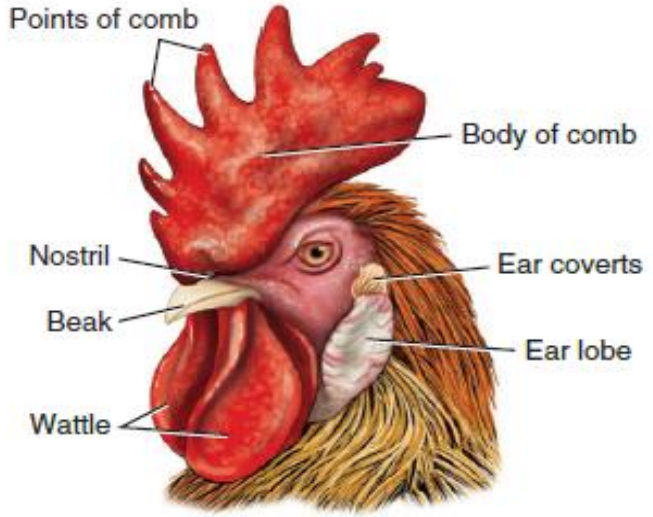
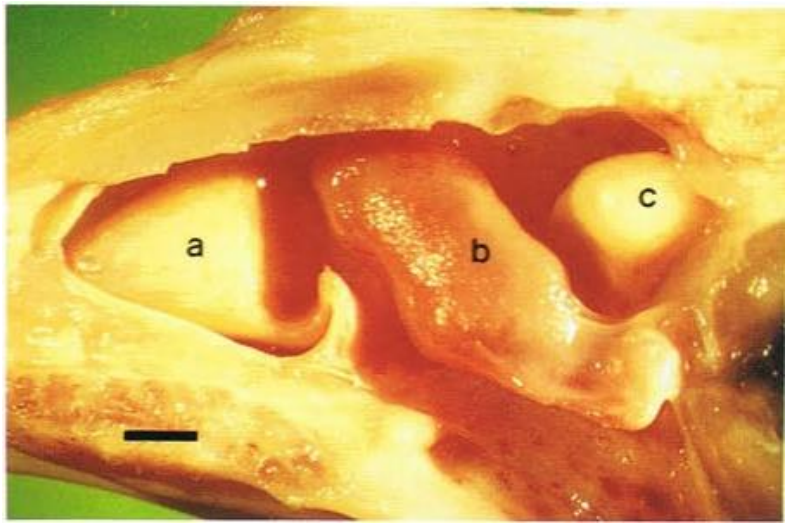


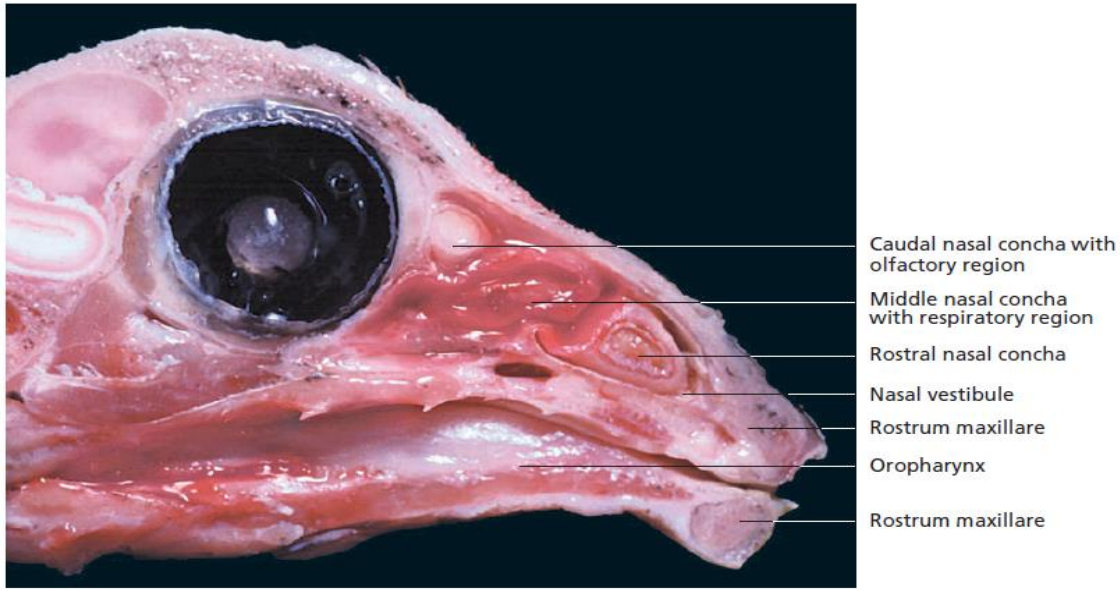
Figure 4.26 Columba livia – Common Rock Pigeon-External Features

FIG. 26.5-1 A pair of Budgerigars. The bird on the left (green and yellow) is male, and the bird on the right (blue and white) is female. In adult budgies, the cere (the fleshy area around the nostrils) is blue in males and brown in females.









7.2 Nasal conchae of a chicken (paramedian section).

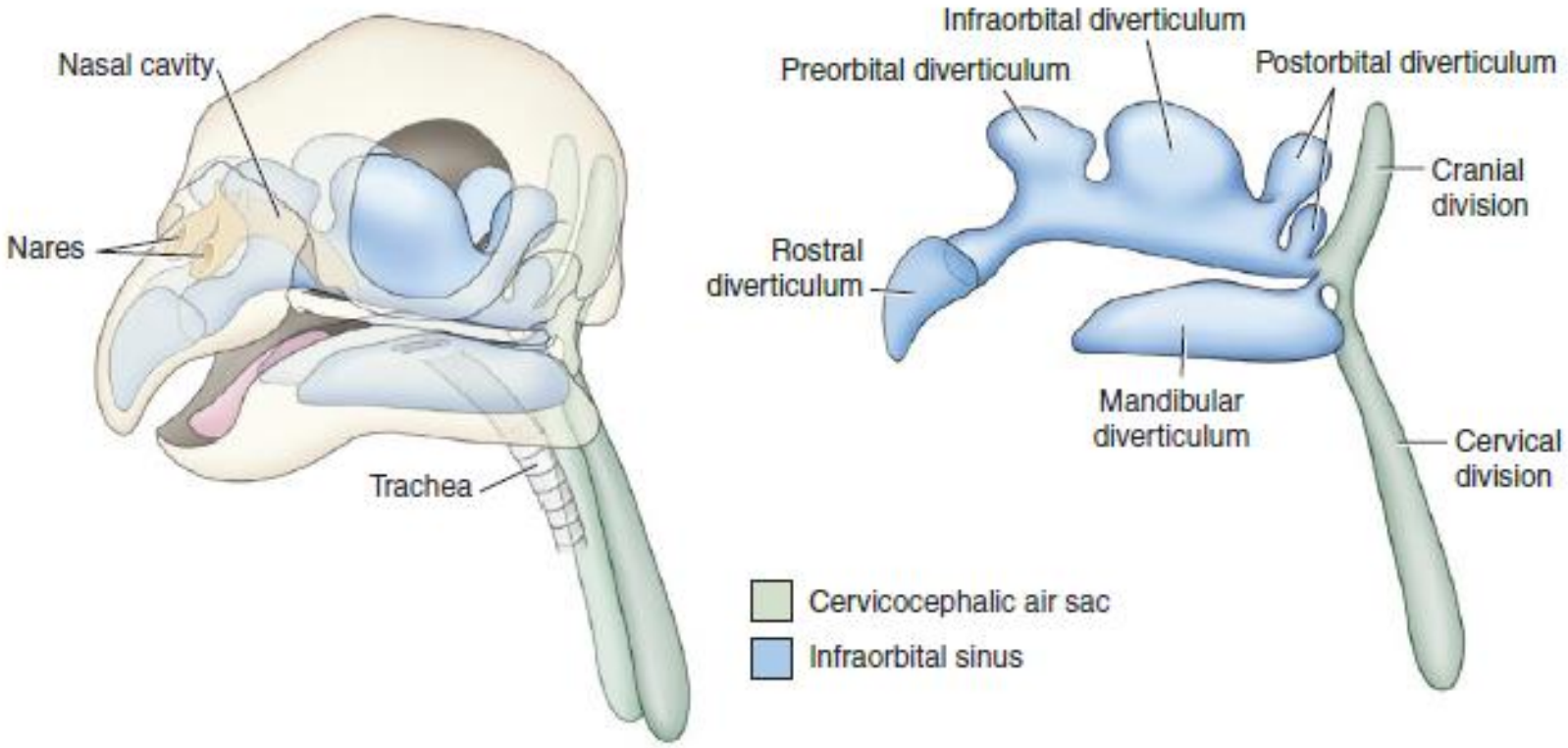


FIG. 25.1-6 Outline of the infraorbital sinus and its extensive diverticula (rostral, pre- and postorbital, axial infraorbital, and mandibular).

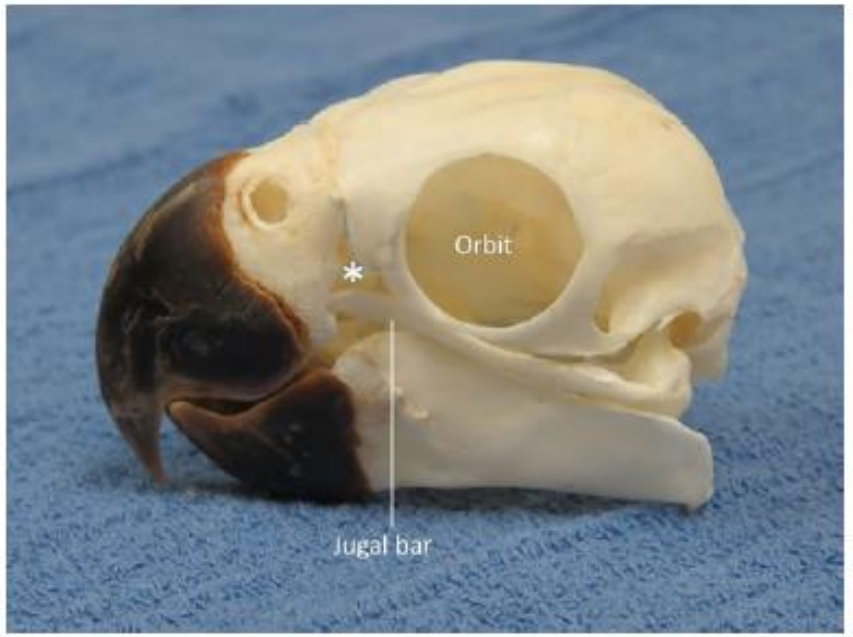


FIG. 25.1-5 Skull of a Lesser sulfur-crested cockatoo, showing the main portion of the infraorbital sinus (*asterisk*) and the bony landmarks for needle placement.

Infraorbital sinusitis is relatively common in pet parrots and may be caused by bacterial or fungal
(e.g., *Aspergillus* spp.) infection. In parrots, these two sinuses on the left and right are connected to each other, and when infected and inflamed, the top and bottom of the parrot's eye become completely swollen. Because of this connection, treating inflammation of this area in parrots is more difficult. Some passerines and anseriformes also exhibit communication between the sinuses

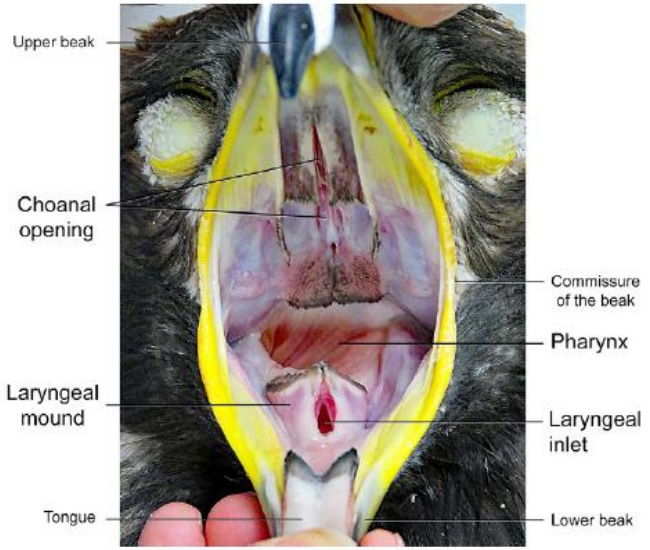
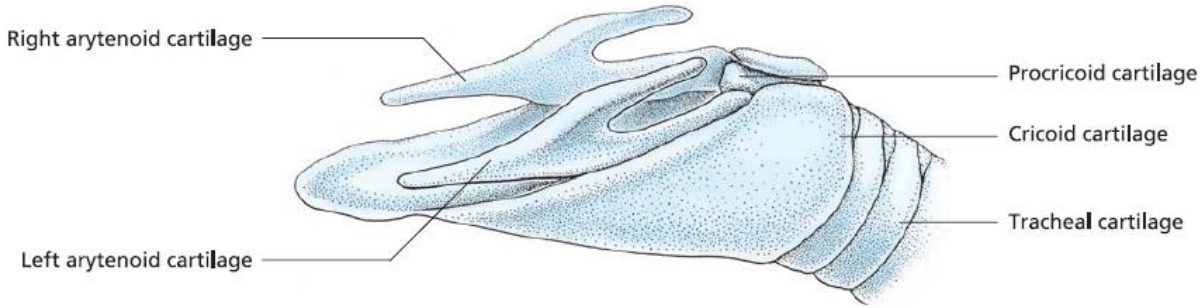


FIG. 25.3-6 Oropharynx of an anesthetized golden eagle. The beak is held open to show the slit-like choanal opening in the roof of the mouth and the glottis, just caudal to the base of the tongue. The glottis aligns with the choanal opening when the beak is closed, leading to the trachea.



7.7 Laryngeal cartilages of the chicken (schematic), adapted from Ghetie, 1976.

At the bifurcation of the trachea, there is a structure called **Syrinx**, which is used to produce sound and sing. This structure is present in ostriches and birds of prey (falcons) in a very primitive and incomplete form, and is most highly developed in passerines.

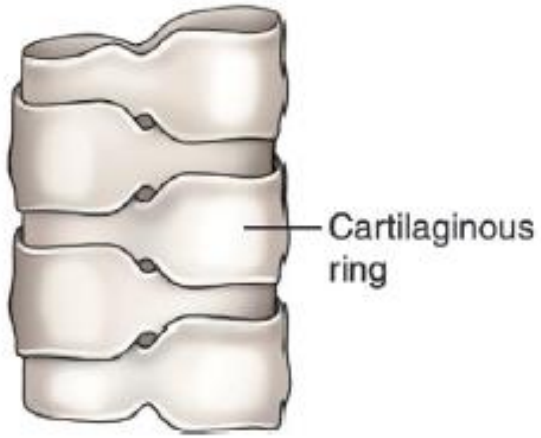


FIG. 25.3-7 Overlapping and interlocking avian tracheal rings.

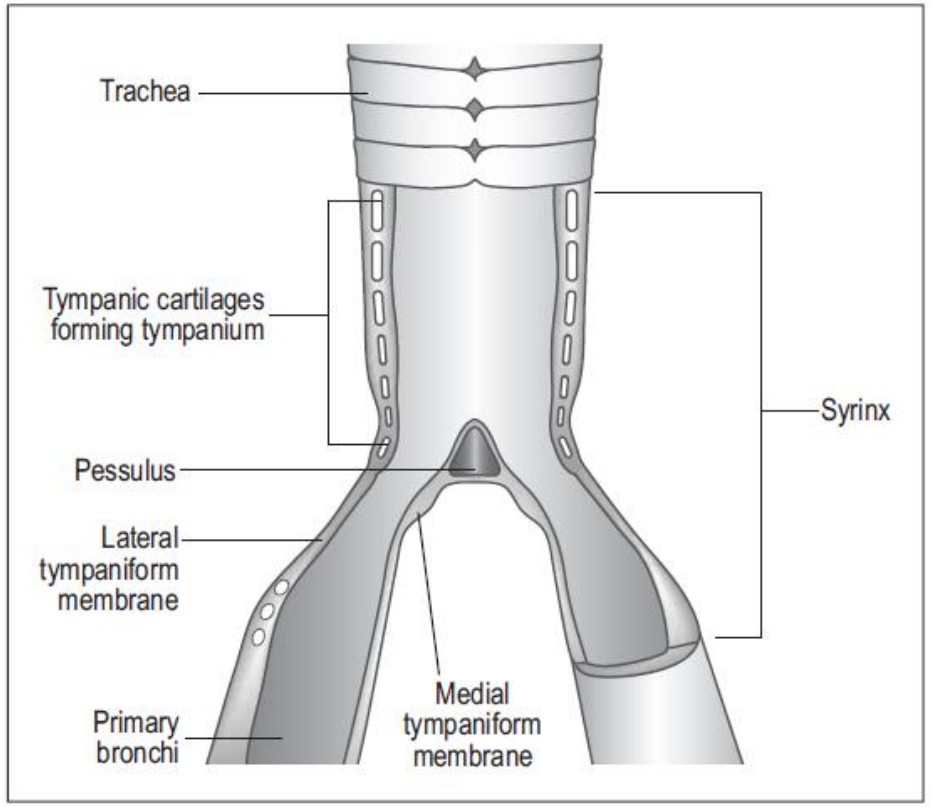


Figure 6.39 • Longitudinal section of tracheobronchial syrinx showing tympaniform membranes and syringeal cartilages.

Syringeal obstruction can arise from various etiologies, including:

Foreign Bodies: Inhalation of items such as millet seeds is common, particularly in seed-eating birds. These foreign bodies can cause acute or chronic obstruction, leading to severe respiratory distress.

Neoplastic or Granulomatous Lesions: Tumors or granulomas can form in the syrinx or trachea, obstructing airflow. For instance, fungal infections like Aspergillus spp. can lead to granulomatous lesions that significantly narrow the airway.

Strictures: These may develop due to trauma or chronic inflammation of the tracheal mucosa, often following intubation or external injuries.

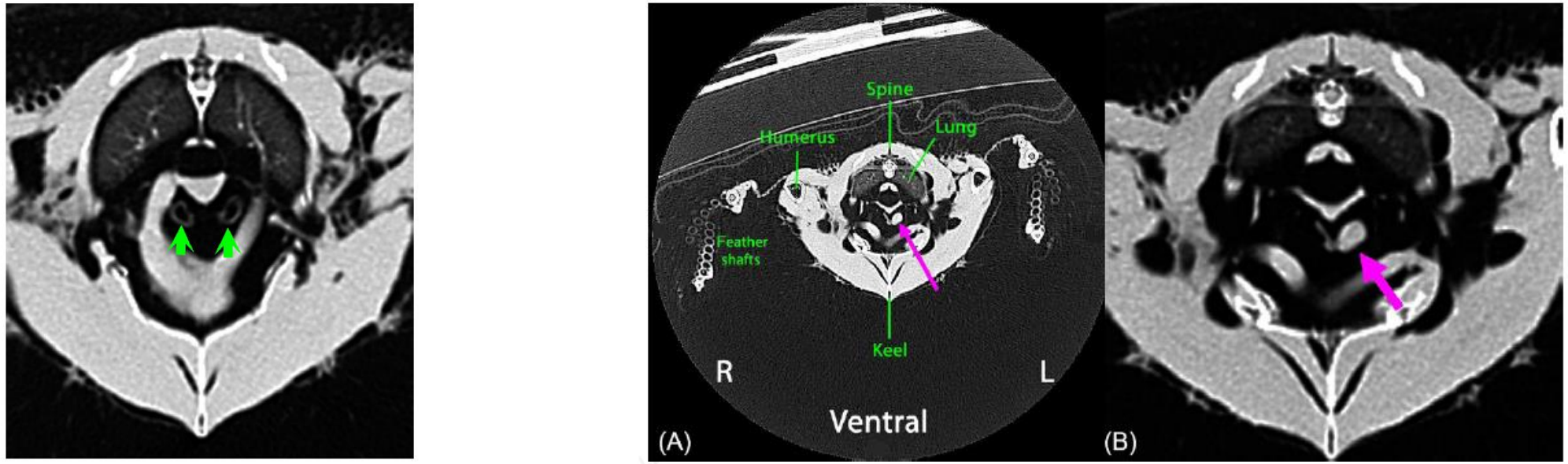
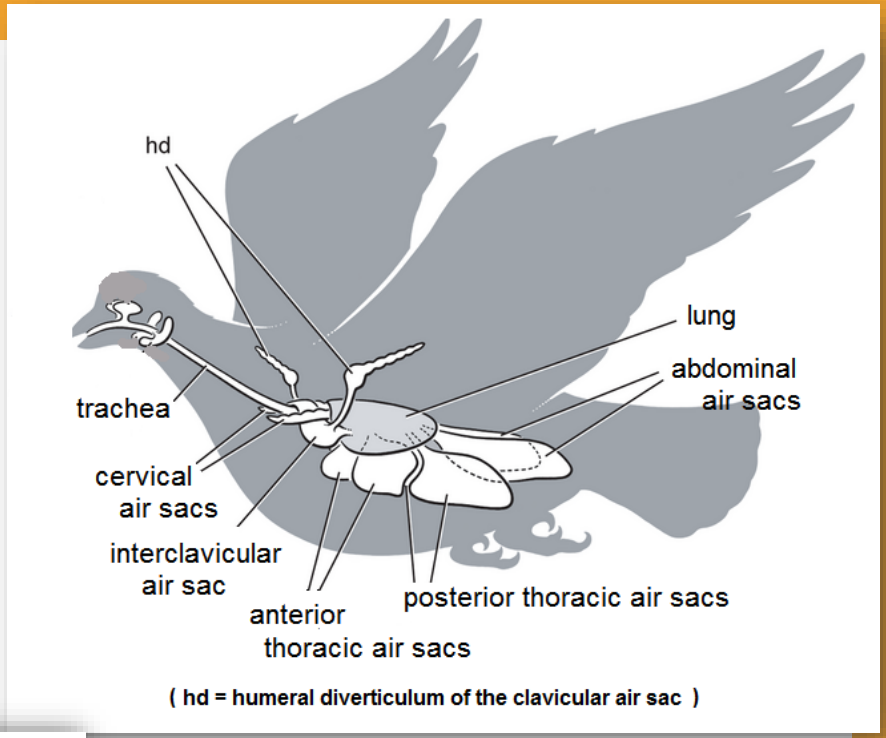


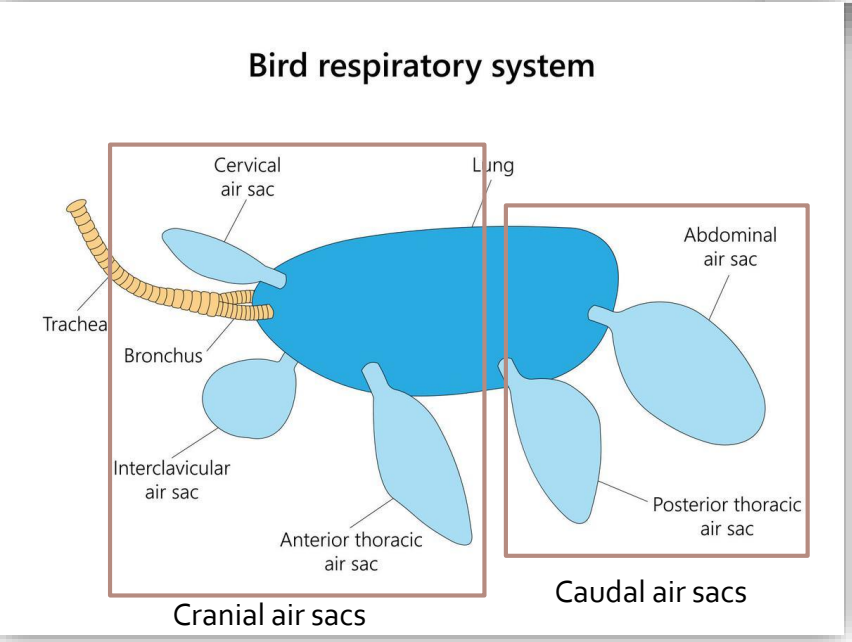
FIG. 25.3-3 Transverse image just caudal to that shown in Fig. 25.3-2. Both left and right primary bronchi are normal (*green arrows*), indicating that the obstruction was confined to the syrinx and first few millimeters of the left primary bronchus.

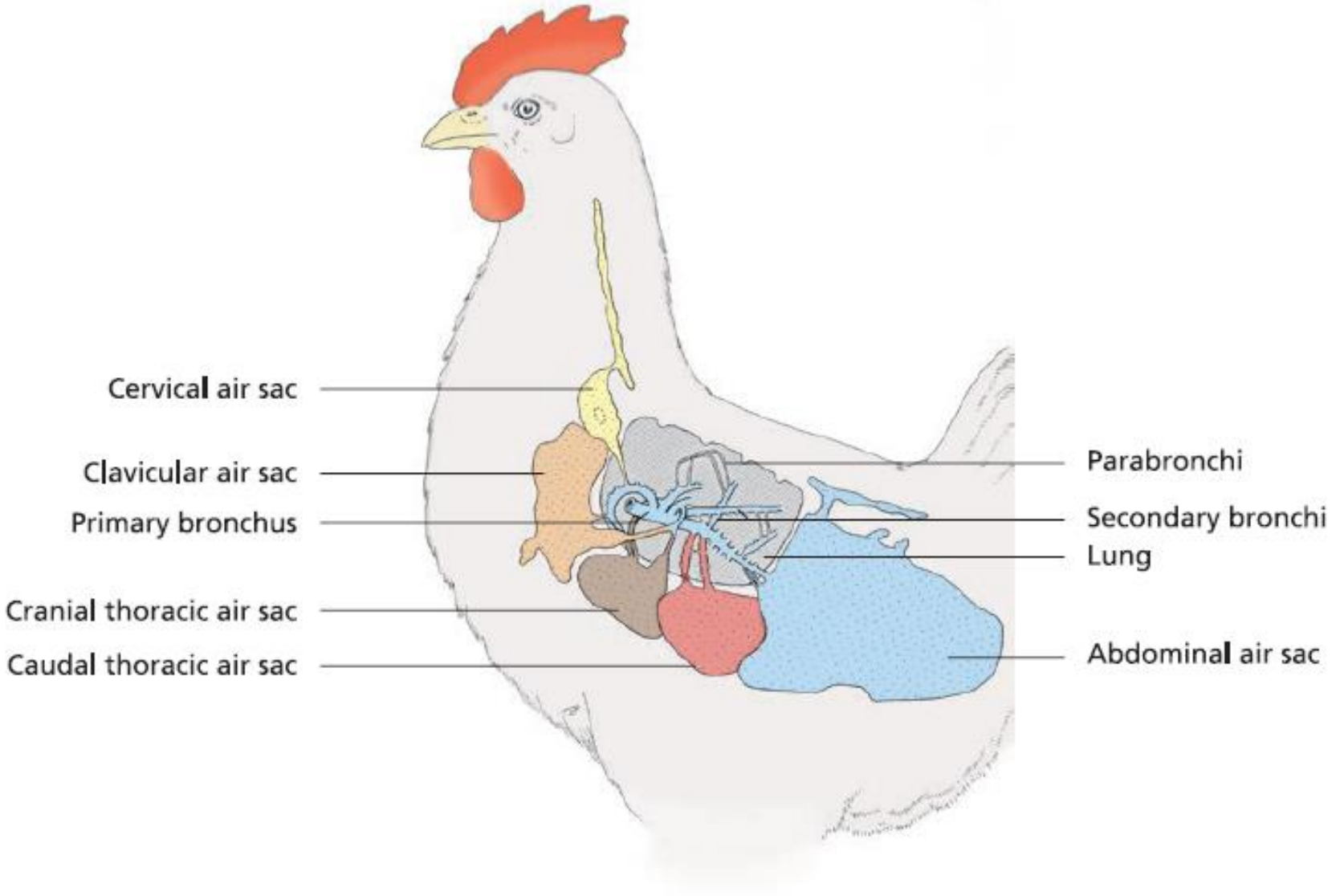
Air sacs help with breathing and storing air, making their bodies lighter.in cases of tracheal obstruction and dyspnea, the air stored in the air sacs helps with the breathing process.

In addition, regulating temperature, protecting the kidneys, helping with sperm production in males, and helping sperm survive in females due to their cooling mechanism are other functions of the air sacs.

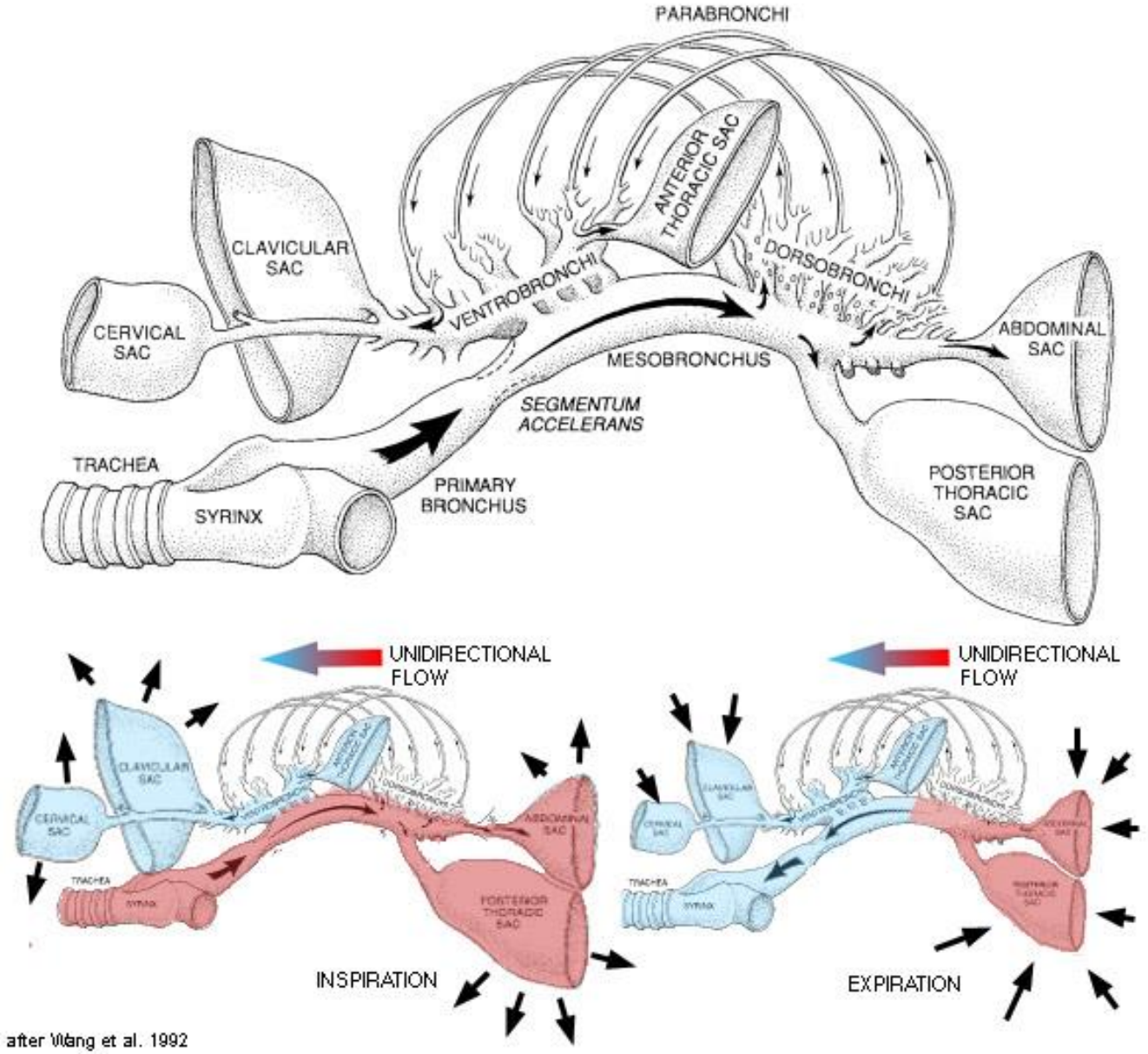
Ostrich does not have air sacs.







7.1 Relationship between the air sacs and the bronchial system in the chicken (schematic).



after Wang et al. 1992

The one-way passage of air through the avian lungs occurs as a 4-phase process:

1. When the bird inhales, air enters the trachea and passes through the primary bronchi into the caudal thoracic and abdominal air sacs, collectively called the caudal air sacs.

2. When the bird exhales, this initial breath travels through the parabronchi and is thereby drawn across the air capillaries of the lungs.

3. With the next inhalation, the original breath travels from the lungs to the cervical, clavicular, and cranial thoracic air sacs, collectively called the cranial air sacs. At the same time, a second breath of fresh air is inhaled through the trachea and enters the causdal airsacs (and another step 1 begins).

4. On the next exhalation, the initial breath is finally exhaled through the trachea.

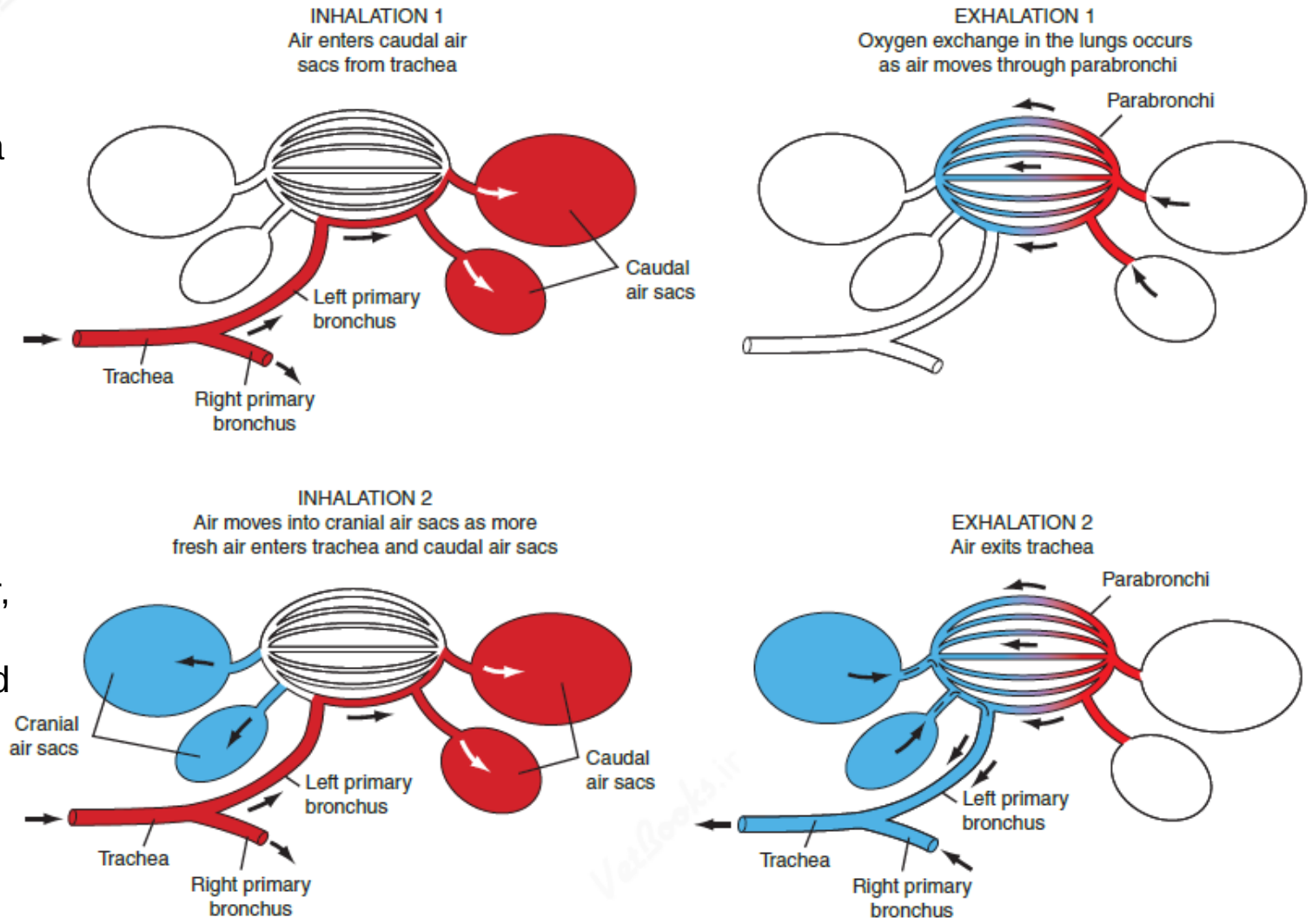
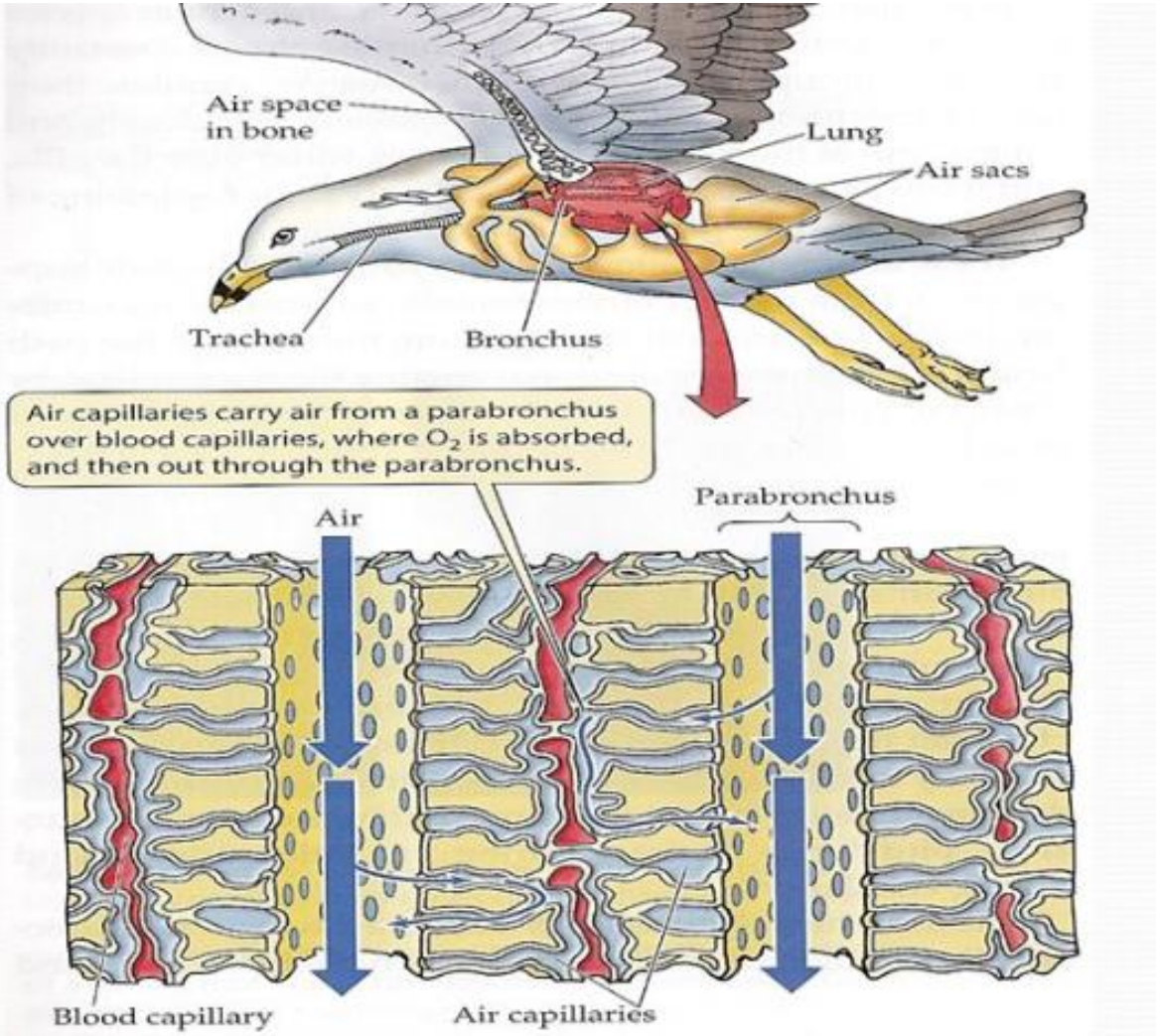
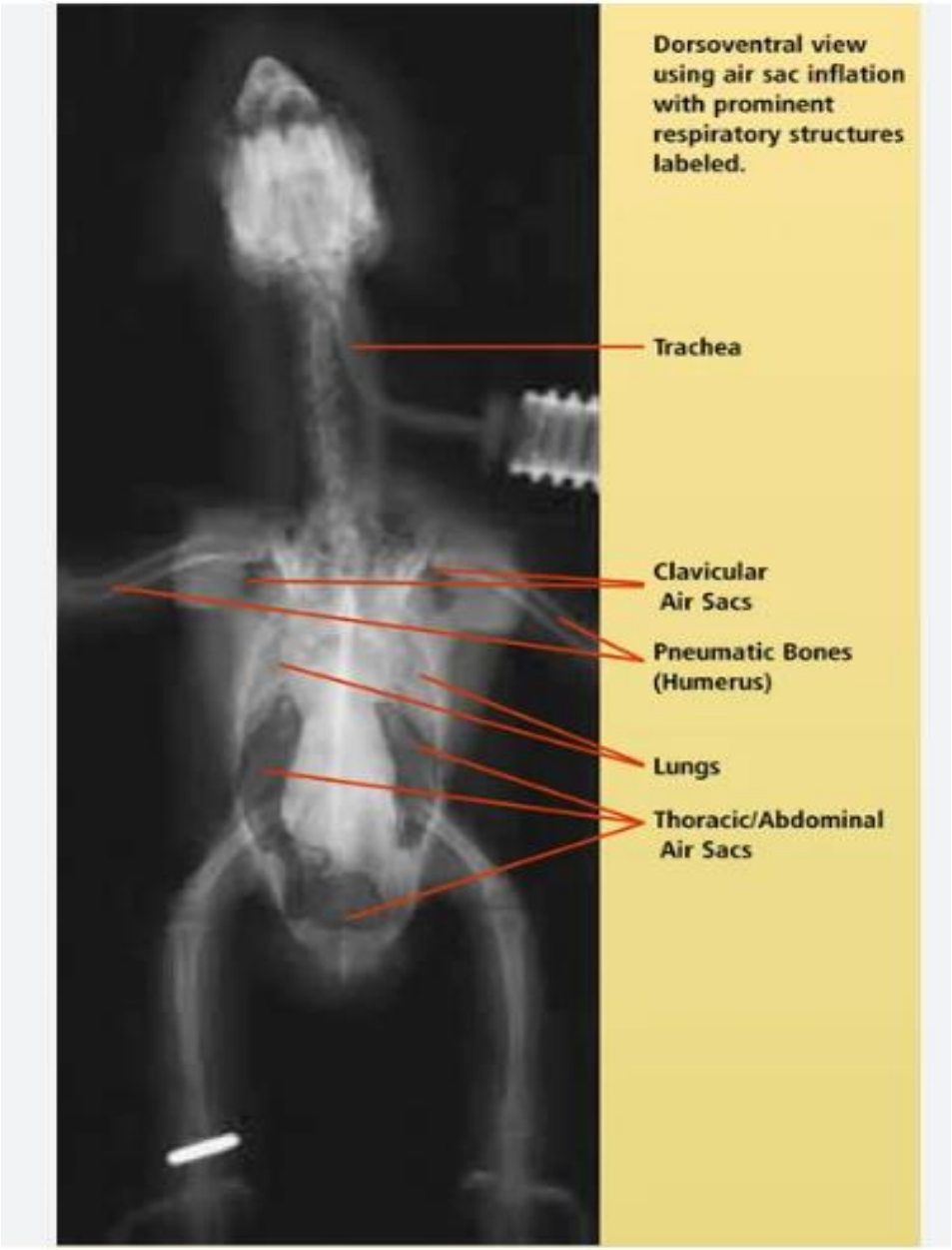


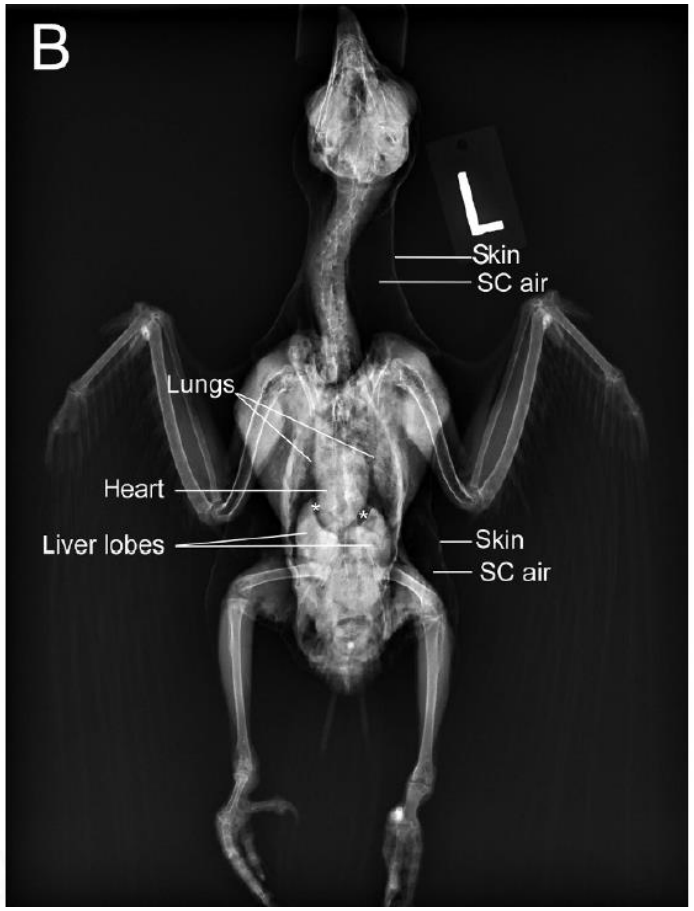
FIG. 26.3-6 The pattern of air flow through the avian air sacs.



48.7 The Respiratory System of a Bird (*a*) The air sacs and air spaces in the bones are unique to birds. (*b*) Air flows through bird lungs unidirectionally in parabronchi. Air capillaries, the site of gas exchange, branch off the parabronchi.



Air sacculitis, also referred to as air sac disease, is a common inflammatory condition affecting the air sacs of birds, primarily caused by bacterial infections, but can also result from fungal or, rarely, viral agents. This condition poses significant health risks, particularly to domesticated poultry, and can lead to substantial economic losses in farming operations due to its infectious nature. Based on clinical signs and confirmed by autopsy, showing red, swollen, fluid-filled air sacs



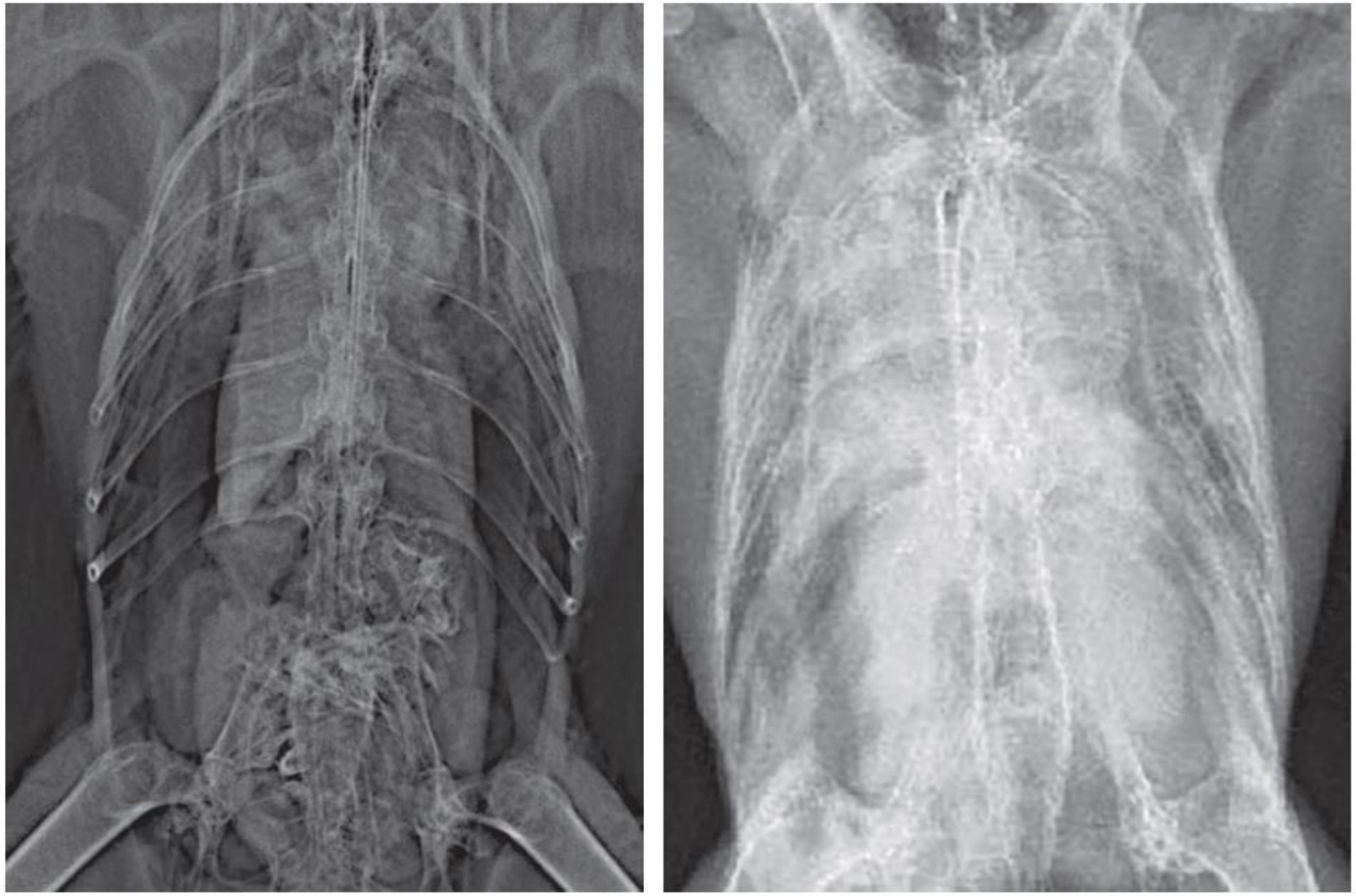
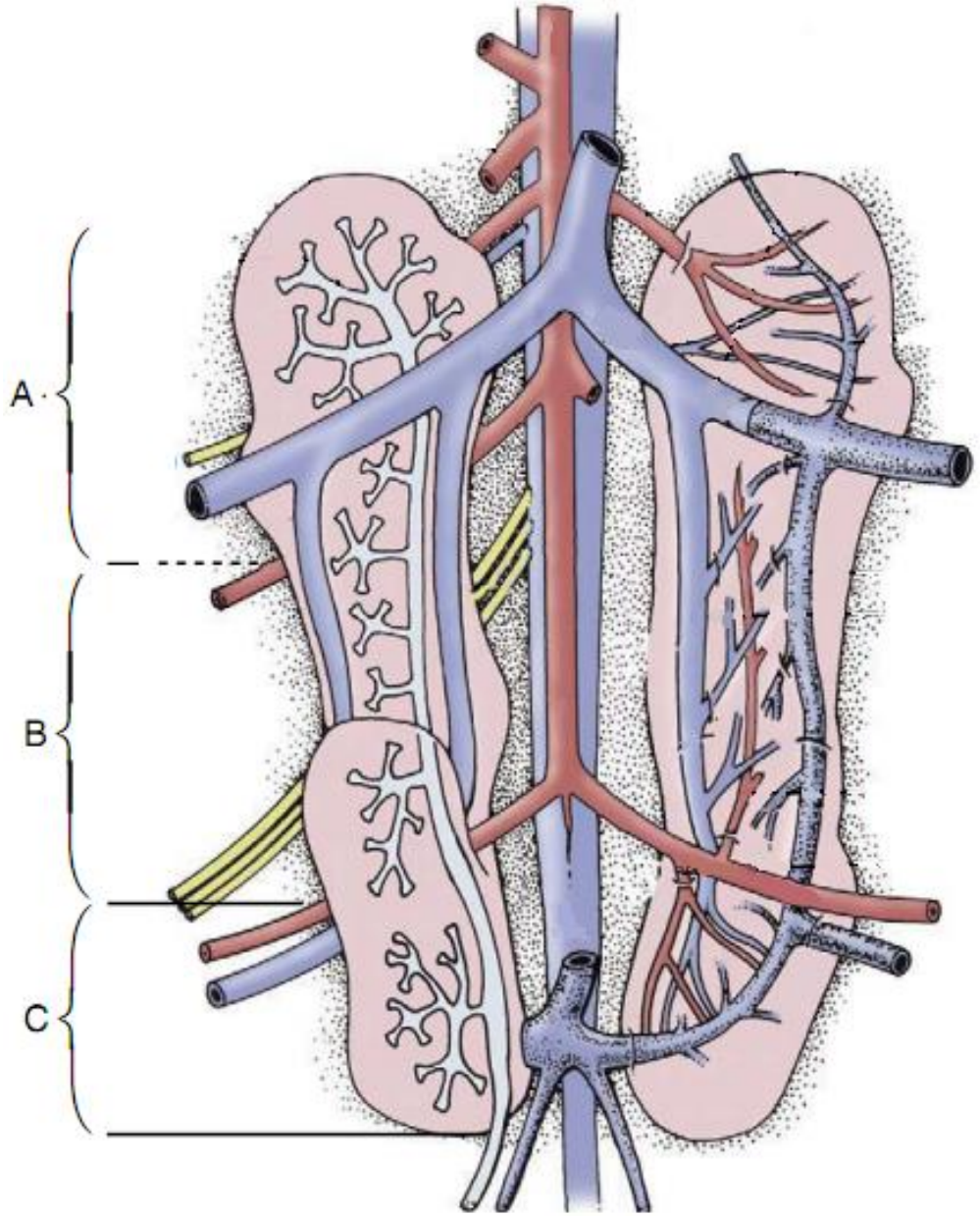
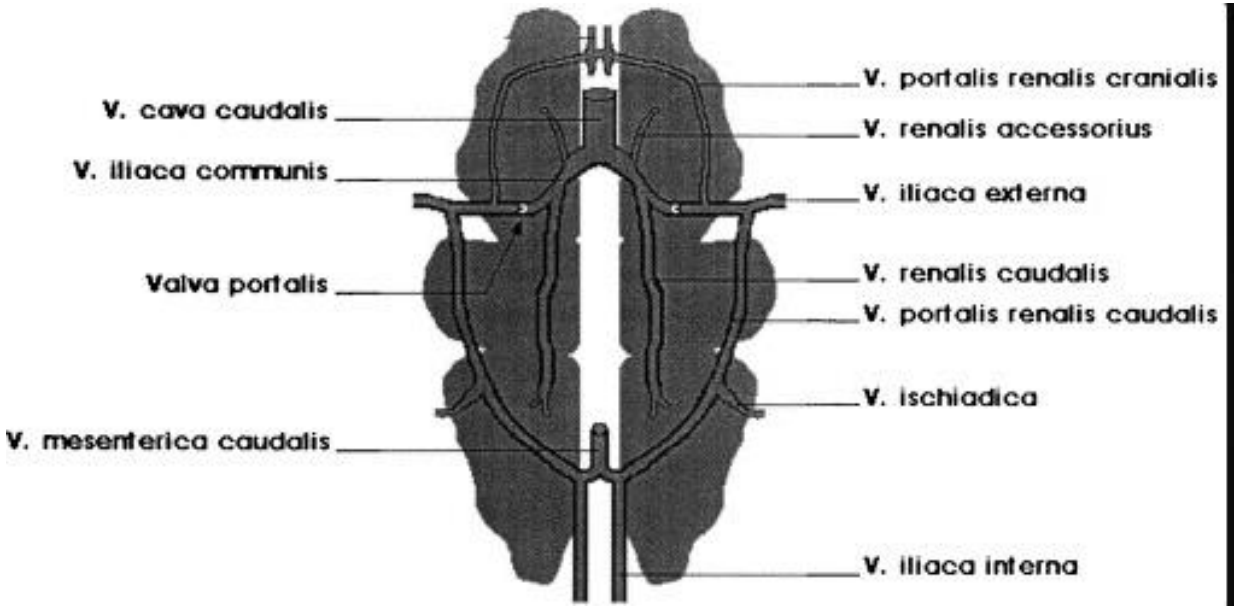


Fig. 2.7. Healthy air sacs (left) appear dark. There may be (as in this radiograph) an hourglass appearance formed by the heart and liver, but this is not always present. Compare to the radiograph on the right from a bird with severe air sacculitis due to Aspergillosis.

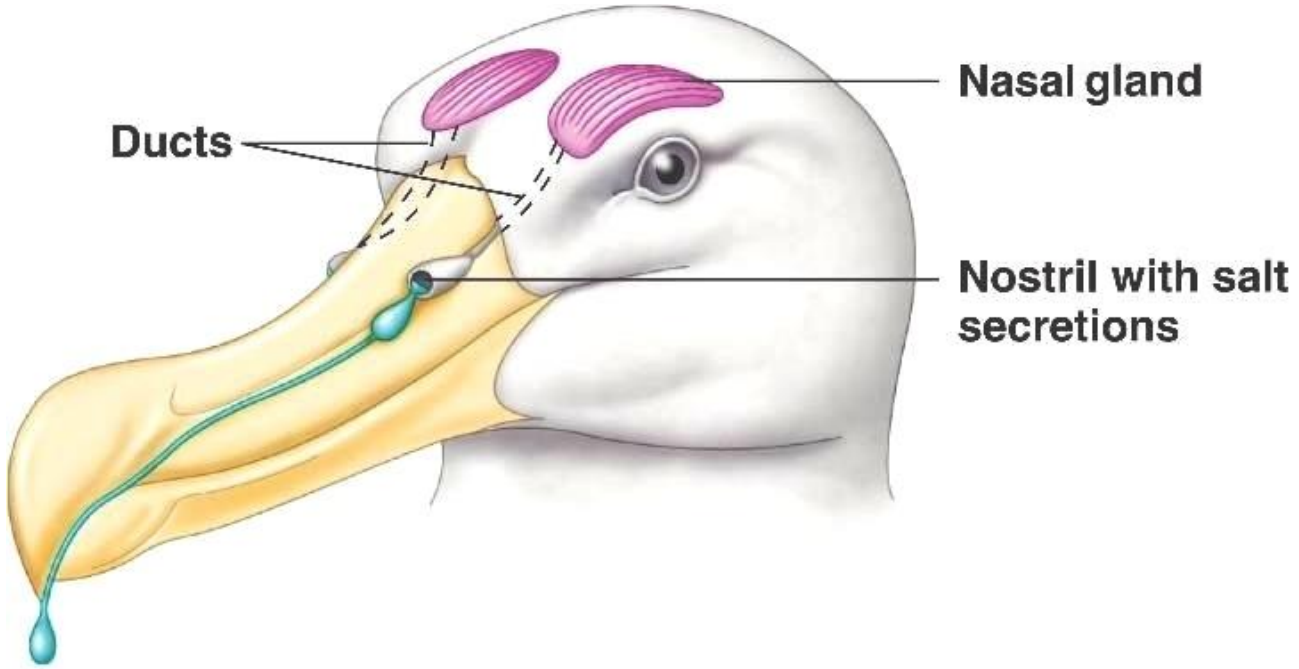

A
B
C


V. cava caudalis
V. iliaca communis
Valva portalis
V. mesenterica caudalis
V. portalis renalis cranialis
V. renalis accessorius
V. iliaca externa
V. renalis caudalis
V. portalis renalis caudalis
V. ischiadica
V. iliaca interna

NASAL (SALT) GLAND

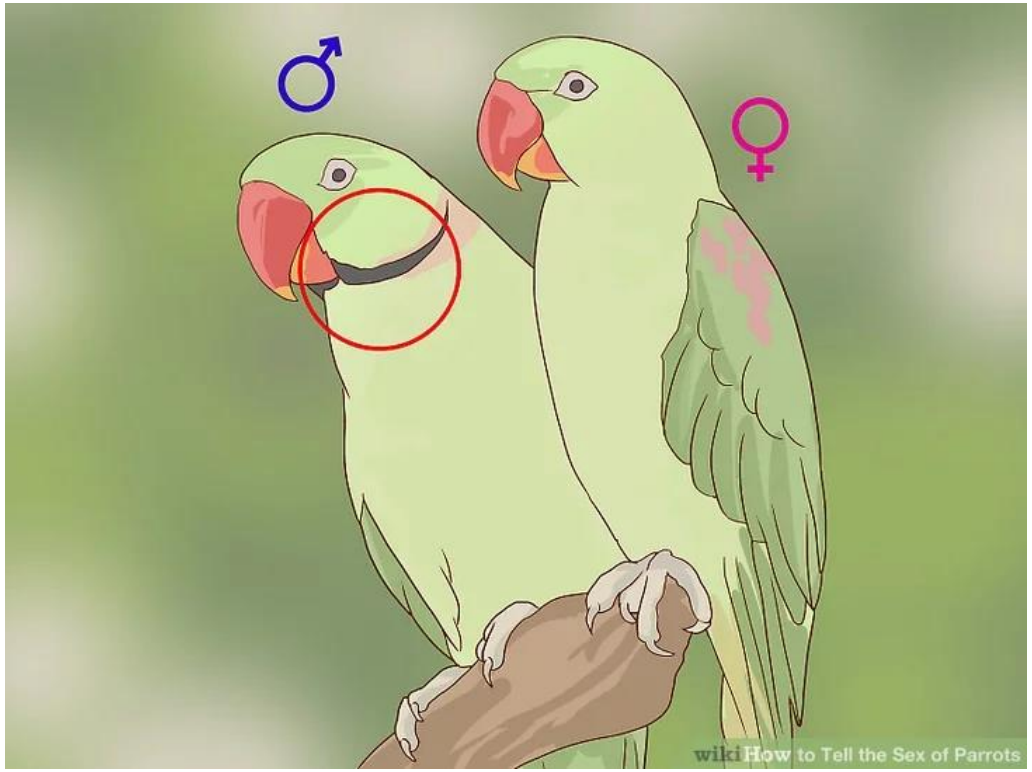
Some avian species, have a paired nasal gland, left and right, that lies within the orbit, dorsonasal (dorsomedial) to the globe. Its duct penetrates the frontal bone and enters the nasal cavity. The gland is bilobed in many birds, although chickens have only a single medial lobe. The nasal gland actively secretes sodium chloride—therefore, it is also referred to as the salt gland—which assists in osmoregulation by providing an extra-renal mechanism for salt excretion.

This renal "assist" is particularly important in marine and some desert birds. For example, in pelagic ("open sea") marine birds with only sea water to drink, the nasal gland allows them to remain at sea without returning to land for fresh water.



GENDER DETERMINATION IN BIRDS

Sexual dimorphism is not universal in birds, and physical examination may not be adequate for gender determination, especially for many species of pigeons, and raptors. Relative body size is usually reliable in raptors (females tend to be larger than males). The advent of DNA analysis of blood or feather samples has decreased the need for surgical or endoscopic gender determination in birds.



بلوغ و تعیین جنسیت در پرندگان

زمان بلوغ در پرندگان مختلف ، متفاوت است . به طوریکه در طوطی سانان کوچک این زمان 6 تا 12 ماه و در طوطی سانان بزرگ 3 تا 6 سال می باشد . در گنجشک سانان 9 ماه تا 1 سال ، در باز سانان 1 تا 3 سال ، در طیور 5 تا 7 ماه و در کبوتر 5 تا 12 ماه است.ه م چنین در مورد پرندگان آبزی ، این زمان در اردک یک سال در غاز 2 سال و در قو 5 سال می باشد .

به طور کلی نور دهی ، دسترسی به غذا و فصل دربلوغ و رشد گناد ها نقش زیادی دارد . به عنوان نمونه اگر سار تحت این شرایط قرار گیرد گناد هایش 1500 برابر اندازه ی معمولی خواهد شد .

تعیین جنسیت در طوطی سانان ، کبوتر و پرندگان آبزی به استثنای اردک مشکل و در بقیه پرندگان معمولا به راحتی صورت می گیرد .

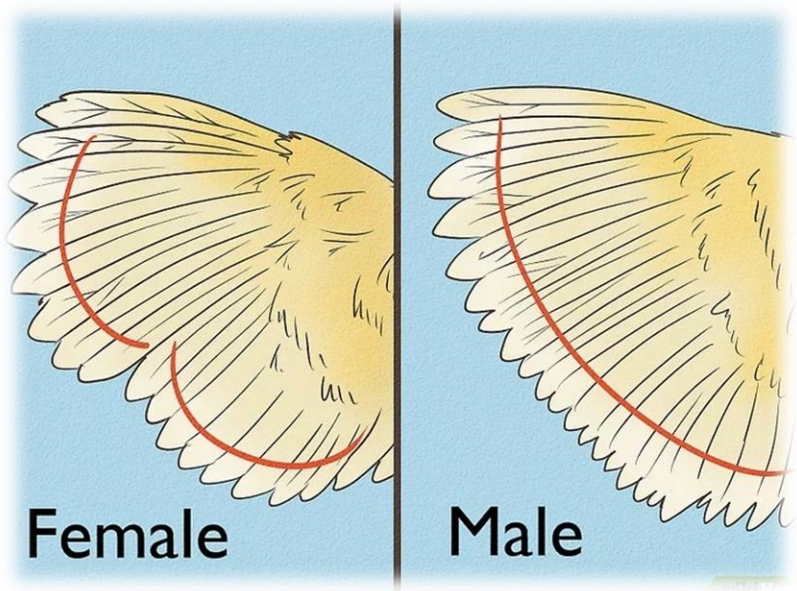
اما تعیین جنسیت در پرندگان از راه های مختلف انجام می گیرد که به شرح ذیل می باشند :

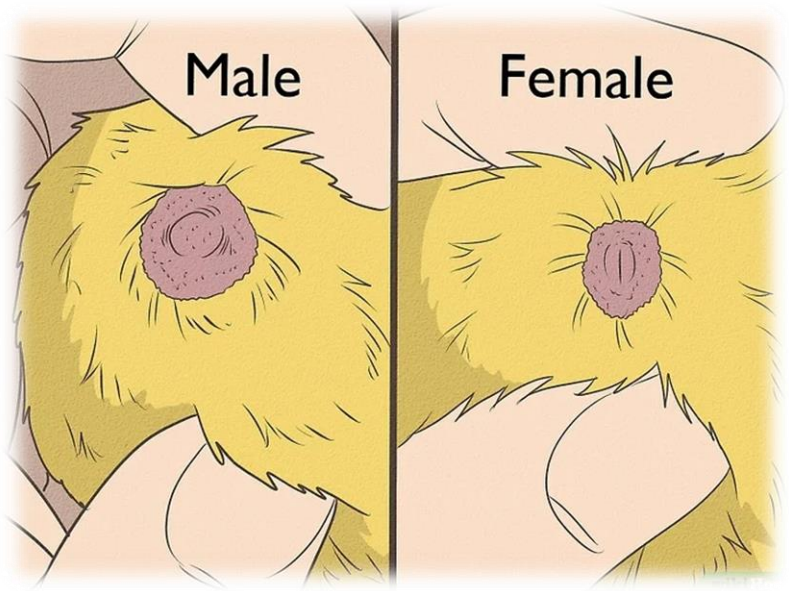
1.مشخصه های ظاهری : مثلا در طوطی استرالیایی یا همان مرغ عشق ، رنگ سی یر (Cere) در جوجه نر آبی و در جوجه ماده قهوه ای رنگ است .

2. مشاهده ی منفذ خروجی کلوآک (Vent sexing) :این یک روش قدیمی برای تعیین جنسیت در سالن های پرورش طیور می باشد . این منفذ در جوجه های نر گرد و در جوجه های ماده مخروطی می باشد .

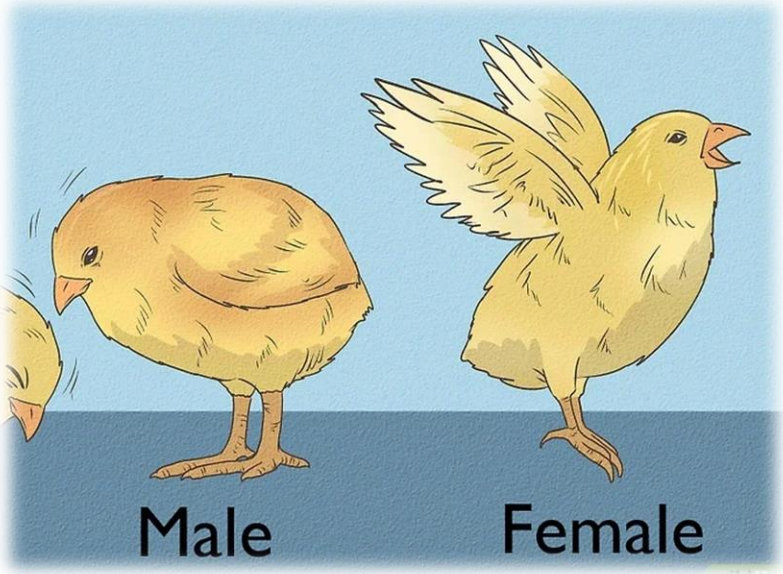
3. تعیین جنسیت از طریق جراحی : در این روش با برش های لاپاراتومی شکم پرنده باز شده و دستگاه تناسلی پرنده مشاهده می گردد . در کبوتر که روش های معمولی در تعیین جنسیت به راحتی جواب نمی دهد ، این روش می تواند کمک کننده باشد .

4. آنالیز DNA خون نیز روش دیگری است که می توان از آن استفاده کرد .





Vent has two dorsal and ventral lips. This opening is circular in parrots and U-shaped in ducks and geese.



In the male sex, there is a pair of testicles, a pair of sperm collecting ducts, and a pair of sperm storage(Receptacle of ductus deferens) cells that bring the sex cells to the cloaca.

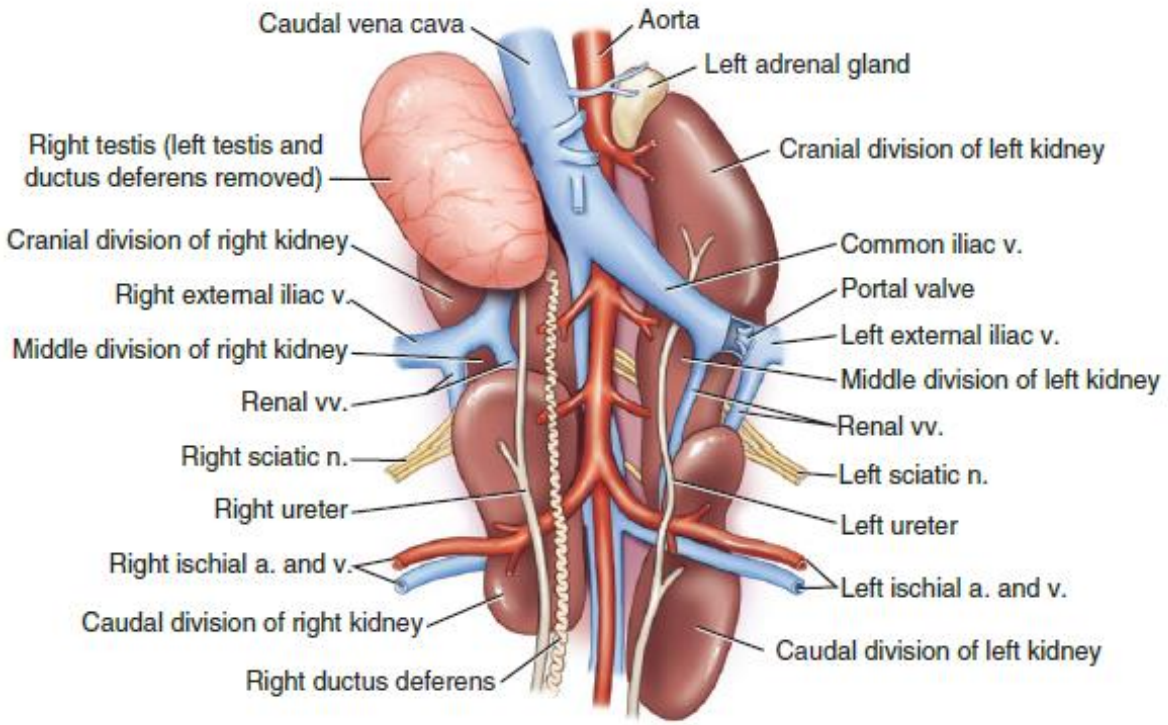
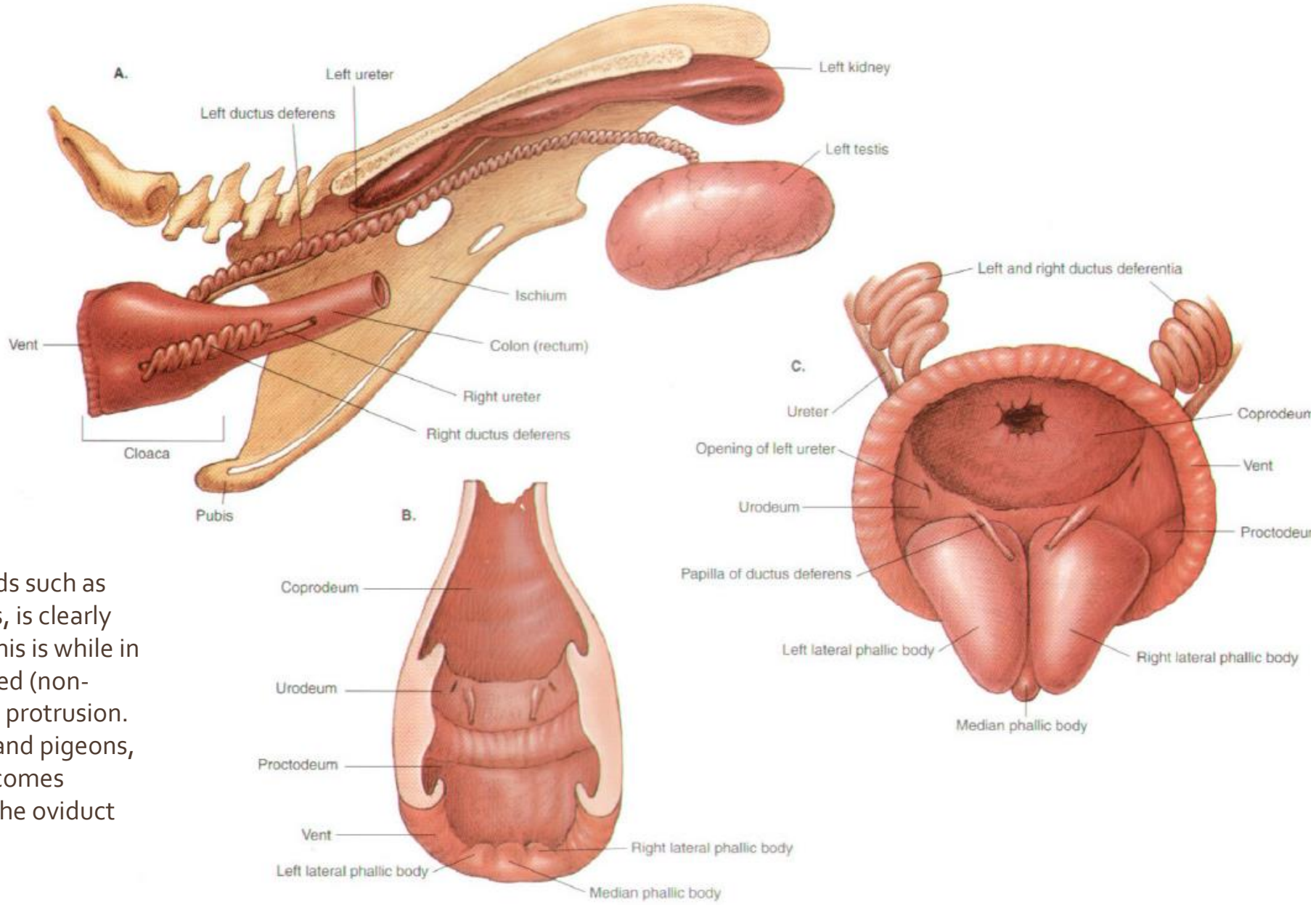
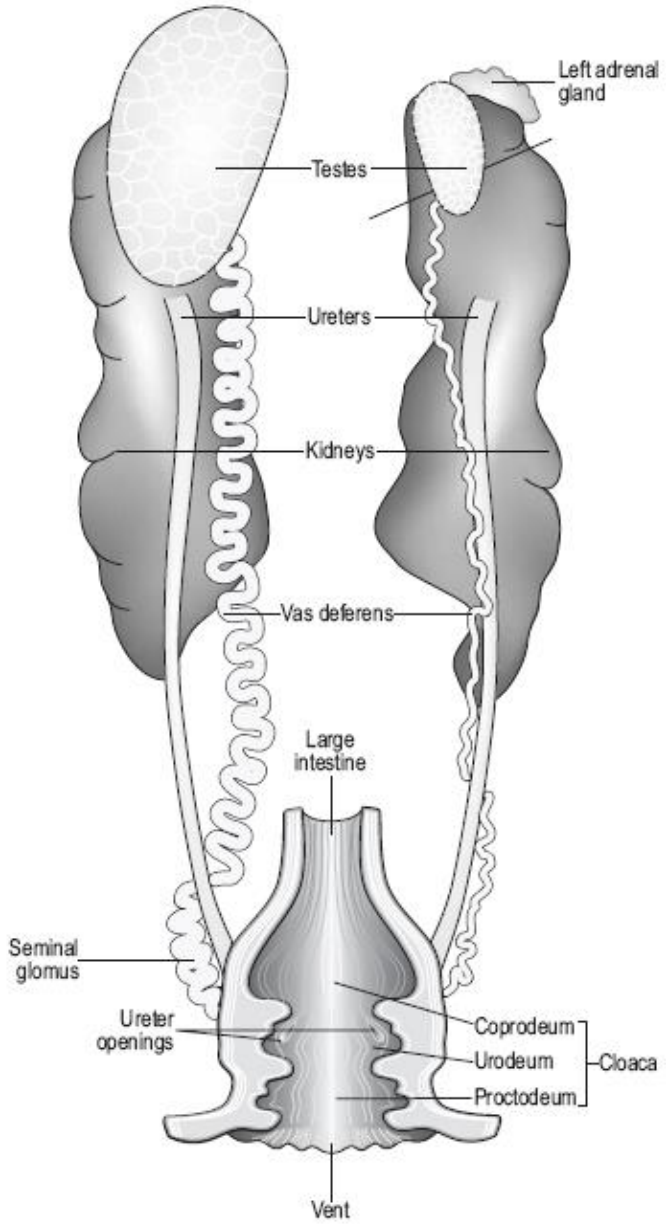


FIG. 26.5-4 Anatomy of the avian male reproductive and urinary systems. (the right testis and, right deferent duct are illustrated; the left testis and deferent duct have been removed to better visualize the left kidney.) Note the position of the sciatic nerve passing through the middle division of the kidneys.



The **copulatory organ** in aquatic birds such as geese and ducks, as well as ostriches, is clearly visible and protruding (protrusile). This is while in roosters, this organ is underdeveloped (non-protrusile) and in the form of a small protrusion. Also, in passerines, parrots, falcons and pigeons, this organ is absent, and the sperm comes directly from the cloaca and enters the oviduct of the female bird.



Because the cloaca is common to the digestive, urinary, and genital tracts, collection of urine that is free of fecal contamination is difficult or impossible in birds. Furthermore, urine samples are of limited diagnostic value because post-renal fluid and electrolyte resorption occurs in birds.

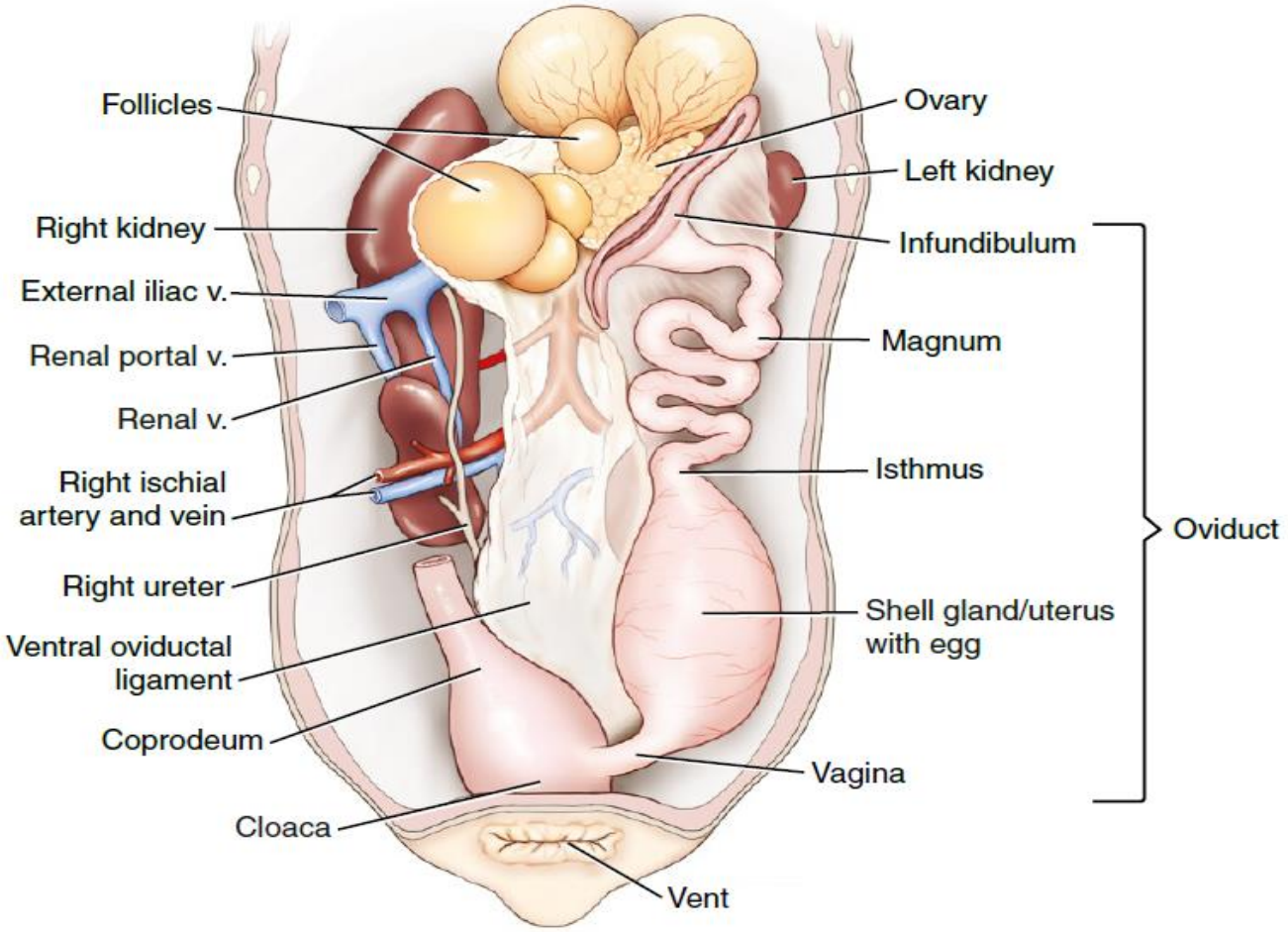
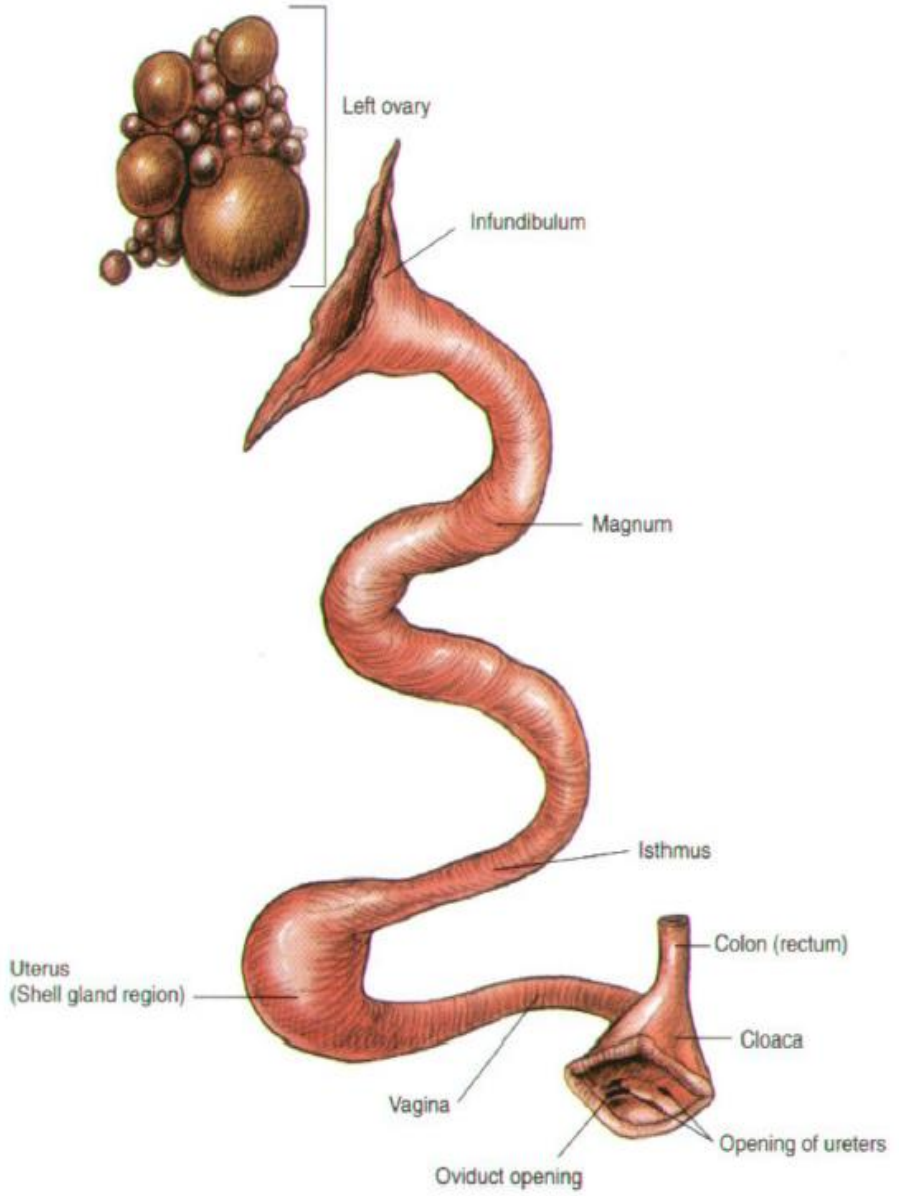


FIG. 26.2-5 Female reproductive system of a chicken (ventral/dorsal view), showing the ovary (and its relation to the kidneys), oviduct (infundibulum, magnum, isthmus, uterus, vagina), cloaca, and vent.

In the female, the left ovary is active and the right is inactive. The oviduct, whose wall has specialized sections that secrete albumen and calcareous shell around the egg (fertilization takes place in the oviduct before the albumen and shell are secreted). Then the egg is expelled from the cloaca, which is the common outlet between the genitourinary and digestive systems.



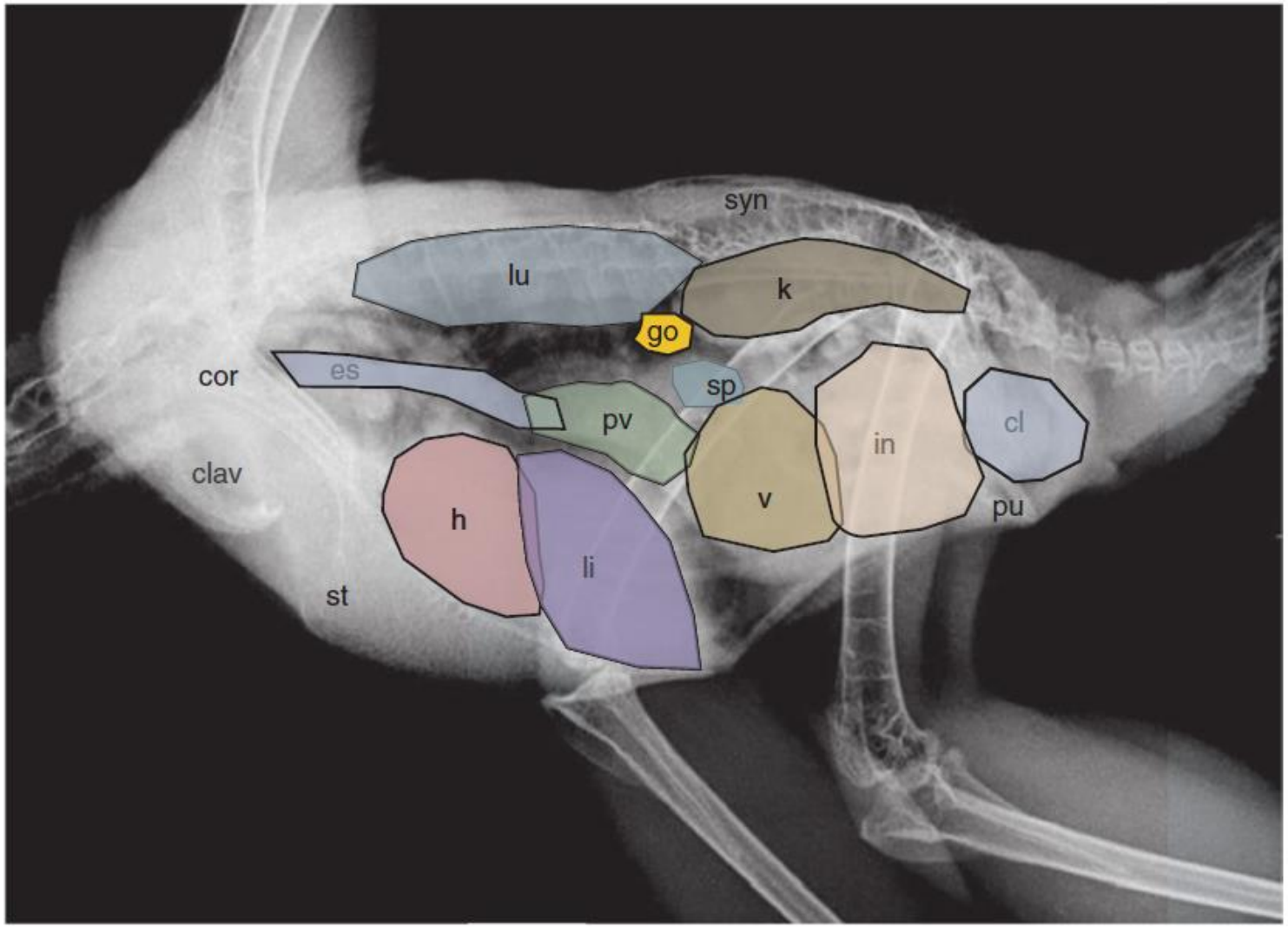


Fig. 2.10. Structures seen on lateral view: clavicle (clav), coracoid (cor), sternum (st), heart (h), liver (li), esophagus (es), proventriculus (pv), spleen (sp), ventriculus (v), lung (lu), kidney (k), gonad (go), intestines (in), pubis (pu), cloaca (cl), synsacrum (syn).

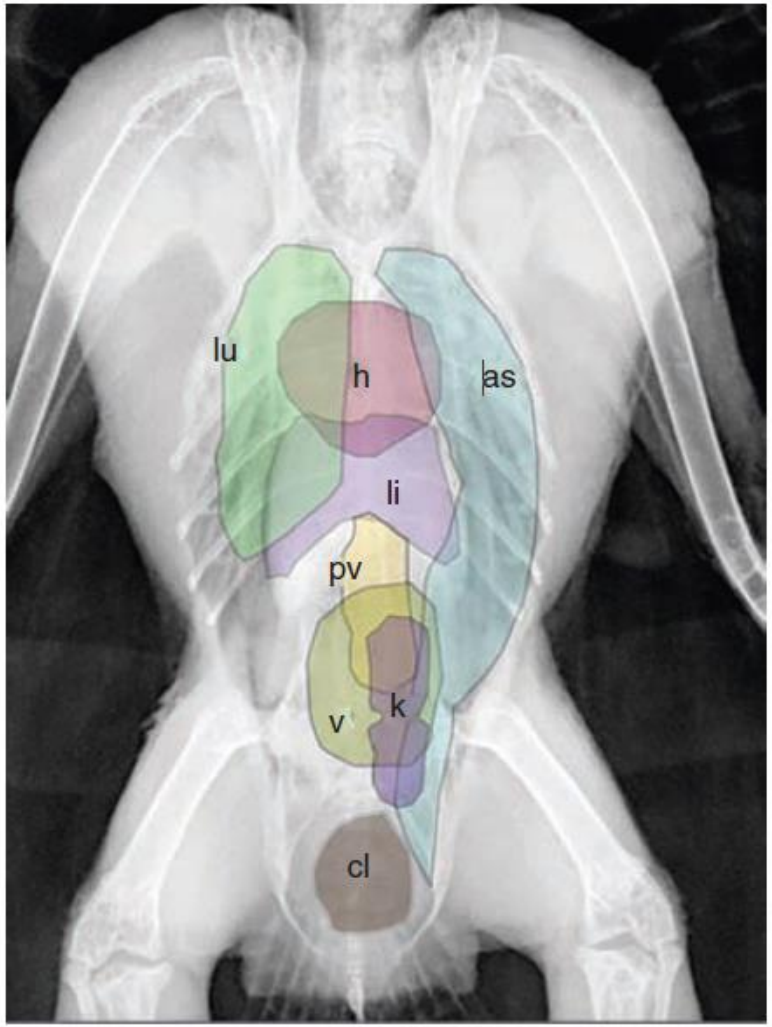
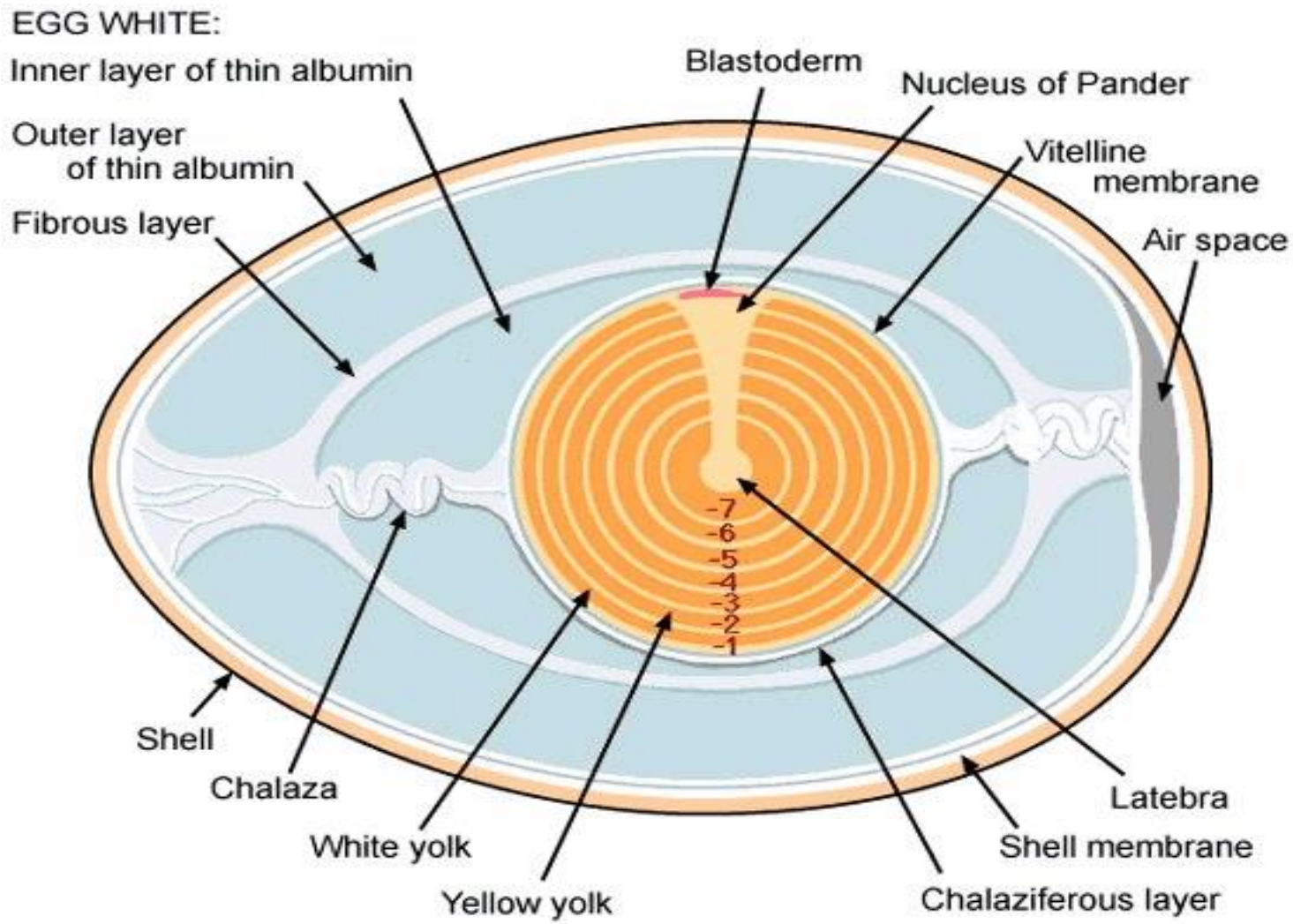
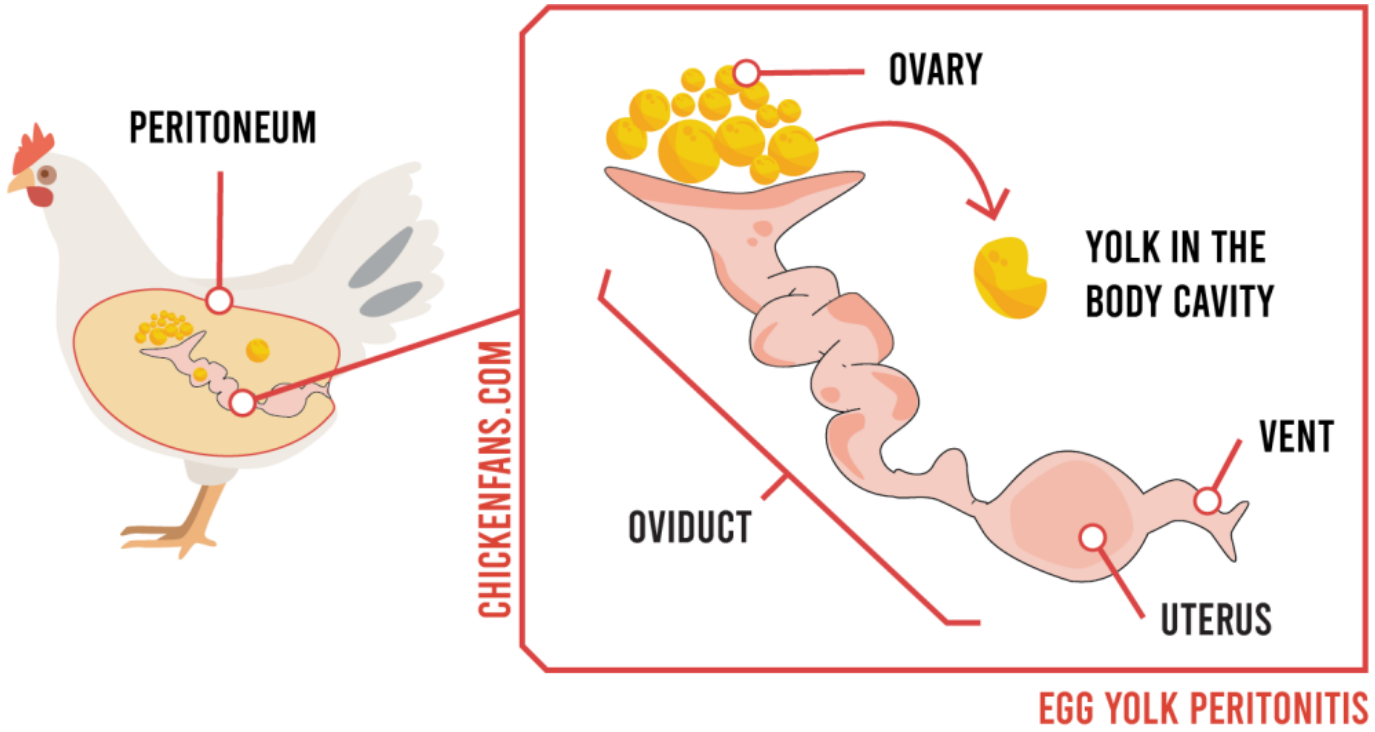
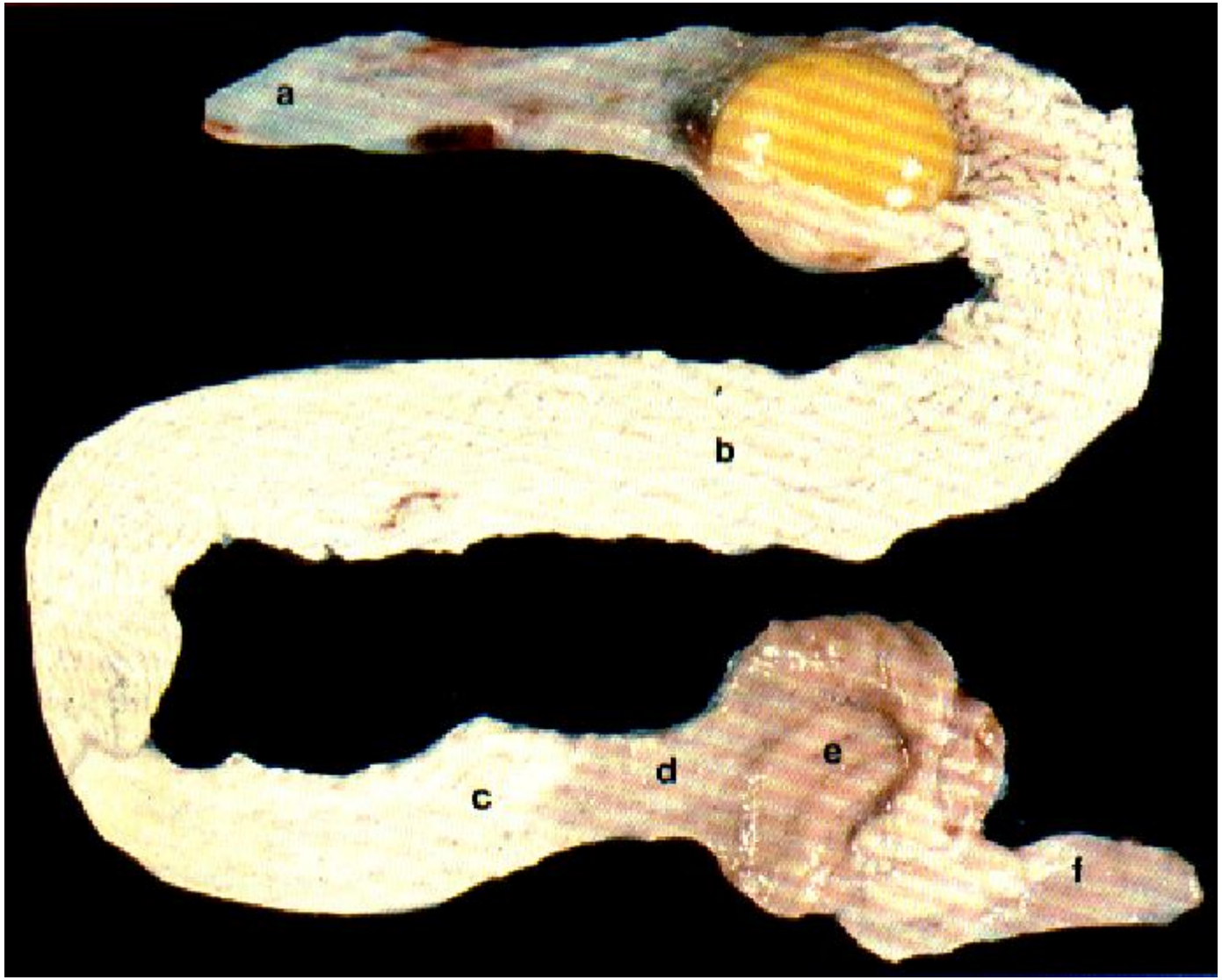


Fig. 2.8. Soft tissue structures seen on VD view: heart (h), lung (lu), air sacs (as), liver (li), proventriculus (pv), ventriculus (v), kidney (k) cloaca (cl).


EGG WHITE:
Inner layer of thin albumin
Outer layer of thin albumin
Fibrous layer
Blastoderm
Nucleus of Pander
Vitelline membrane
Air space
-7
-6
-5
-4
-3
-2
-1
Shell
Chalaza
White yolk
Yellow yolk
Latebra
Shell membrane
Chalaziferous layer

Egg yolk peritonitis (EYP) is a serious condition primarily affecting laying hens, characterized by the deposition of yolk material into the coelomic cavity, leading to inflammation of the peritoneum. This condition can arise when a yolk is not properly captured by the oviduct during egg formation, resulting in it becoming free-floating within the abdominal cavity. The yolk can then induce an inflammatory response and potentially become infected with bacteria, most commonly Escherichia coli (E. coli), which can lead to severe complications.




a
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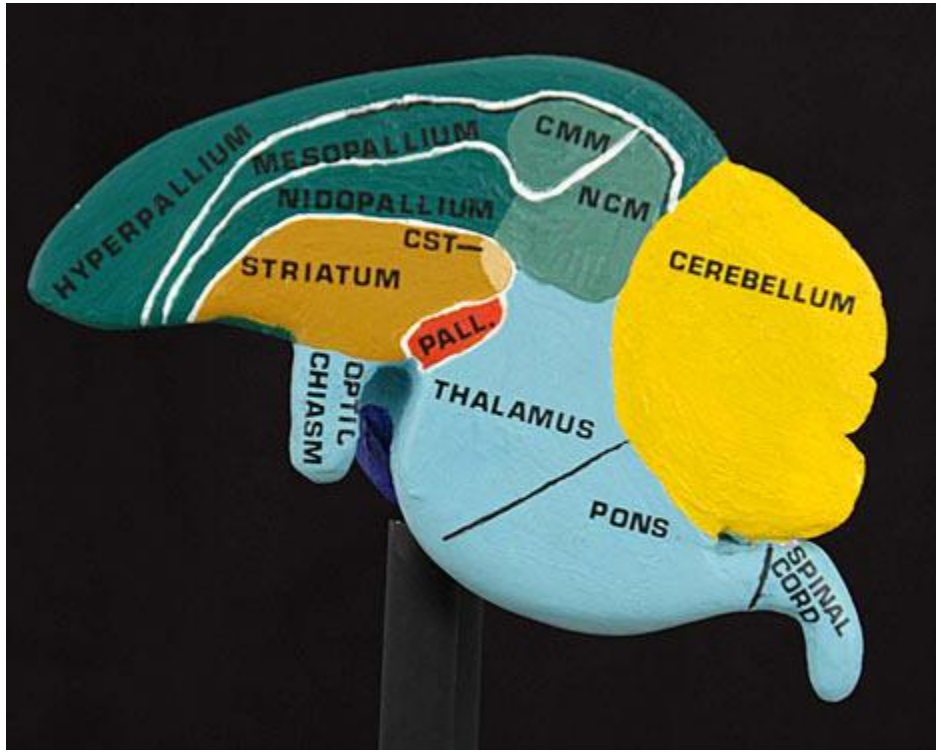
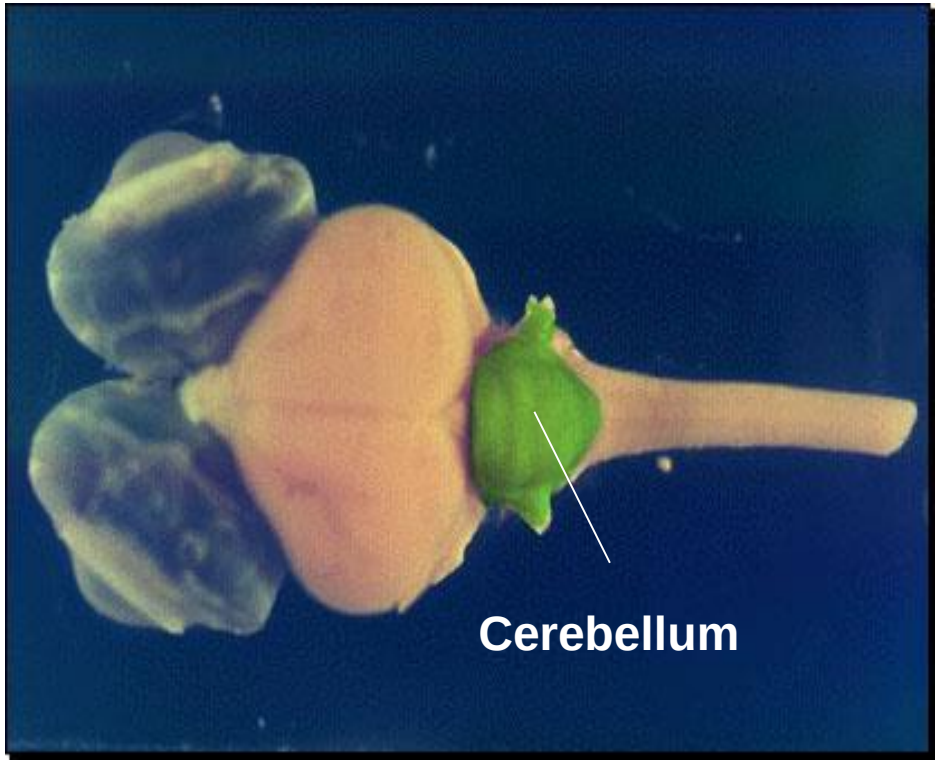
Egg Tooth

پرندگان زندکی اجتماعی دارند.

پرندگان نیز مهاجرت می کنند . تغییرات مدت شبانه روزی روی غده هیپوفیز اثر مي گذارد و باعث مهاجرت می گردد.

در پرندکان سیستم عصبی مخچه رشد بیشتری پیدا کرده است. به لحاظ حواس هم حس بینایی و شنوایی قوی است و حس بویایی و ذائقه نسبتا ضعیف است.





Birds have a four-chambered heart, consisting of two atria and two ventricles.

The avian heart is relatively large compared to body size, with some species having hearts up to 4% of their body weight.

The right atrium is typically larger than the left atrium in most birds.

The left ventricle sends oxygenated blood to the body, while the right ventricle sends deoxygenated blood to the lungs.

The right atrioventricular valve consists of a single spiral flap of myocardium, unlike in mammals.

The left atrioventricular valve in birds is tricuspid, compared to the bicuspid valve in mammals.

Birds have a higher stroke volume and more beats per minute compared to mammals, allowing for efficient blood flow during flight.

The avian heart has two to four coronary arteries, with the right branch often being the dominant vessel.

The bird heart is conical in shape, with its apex directed to the rear and slightly left of middle

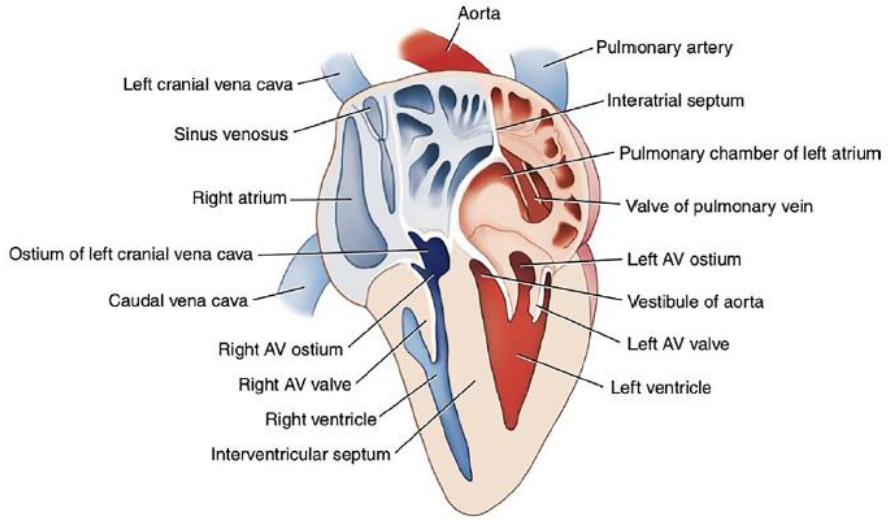


FIG. 26.1-8 The avian heart, with an emphasis on the interior of the atrium, ventricle, and AV valve.

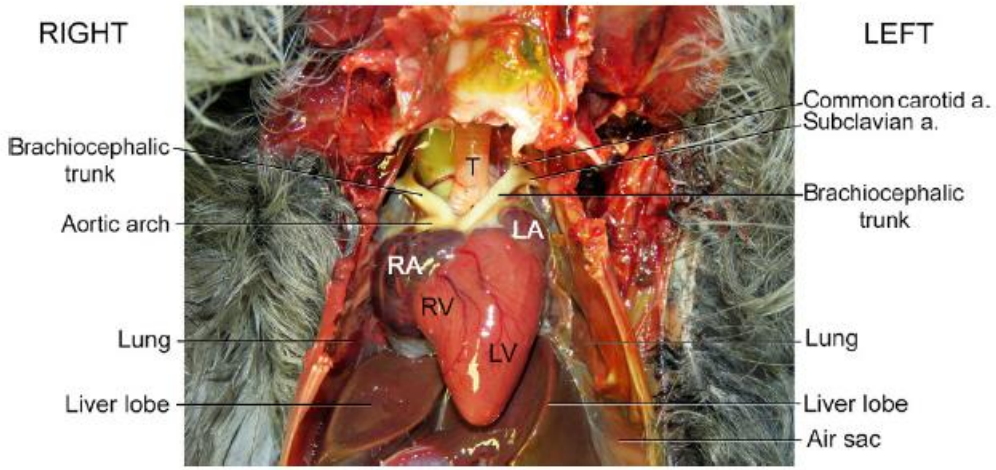


FIG. 26.1-4 Close-up image of the prosection shown in Fig. 26.1-3, the ventral aspect of the heart of an American coot. Key: *a.*, artery; *A*, atrium; *L*, left; *R*, right; *V*, ventricle; *T*, Trachea.

The right jugular vein is routinely used for venipuncture in birds, especially in small patients such as budgerigars, because it is generally larger than the left. In larger birds, the basilic or ulnar vein may be used . It is safe to take a sample that is 1% of bodyweight, or 10% of estimated blood volume.

FIG. 26.1-9 Jugular venipuncture in a budgerigar. Left: The apteric (featherless) area overlying the jugular veins makes the right jugular vein an ideal site for blood sample collection in small birds. Right: blood collection from the right jugular vein.

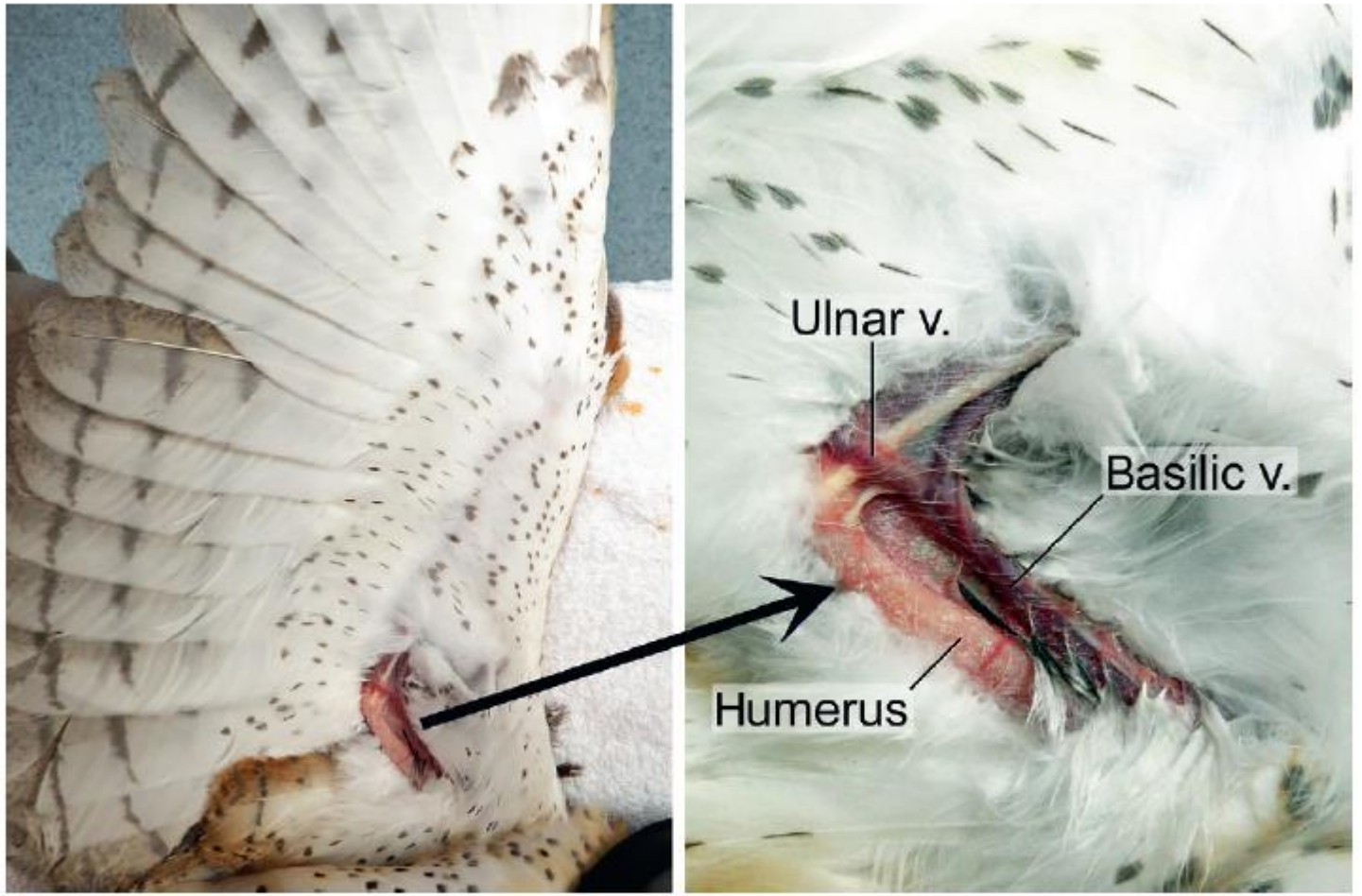
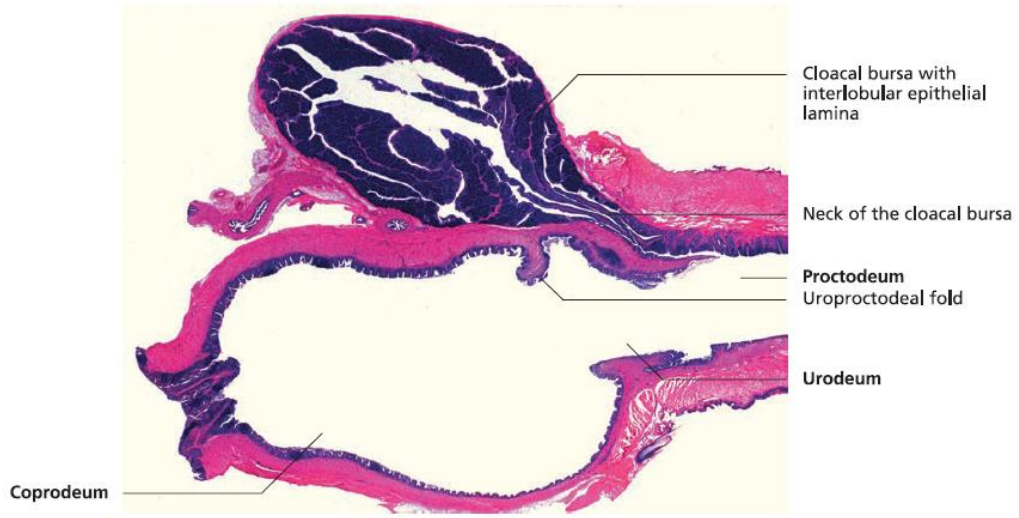


FIG. 26.1-10 Right basilic/ulnar vein of a common barn owl. Left: The wing is extended to show the location of the apteric area overlying the vein on the ventral aspect of the elbow joint. Right: magnified view of the vein, with the elbow flexed. The feathers have been dampened with alcohol and swept aside to allow visualization of the superficial vein just beneath the skin. This vein can be used for blood sample collection in larger birds.



12.1 Histological section of the cloacal bursa (bursa Fabricii) of a chicken.

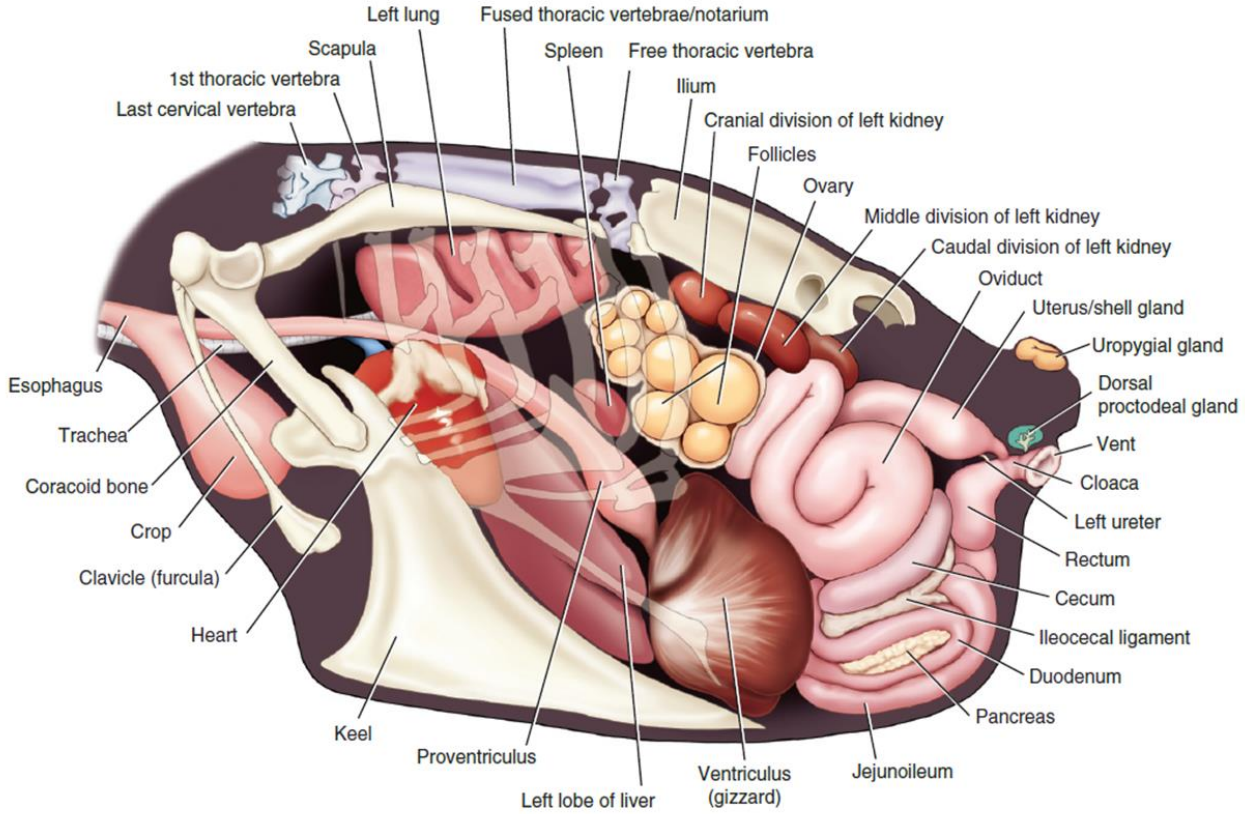


FIG. 6-5 Left view of the avian thoracic and abdominal cavities and pelvis—Female.

The bursa of Fabricius is a specialized lymphoid organ unique to birds, located at the dorsal side of the cloaca. It plays a crucial role in the development of the avian immune system, particularly in B cell maturation.

Infectious Bursal Disease (IBD):

Swelling of the bursa due to edema and hemorrhage in early stages.
Atrophy of the bursa 7-8 days post-infection.


Thanks for your nice attention