

Anatomical atlas of the chinchilla

By

Adeline HELAUDAIS



Supervisor:

Dr. Hazai Diána, PhD

Department of Anatomy and Histology

University of Veterinary Medicine, Budapest

Budapest, Hungary

2021

Table of contents

| | |
|--|-----------|
| 1. Introduction..... | 2 |
| a. Origin..... | 2 |
| b. Domestication of the chinchilla..... | 3 |
| 2. Literature review..... | 5 |
| 3. Goal and questions..... | 11 |
| a. Why chinchilla?..... | 11 |
| b. Goal of the thesis..... | 11 |
| 4. Materials and methods..... | 12 |
| a. Dissection technique..... | 12 |
| b. X-ray and CT Scan technics..... | 13 |
| 5. Discussion, results and conclusion..... | 15 |
| a. External features: general overview of the chinchilla, integuments, digits and fur..... | 15 |
| b. Skeleton of the head, features of the head and mandibula..... | 17 |
| c. Anatomy and features of the head: ear, brain. CT and X-ray images of the head..... | 19 |
| d. Muscles of the chinchilla: overview of the body, forelimb and hindlimb.... | 22 |
| e. Anatomy of the thorax: general aspect, description of the different organs and vessels..... | 24 |
| f. Anatomy of the abdomen: general aspect, description of the organs and vessels | 25 |
| g. Anatomy of the genital apparatus male and female..... | 29 |
| h. Nervous system, brachial plexus, sacral plexus..... | 31 |
| 6. Summary..... | 32 |
| 7. Bibliography..... | 35 |
| 8. Acknowledgements..... | 37 |

1. Introduction

The purpose of the thesis was to create an Atlas, showing different aspects of the anatomy of a unique species, the chinchillas. We wanted to demonstrate the macroscopic anatomy of the animal with pictures and also using X-ray, CT scan techniques, in order to have a clinical approach of the anatomy of the chinchilla for veterinarians and researchers.

Chinchilla is a special animal in many ways. The first is an economic aspect, because in Hungary the breeding of chinchillas for the use of their fur is very important.

The second aspect is the use of chinchilla as a model animal in medical research. This is because the tympanic bulla of the chinchilla (in the middle ear) has a similar structure to that of humans, which is why it is widely used in research on human deafness, for example.

The last aspect was the spread of chinchilla as a pet in the last 15 years and therefore its appearance in veterinary practice.

It is therefore important to have adequate knowledge of the structures of the chinchilla's body, so we aimed to make an easy-to-use anatomical atlas of it.

A study of the literature revealed that although there are detailed descriptions of chinchillas, they only cover certain organ systems of the animal, and a comprehensive presentation that we designed and prepared proved to be a fill.

This thesis will describe the proper anatomy of this animal. Due to this Atlas, scientists or researchers can have a proper strategy or support for work and have a clear view about the topic. With the help of the comparative images, they can have a global idea of a healthy chinchilla and make proper diagnostics when doing X-rays or CT scans during their veterinary work.

Origin

Chinchilla originated at first in South America; from Chile, Peru, Bolivia and Argentina (demonstrated in figure 1). Two different types of chinchillas exist. The Chinchilla lanigera: originated from the Andes mountains in North Chile, with the specificity of being grey with large ears and long tail (called long-tailed chinchilla). The second type is the Chinchilla brevicaudata originated from the north of Chile, Bolivia, south of Peru and north Argentina, and this type is more coated with small ears and short tail (called short-tailed chinchilla). They lived at altitude from 3000 to 6000 meters. They need a dry environment, and the only way to provide them water is the morning dew which makes the

rocks wet. Temperature needs to be low during the night. They live in colonies and are very sociable animal. Their fur is quite dense and thick due to their origin of environment and permit them to live in the cold. (Spotorno et al., 2004).

The domestication of the chinchilla

The chinchilla was hunted by the Incas, followed by the Spanish and then the English for the quality of its fur in the 1800s. These animals were exploited for their luxurious fur, causing their numbers in the wild to dwindle. Nowadays the wild chinchilla is endangered. Mathias F. Chapman, who was a miner engineer working in Chile, met this species because people were trading them as a source of money. Fascinated by the chinchillas, he initiated some research and work around them. He decided to hunt them in the Andes, but only in purpose of catching them and not to kill them. This capture lasted for 3 years, where he successfully could catch 11 chinchillas. In the beginning of the 1900s, he brought them from South America to California. This is where the first breeding place of chinchilla located, and this work continued by the son of Mathias F. Chapman. (Trevino et al., 2019).



Figure 1 : Historic geographic distribution of *Chinchilla lanigera*. Stars indicate sites of current wild populations: La Higuera, Coquimbo, and Aucó, Illapel, Chile. (Picture from Spotorno et al., 2004).

Nowadays, the chinchilla became a new domestic animal “to have, and gaining more popularity year after year as a pet. They find their place in breeding as well, especially for their fur. Farmers made some breeding and created some hybrids for having a genetically modified animal with a better quality of the fur. With the fur farming, the market found its place especially in Europe, where Hungary became the first country for fur production. As a direct concurrency, Poland, Croatia and Slovakia need to be taken in consideration as well. The annual production in Hungary is around 200 000 skins, half of the world’s production. (Spotorno et al., 2004)

Regarding the classification: order Rodentia, suborder Hystricognatha (Caviomorpha), superfamily Chinchilloidea, family Chinchillidae. They discovered 3 subspecies of the chinchilla (Osgood, 1943), but most recent authorities recognize 2 species of it: the *Chinchilla lanigera* and *Chinchilla brevicaudata* (also known as *Chinchilla chinchilla*) (Cabrera, 1961; Corbet and Hill, 1980; Woods, 1993). A distinction that was made by a recent molecular data (Spotorno et al., 2004).

The chinchilla as a pet animal is breeding from two different wild species: *Chinchilla lanigera* and *Chinchilla brevicaudata*.

2. Literature review

Morphology

As it is described in Table 1 and 2, adult chinchillas are small rodents having a body weight from 400 to 800g. Females are bigger than males. The average lifespan of the chinchillas is from 10 to 16 years. They are nocturnal animals but have activity during the day as well. Their anatomy is quite unique. They have a large head with a short chest, big ears, small fragile legs and a fluffy tail. The color of the fur can be different due to the color mutation, normally it's blue-grey but can be silver, beige and black. (Riggs et Mitchell, 2009).

Basics information

| | |
|--------------------------------------|-------------------|
| Snout to the root of the tail | 28 cm to 40 cm |
| Tail | 13 to 16 cm |
| Ear | 4,5 to 5 cm |
| Width of the ear | 3cm to 3,5cm |
| Ankle- tip of the nail | 5cm to 6cm |
| Width of the palm of the hand | 2,5cm to 3cm |
| Length of the nails of the front paw | 0,2cm to 0,25cm |
| Length of the nails of the hind paw | 0,35cm to 0,40 cm |
| Length of the whiskers | 10cm to 13 cm |

| | |
|-------------------|----------------------|
| Life expectancy | 9 to 16 years |
| Weight | 350g up to 659g |
| Hair length | 1,8 to 3,5 cm |
| Sexual maturity | 4 to 5 months |
| Heart rate | 100 to 150 bpm |
| Body temperature | 37 to 39°C |
| Gestation | 111 days |
| Number of litters | Up to 6, generally 2 |
| Liter per year | Up to 3, generally 1 |

(THE CHINCHILLA, 2003).

Musculoskeletal system

Cranium and mandibula: the tympanic bulla is bigger than in any other rodents existing (Figure 2). That is the reason why chinchilla is used as model in human hearing studies. The chinchilla is the traditional animal model for most types of research related to the ear, specifically, hearing loss and otitis media. It is used as a model related to aural diseases, related to hearing loss, and as a model of aural pathologic conditions associated with hearing loss. The chinchilla's inner ear anatomy and ear physiology are similar to humans. The chinchilla's ear has three turns in the cochlea, a tubotympanum that shares similar anatomy with that of humans. Chinchillas have been used to develop models of single pathogen-induced otitis media and are the predominant host and considered the gold standard. Several new areas of research using chinchillas are being developed. Chinchillas continue to be important models for ear-related research and play critical roles due to their specific attributes, despite the trend toward mouse models. (Wang et al., 2016). Chinchillas have other important characteristics compared to other rodents, like the presence of the infraorbital foramen, absence of the masseteric crest of the mandible and large lacrimal bones. Regarding the teeth, in total the chinchillas have 20 teeth: 2(I 1/1, C 0/0, P1/1, M 3/3) The incisors are separated from the molars by a diastema. When speaking about the teeth of chinchillas, we describe them with the term of open rooted, because as rodents, their teeth are growing continuously, about 2-3 inches per year. (Brenner et al., 2005).

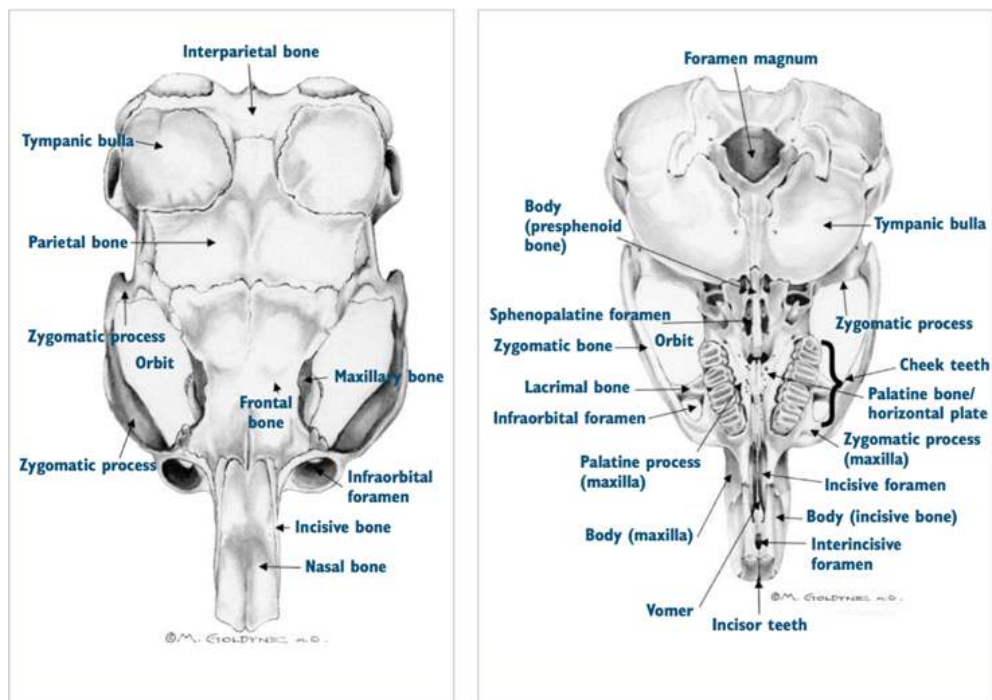


Figure 2 : Anatomic drawing of the skull of a normal chinchilla, mandible not present. (Picture from Brenner et al., 2005).

Thoracic girdle and the thoracic limb: however clavicles can be absent in several species like in dogs or other rodents as rabbits, the chinchilla's thoracic girdle is composed of two bones: scapula and a clavicle. The shape of the clavicle is an "S", and has two junctions, one with the sternum and one with the proximal epiphysis of the humerus. The humerus of the chinchilla has an expanded articular head and reduced greater and lesser tubercles. The distal epiphysis has a larger trochlea. The ulna and radius, both bones have an identical development. The ulnar styloid process is somewhat longer than the distal extremity of the radius. There are 4 digits of the forelimb, as the first is missing. Phalanges of the chinchilla are short. Knowing some important details regarding these bones of the chinchilla, it can help for the diagnosis of the orthopedic conditions and find an appropriate treatment in human conditions (Irimescu et al., 2014).

Pelvic girdle and hindlimb: The hip bone of the chinchilla has a direct horizontal axis, the ischium and pubis demarcating a large obturator foramen. The ilium has a prolonged wing. The wing of the ilium owns an important gluteal crest that follows the lateral side of it and ends with the tubercle caudally to the acetabulum. On the femur, there is no existence of the third trochanter which can be present in the rabbit for example. Between the greater and lesser trochanters there is a vertical intertrochanteric crest. The tibia and the fibula are not fused. The fibula is a complete bone on its own and has the same length as the tibia. The chinchilla is known as a plantigrade type, which means they are walking and put all of their weight on the complete feet. There are only 3 digits of the hindlimb, as the first and fifth are missing. The 4th digit of the chinchilla contains only two phalanges on the hindlimb. (Chende et al., 2014).

The chinchilla owns 7 cervical, 13 thoracic, 6 lumbar, 2 sacral and 23 caudal vertebrae. For a total of 51 vertebrae, with 13 pairs of ribs. (Alworth et Harvey, 2012).

Abdominal muscle of the chinchilla. The external abdominal oblique muscle is different from what we would expect regarding the insertion, as the muscle has a strong tendinous attachment on the pubis close to the pubic symphysis and also on the fascia of the gracilis muscle (Ashdown et al., 1967).

Cardiovascular system and respiratory system

Anatomical studies regarding the cardiovascular system show that chinchillas have only the left coronary artery which supplies the heart with blood, and the right coronary is absent. Concerning the arterial branches, the brachiocephalic trunk and left subclavian artery, originating from the aortic arch is present. Internal carotid arteries are absent. So the brain is supplied by blood only by the vertebral basilar artery system. (Alworth et Harvey, 2012).

The lungs are divided in two parts, the right and the left one. The right part contains four lobes, and the left part contains three lobes. (Spotorno et al., 2004).

Digestive system

Chinchillas have an opening in the soft palate through which the oro-pharynx communicates with the pharynx. The pancreas is composed of three lobes: the splenic, the gastric and the duodenal lobe. The pancreas can be seen as a triangular form. (Stan, 2018b). The liver is a four-lobed structure where the gallbladder is situated on the median side of the right medial lobe (Stan, 2018a). The stomach has a pyriform shape. For an adult chinchilla the length of the gastrointestinal tract will be up to three meters. (Hoefer, 1994; Johnson-Delaney, 2006; Spotorno et al., 2004). The cecum holds 23% of the dry matter content of the large intestine. The caecum of the chinchilla can be compared with the one of the horse, pig or rabbit because of the thin-walled, coiled and sacculated caecum. (Alworth et Harvey, 2012). On the caecum there are three taeniae with medial, lateral, and ventral dispositions (Stan et al. 2014.). The ascending colon is divided in three parts: ansa proximalis coli (with taeniae), pars intermedia and ansa distalis coli. (Pérez et al., 2011). The chinchilla is similar to rabbit in the large intestine digestion as they both have a hind-gut fermentation. (Stan et al., 2014).

Reproduction system

Male chinchillas reach full sexual maturity at 8 months. Females can reach it, when they are around 450g and 8-9 months old. They are seasonally polyestrous. The estrous cycle lasts for 40 days. And the gestation period lasts for 111 days. Parturition occurs normally in the early mornings. The number of offspring for the chinchilla can be up to 6 but on average of 2. Chinchillas give birth directly onto the floor, they don't need a nest. (Hoefer, 1994).

The offspring weight at birth 35g in average. They are born with open eyes and covered by fur, arising teeth, and are able to walk after 1 hour of life. (Spotorno et al., 2004).

Female chinchillas: the ovaries are between 6 to 8 mm in length and situated caudally and laterally to the kidney. The body of the uterus is situated dorsal to the urinary bladder. And the ovarian vessels are short. (Hoefler, 1994).

Male chinchillas: The penis is 6-7cm long and S-shaped. Composed of a cavernous body and spongy body that will surround the urethra. The 2 types of tissues permit the access to the ejaculation and copulation. Muscles of the penis help to guide the penis during the copulation. These muscles, the retractor and the ischio-cavernosus muscles play a great role here. Male chinchillas have seminal glands referred to as accessory glands. (Călămar et al., 2014).

Nervous system

As there is no internal carotid artery present in chinchillas, the brain is supplied by the vertebral arteries which have an anastomosis and form a vessel called ventral basilar artery. They create the arterial circle around the brain. Three cerebral arteries are important inside the brain: caudal, medial and rostral ones.

The brachial plexus is composed of a single truncus where branches of the cervical nerves form this plexus from C5-C8, T1 and T2. Subscapular nerve: coming from C7, innervated teres minor muscle and subscapularis muscle. Long thoracic nerve: coming from C6 and C7 and divided in extrinsic and intrinsic nerves running all along the forelimbs and innervate muscles. A branch coming from the C7, C8 and T1 will innervate the coracobrachialis muscle. (Cevik-Demirkan et al., 2007).

The lumbo-sacral plexus LSP, comes from L4 to L6 and from S1 to S3 and innervates the pelvic limb, abdominal, inguinal and perineal regions of the chinchillas (Figure 3). One ventral spinal branch originating from the lumbar plexus is created by five different nerves. L1 and L2 together coming from the ventral branch will create the ilio-hypogastric nerves. L1 will form the cranial and L2 will form the caudal hypogastric branch. Ilioinguinal nerve is coming from L3, which leads to the genitofemoral nerve. The femoral nerve is coming

from the medial branch of the L4 and the obturatorius nerve will come from the lateral branch of the L4. The ischiadic plexus is formed by the branch of L5, entire L6 and some branch of S1. Ischiadic plexus is composed of the following nerves: cranial and caudal gluteal nerves, caudal cutaneous femoral nerve and ischiadic nerve. Those nerves innervate the hindlimb. The plexus sacralis after giving the first branch for the ischiadic plexus will form the pudendal nerve with S2, and then the other branch of the S2 joins the branch of the S3 and make the rectal caudal nerve. (Martinez-Pereira et Rickes, 2011).

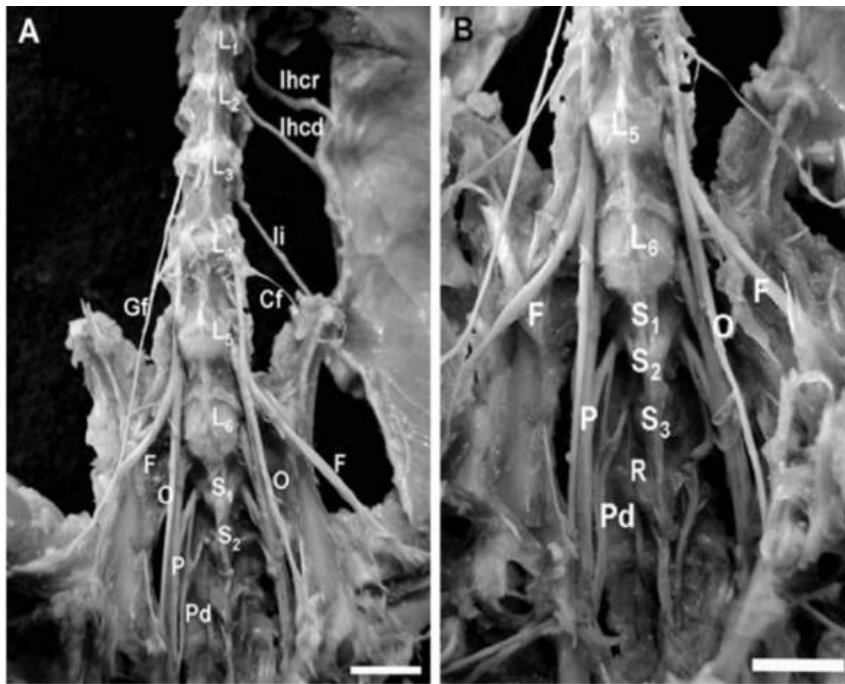


Figure 3 :

A: Ventral view of the vertebral column showing the spinal origins of the lumbosacral plexus in the chinchilla. A, cranial iliohypogastric (Ihcr), caudal iliohypogastric (Ihcd), ilioinguinal (Ii) and genitofemoral (Gf), lateral cutaneous femoral (Cf), and the following nerves: obturator (O) and femoral (F) originating from the union of L4 and L5, and pudendal (Pd) originating from the joint union of S1–2. The emergence of the ischiadic plexus (P) from L5–6 and S1 is present.

B: Enlargement of the ventral view of the vertebral column showing the spinal nerve origins of the following: obturator (O), femoral (F), pudendal (Pd), rectal caudal (R) and the ischiadic plexus (P). Scale bar: A: 1 cm; B: 1.5 cm. (Picture from Martinez-Pereira et Rickes, 2011).

3. Goals and questions

Why the chinchilla?

Nowadays, there are still few studies on the anatomy of the chinchillas. Some studies can be found on the details of the body but not a general overview of the entire body. Chinchillas are extremely important in the fur-farming animal production, because they are considered to be an economically important species for it. Chinchilla is important in the research too, because studies of their ear can be used as a model of the human ear. And finally, in the 21st century, the chinchilla became “a new pet to have” for people. In those cases, the veterinary importance is a crucial point. Some literatures can be found regarding the diseases, especially the zoonotic ones. There is a considerable interest in the chinchillas: as a model for researchers, as a fur supplier from an economic aspect or simply as an animal of pleasure. This research can demonstrate an introduction of how the chinchilla is built up. The available anatomical demonstrations are mostly drawings and schematic images, but the aim of this study was to create much more than this.

Goal of the thesis

The goal was to create an Atlas where proper photographs can be found with definitions and explanations, and we wanted to give a new perspective of the actual review. The Atlas contains a series of colored photographs on detailed anatomical structures. Added to the dissection, X-rays and computed tomography scan pictures are also presented. A complete analysis of the chinchillas was planned to be made, based on 3 different techniques of veterinary medicine.

4. Materials and methods

a. Dissection

Cadaver's origin

After contacting few clinics in Budapest, one exotic clinic “Exo-Pet Veterinary Center” gave us one cadaver of chinchilla thanks to Dr. Ana Brunen. It was euthanized because it couldn't be cured by a veterinarian and this action was authorized by the owner. The right hindlimb was amputated and had a broken femur on the left hindlimb. The department of Anatomy and Histology in the University of Veterinary Medicine participated as well to give us 3 carcasses as well, females and males.

Strategy of the thesis

All the dissections were made inside the dissection hall of the Department of Anatomy and Histology, by the help of Dr. Hazai. In the first session we started on 2 male chinchillas and in total we used 4 chinchillas. The dissection followed a strategic plan elaborated before and it was performed with basic instruments: blades, forceps, scissors. All the steps were documented with photos.

Starting with the external features: general overview, checking the integuments, digits and fur. We had to make sure if there were no anomalies like alopecia, or missing digits. After removing the skin, the main muscles of the body were dissected. Then the oral cavity was cut open with a scissor on one side and we checked if there were no dental disease, missing teeth or discoloration of the teeth present. As the oral cavity was opened, the tongue was checked too with all the features of it. The skull was open to dissect the brain and to check the huge tympanic bulla.

Next region was the thorax. The ribs were cut to open the thoracic cavity. We located the aorta with the branches of the aortic arch, the veins and the nerves of the thorax. The heart was taken out and its features were examined. The lobulation of the lungs were checked and documented.

After the thorax, the abdomen was dissected. A transverse cut was made under the xiphoid process of the sternum followed by a cut along the linea alba. Inside the abdomen a focused first look was made on a general overview of the organs, the color of the internal

wall, and then we checked the organs step by step. Starting with the gastro-intestinal tract, together with the pancreas, liver, and their suspension. Then, the uro-genital system of the males, checking the kidneys, urinary bladder, testis, epididymis, accessory glands.

Finishing the dissection, we focused on the nervous system, first the brachial plexus of the forelimb then the lumbo-sacral plexus. This first dissection was made on both chinchillas to have a different approach on related subjects. The second session of the dissection was performed on the female chinchilla. We focused on the female genital organs. We checked the uterus, ovaries and suspension. We determine if anomalies were seen or not, or if there was a sign of pregnancy.

The dissection continued with the head again because we wanted to focus on the ear. We checked the external ear and we opened the tympanic bulla of the middle ear.

b. X-ray and CT scan

In the third session, the aim was to create X-ray and computed tomography (CT) pictures (Figure 4 and 5). The Department of Exotic Animal and Wildlife Medicine of the University provided us a live chinchilla. The owner was Dr. Papp Antal himself. Him and his team helped us during the process. First, the anesthesiology: ten minutes before induction Dr. Papp applied 30 ml/BwKg Rigger solution subcutaneously to support circulation. Premedication was not used, just induced anesthesia in an anesthesia chamber with 5 % isoflurane in pure oxygen. After induction, the maintenance was on 2% isoflurane through a face mask. Premedication was decided not to be used because induction and recovery are also smooth and less problematic by this method. Planning to do a procedure with pain, premedication is necessary but for X-ray and CT scan -as these are not an invasive procedures- the use of isoflurane on its own was enough.

It was needed to make the X-ray and the CT scan with a live chinchilla. The use of dead, or frozen cadavers was not an option due to necrosis, and the possible distortion of the organs, which would not have allowed us to take accurate photographs.

After anaesthetizing the chinchilla, Dr. Arany-Tóth Attila, working at the Clinic of Small animal Medicine in the University, helped us to make the CT-scan and the X-rays pictures with the help of his team. We started with the CT scan, and we continued with the X-ray pictures. The work continued with Dr. Papp Antal, who made X-rays pictures focusing on the head, and teeth, where diseases might be found. 20 pictures were taken in planes with different views. Dr. Papp wanted to focus more on the head properly. Oral cavity of the

chinchilla is hard to examine because of the anatomy, so ancillary methods are required. It's important to have X-ray of different planes from the head like latero-ventral, because thanks to this method teeth problems can be detected. In chinchilla tooth crown or root abnormalities are quite common for this species. Radiography is the first method to choose for detecting this problems, but radiography will not detect early tooth problem, only CT scan is able to do so.



Figure 4 : CT-scan technique with Dr. Arany- Tóth assistant.



Figure 5 : X-ray technique with Dr. Papp Antal and his assistant.

5. Discussion and results

a. External features: general overview of the chinchilla, integuments, digits and fur.



Figure 6 : General overview of a Chinchilla lateral position

Soft and dense, **the fur** covers the entire body of the chinchilla.

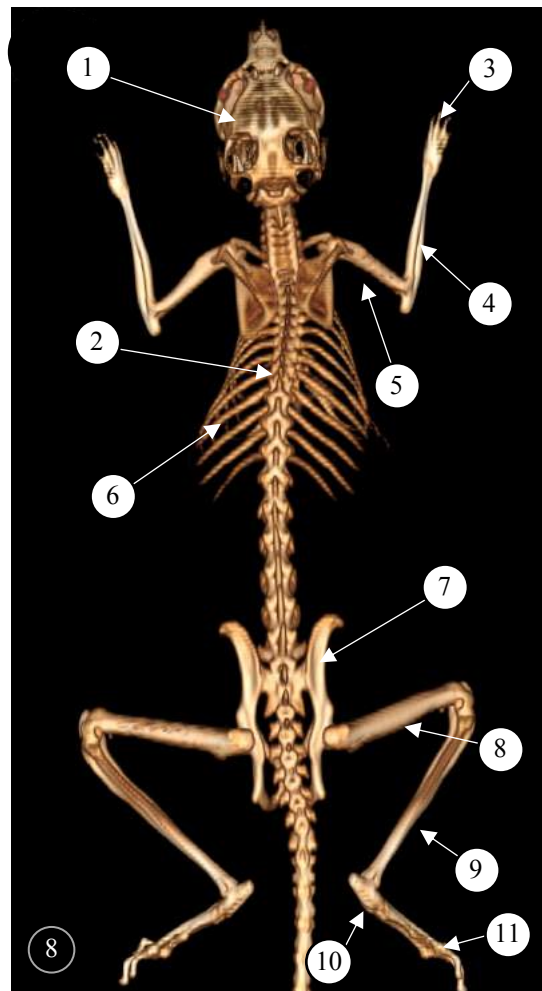
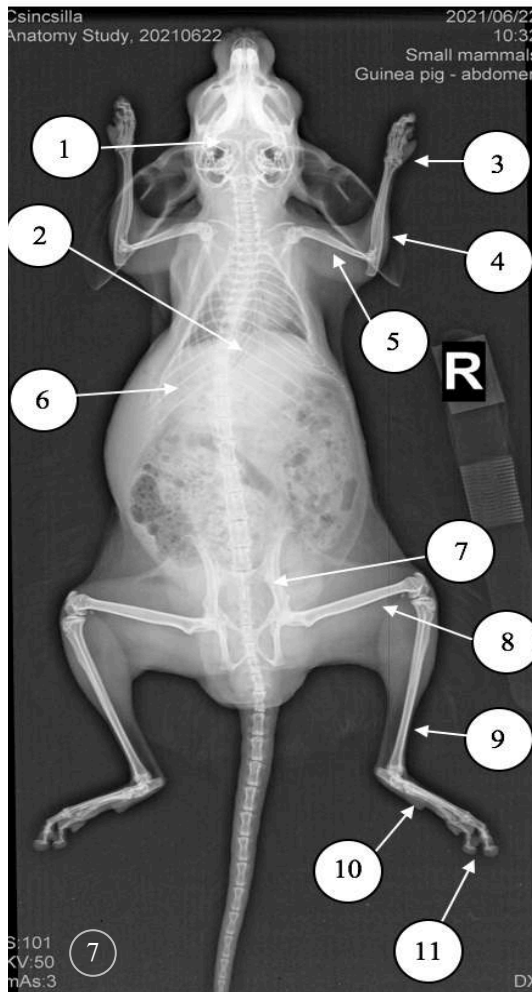


Figure 7 : Complete analysis of a healthy chinchilla's X-ray skeleton in dorso-ventral penetration
Figure 8 : 3D volume rendering of the skeleton of a chinchilla (CT images of an adult chinchilla.
(100mA, 120kV, 1,25mm slice thickness, standard kernel, helical mode, prone position)

1: Skull, 2 : Spine, 3 : Digits of the left forelimb, 4 : Radius and ulna - left, 5 : Humerus - left, 6 : Ribs, 7 : Pelvis, 8 : Femur - left, 9 : Tibia and fibula - left, 10 : Left Metatarsals, 11: Left Digits of hindlimb

The shape of the skull is particular because of the **big sensory organs like eyes, ears and large brain**. The chinchilla has 7 cervical, 13 thoracic, 6 lumbar and 2 sacral vertebrae and the particularity of this species is **the small thorax size with a large abdomen**. It has 4 fingers on their front paws, has 3 floating ribs, and the rest are attached to the sternum by cartilage, in total they have 13 ribs. Composed of 3 bones for the pelvis: ilium, pubis and ischium. The tibia is the longest bone of the hindlimb. The chinchilla owns: 6 tarsal bones, 4 metatarsal bones 3 digits and 3 phalanges for each digits, except the last digit which contains only two phalanges.

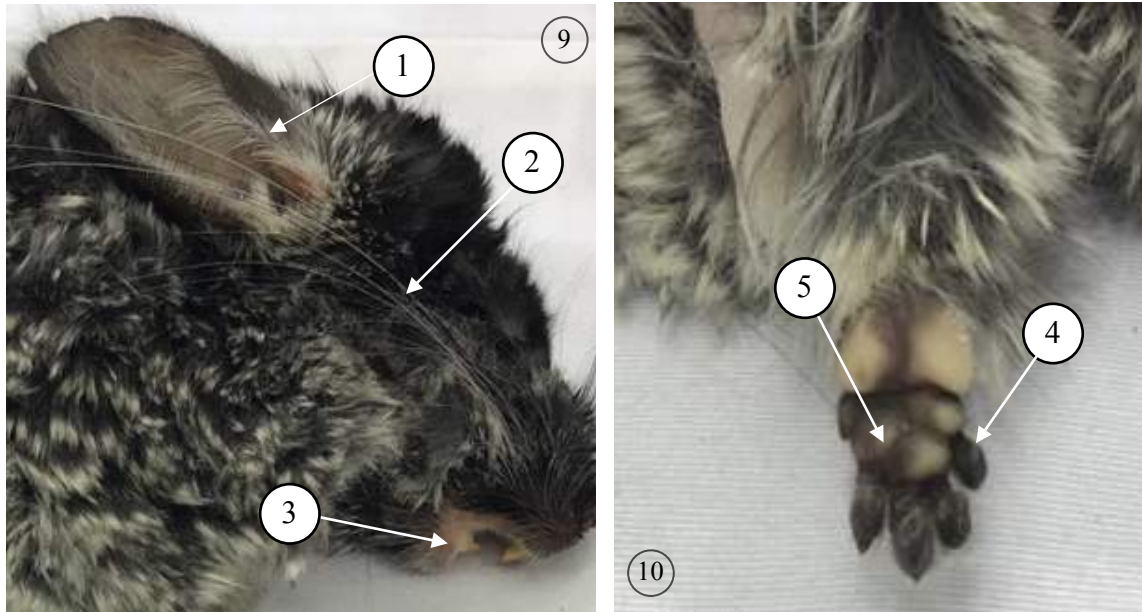


Figure 9 : General overview of the head in lateral position
Figure 10 : General overview of a the digit (forelimb) of a chinchilla

1: External ear, 2 : Whiskers 3 : Lower lip
 4 : Fifth digit of the forelimb 5. Digital pad

Whiskers protrude laterally and forward from both sides of the upper lips. The **forelimb** is short, it helps to grab the food. The **hindlimb** is longer, more muscular and helps to jump. They have 4 digits on the forelimb (1st is missing) and 3 digits on the hindlimb (1st and 5th are missing)



Figure 11 : General overview of the external genital of a female chinchilla in ventral view
Figure 12 : General overview of the external genital of a male chinchilla

1: Vagina, 2 : Penis, 3 : Scrotum, 4 : Anus

In male chinchilla the ano-genital distance is long. The **penis** has an S-shaped form, and contains a bone of 1 cm long to help and support erection. The testicles can be pulled into the abdomen as the inguinal canal remains broad. In female chinchilla, the ano-genital distance is shorter, the **labia** are not present

b. Skeleton of the head, features of the head and mandibula

Figure 13 : Lateral view of the skull

- 1 : Incisive bone
- 2 : Nasal bone
- 3 : Zygomatic bone
- 4 : Orbit
- 5 : The temporal fossa
- 6 : Zygomatic arch
- 7 : Tympanic bulla
- 8 : External acoustic meatus
- 9 : Mandibula

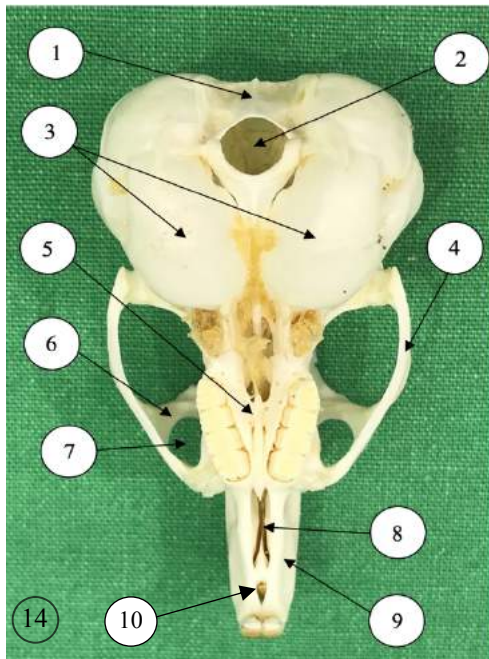
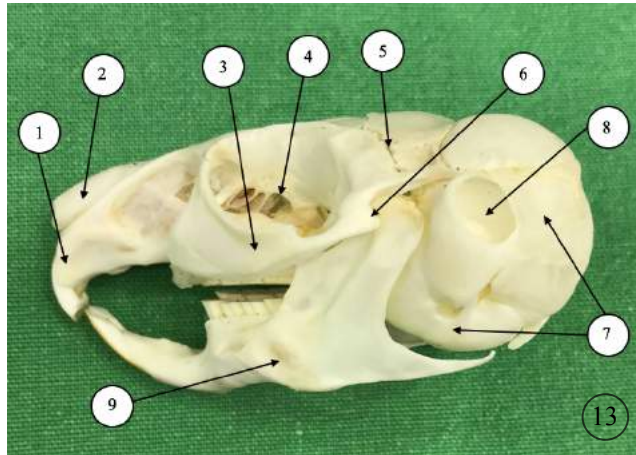
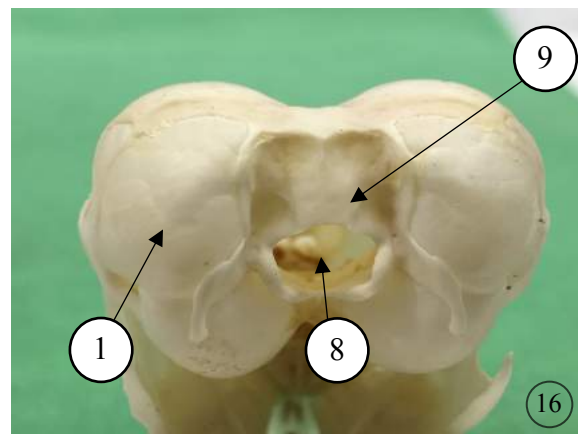
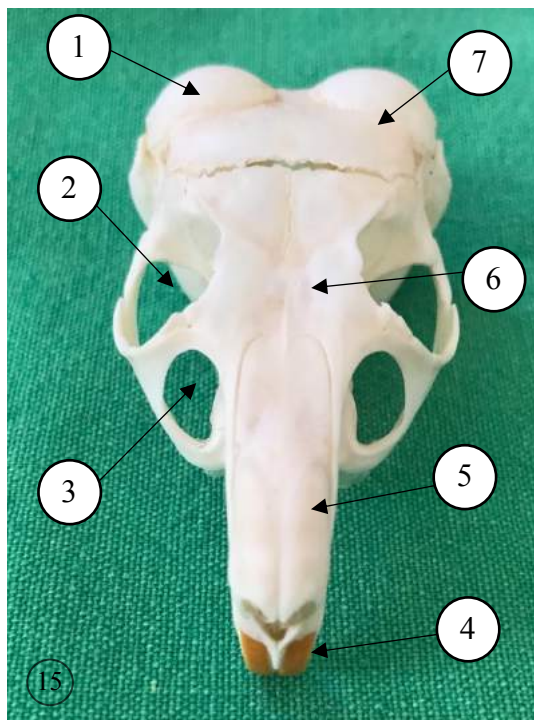


Figure 14 : Ventral view of the skull

- 1 : Occipital bone
- 2 : Foramen magnum
- 3 : Tympanic bulla
- 4 : Zygomatic arch
- 5 : Palatine bone
- 6 : Lacrimal bone
- 7 : Infraorbital foramen
- 8 : Vomer
- 9 : Incisive bone
- 10 : Interincisive foramen

**Figure 15 : Rostro-dorsal view of the skull
Figure 16 : Caudal view of the skull**

- 1 : Tympanic bulla
- 2 : Orbit
- 3 : Infraorbital foramen
- 4 : Incisive
- 5 : Nasal bone
- 6 : Frontal bone
- 7 : Parietal bone
- 8 : Foramen magnum
- 9 : Occipital bone



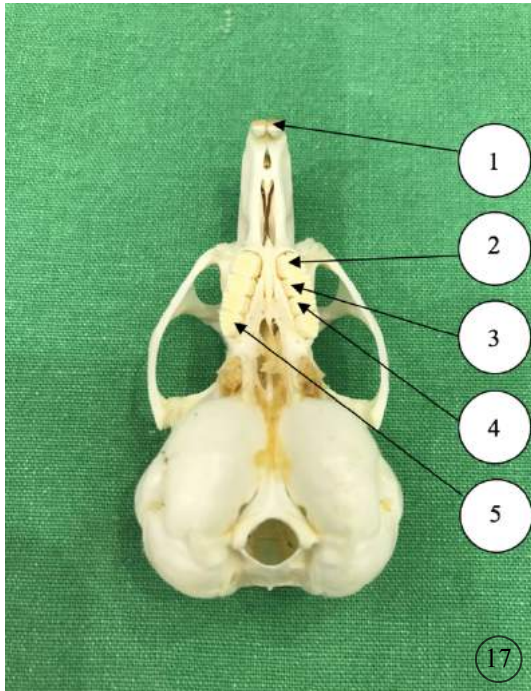


Figure 17 : Dentition of the chinchilla on ventral view

Dental formula of the chinchilla
 $2(I\ 1/1, C\ 0/0, P\ 1/1, M\ 3/3)$.

Malocclusion : irregular occlusal surfaces of the cheek teeth premolars and molars and/or overgrown incisors.

Appropriate **diet** is needed to prevent dental disease.

In veterinary practice, **dental diseases are the first common problem** in chinchilla. It is important to have a strong knowledge about it.

Figure 18 : Occlusal view of the mandibula

- 1 : Incisor 1
- 2 : Premolar
- 3 : Molar 1
- 4 : Molar 2
- 5 : Molar 3

They have strong **incisors** in the front of the upper and lower jaw and heavy **molar** teeth at the back for grinding the food. Upper incisor goes towards the right angle compared to the lower incisor which goes downward and very sharp. The incisors are normally reddish and yellow and they grow continuously.

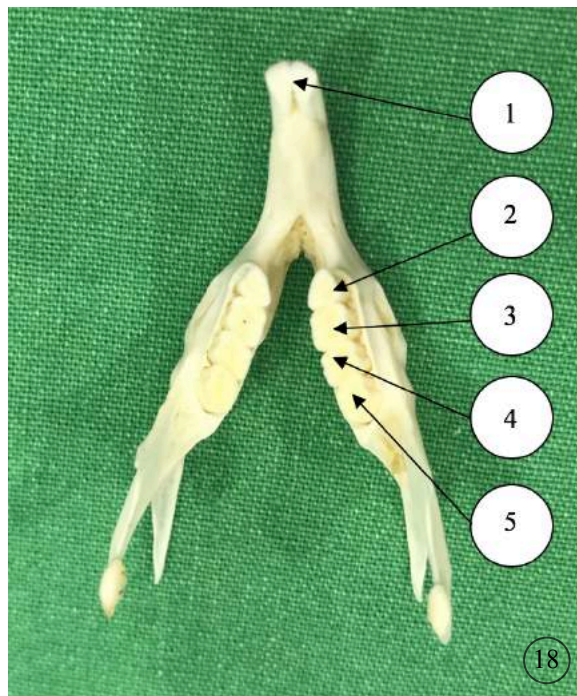


Figure 19 : Molar tooth of chinchilla

Occlusal plane of the molar, like the premolar, is moderately angled from buccal to lingual surface. There should be **no prominences** on the premolar and the molar teeth in **healthy chinchilla**.

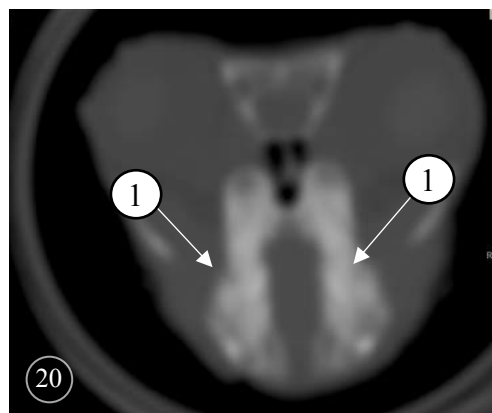


Figure 20 : Normal dentition of an adult chinchilla skull

CT images of an adult chinchilla. Transversal view (100mA, 120kV, 1,25mm slice thickness, standard kernel, helical mode, prone position)

1: Allaying of the teeth, separation between occlusal surface and upper teeth.

c. Anatomy and feature of the head: ear, brain. CT and X-ray images of the head.

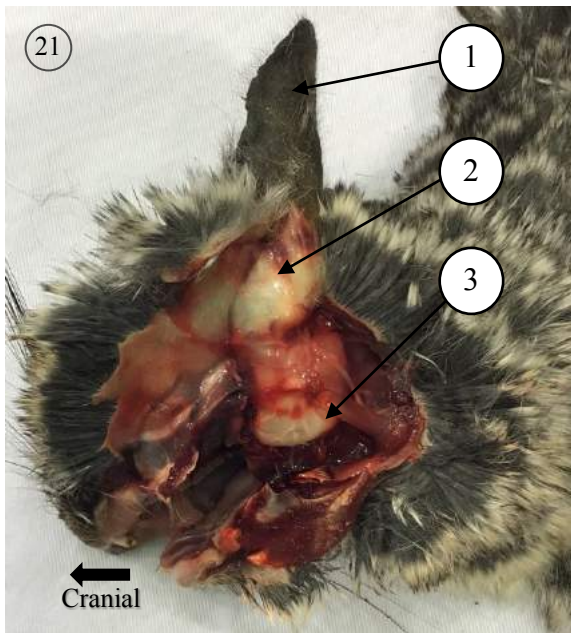


Figure 21 : Lateral view of the intact middle ear of the chinchilla

Figure 22 : Lateral view of the internal middle ear of the chinchilla

- 1 : External ear, 2 : Middle ear pars proximalis, 3 : Middle ear pars distalis,
4 : Cavity of the tympanic bulla

The **large tympanic bulla** helps to have a greater compliance of the middle ear air space. The bony capsule of the bulla is thin, and the bulla possess different **septa** inside and each septa owns a different audible frequency. The middle ear cavity of chinchilla has a unique anatomy.

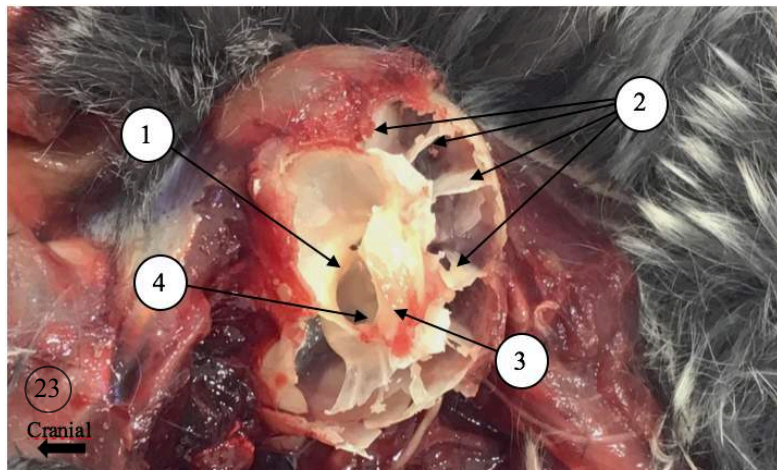
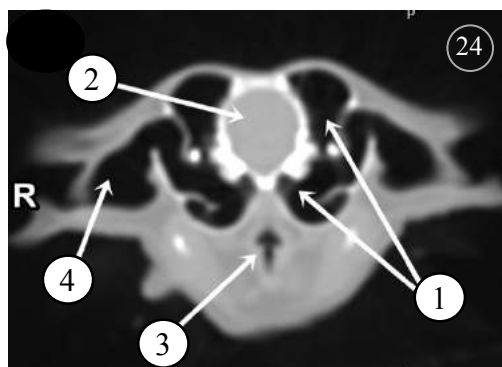


Figure 23 : Composition of the middle ear inside, lateral view

- 1 : Malleus , 2 : Septum, 3 : Tympanic ring, 4 : Tympanic membrane

The **tympanic membrane** and the tympanic cavity, compared to the size of the animal is extremely large. The chinchilla has the same range of hearing as human. They are used as model for research about the deafness of human.



CT images of an adult chinchilla.
(100mA, 120kV, 1,25mm slice thickness, standard kernel, helical mode, prone position)

Figure 24 : Transverse image of the skull at the level of the tympanic bullae

- 1 : tympanic bulla
2 : cerebrum
3 : larynx
4 : external ear canal

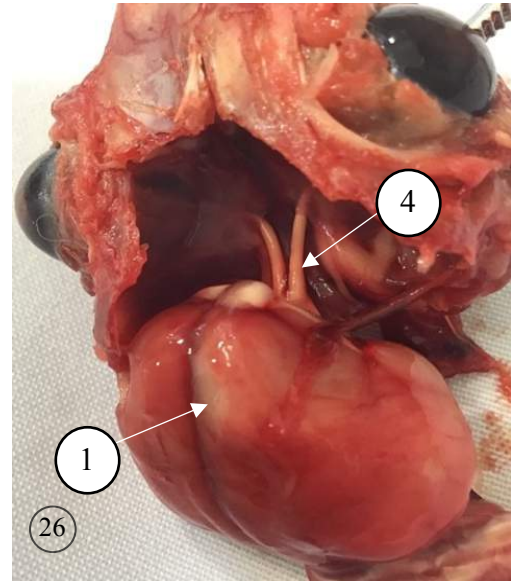
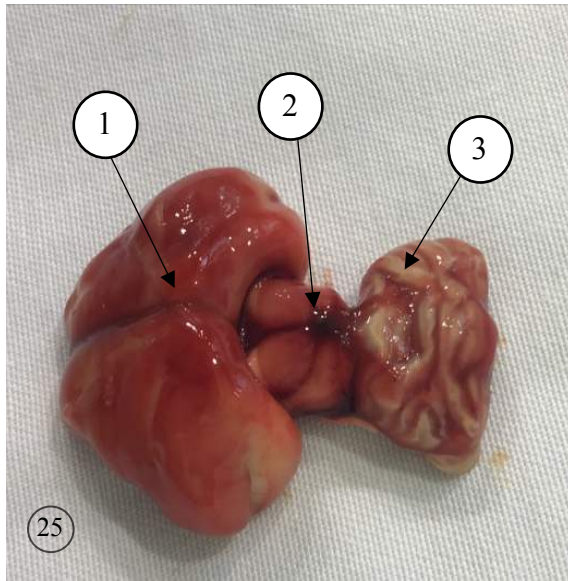


Figure 25 : Brain of the chinchilla detached from the skull
Figure 26 : Chiasma opticus of the chinchilla
 1 : Cerebrum, 2 : Mesencephalon,
 3 : Cerebellum, 4 : Nervus opticus
 Cerebrum is divided into two hemispherium, and they don't have very deep gyruses.



Figure 27 : Dorso-ventral view of the head of an adult chinchilla
Figure 28 : Rostro-caudal view of the head of an adult
X-ray picture: projection of three-dimensional anatomic objects on the plane of a detector. X-rays passing through the body are unequally absorbed by the anatomical structures, depending on the specific density of the chemical elements that build them. X-ray picture of the anatomy of the skull resembles their cross-section, where more mineralized tissues produce whiter areas compared to structures of lower mineralization. It can detect the presence of inorganic part of the bone structure. Any deviations of the absorption can show the presence of a pathology.



Figure 29 : Right laterolateral view of the skull of an adult chinchilla

Figure 30 : Left laterolateral view of the skull of an adult chinchilla

R : Right

L : Left

Parameters of a healthy chinchilla by X ray method:

– **Incisors:** tooth canals, pulps and growing center need to be clearly distinguish on the X ray. The edge of incisors shouldn't have sign of mineralization. They should have a proper size.

– **Molar:** No prominence visible on the molar teeth, shape, structure and cavities are not showing sign of pathology. The root and pulp of molar teeth should be well seen.

– **Skull:** The shape of it should not have signs of pathological problem. Lacrimal duct need to be visible inside the orbital area.



Figure 31 : Right laterolateral oblique view of the skull of an adult chinchilla

Figure 32 : Left laterolateral oblique view of the skull of an adult chinchilla

R : Right, L : Left

This conventional view can help to determine lateralization of abnormalities. On standard laterolateral projection abnormalities of the two sides can superimposed but the oblique view can help to determine which side is affected. CT scan is recommended for detect early abnormalities in premolar and molar teeth. Diagnostics imaging can a first help for the diagnostics of the disease and the severity of it for process to an appropriate treatment.

d. Muscles of the chinchilla: overview of the body, forelimb and hindlimb

OVERVIEW OF THE BODY

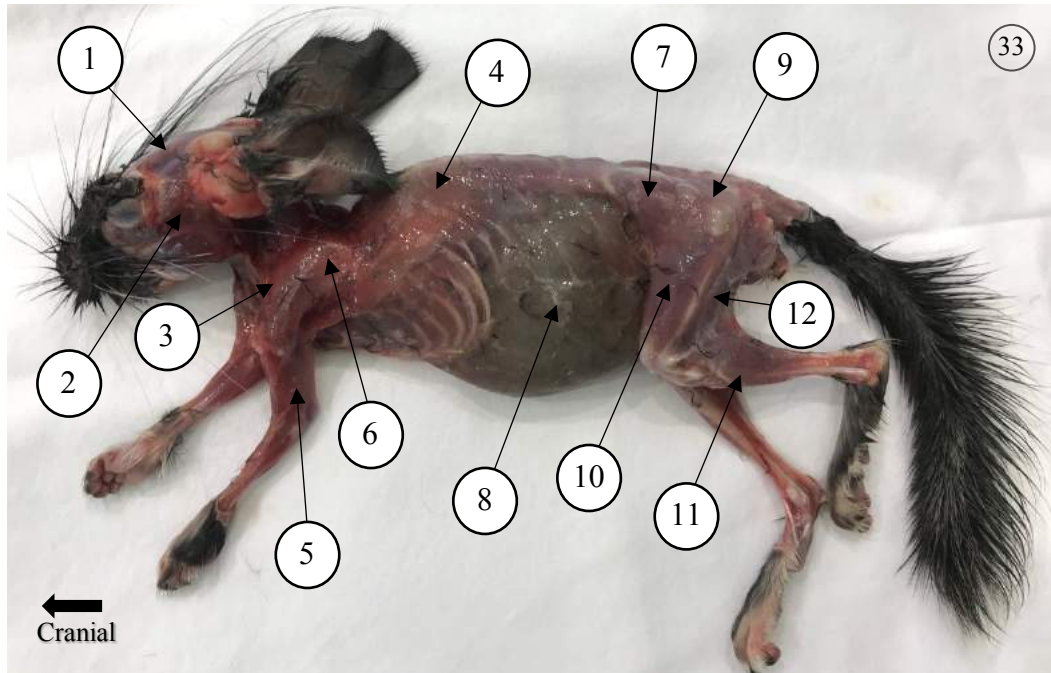


Figure 33 : Overview of the muscles of an adult chinchilla in lateral view

1 : M. temporalis, 2 : M. masseter, 3 : M. supraspinatus, 4 : M. latissimus dorsi, 5 : M. triceps brachii, 6 : M. trapezius 7 : M. gluteus medius, 8 : M. obliquus externus abdominis, 9 : M. gluteus superficial, 10 : M. biceps femoris, 11 : M. tibialis cranialis, 12 : M. semitendinosus

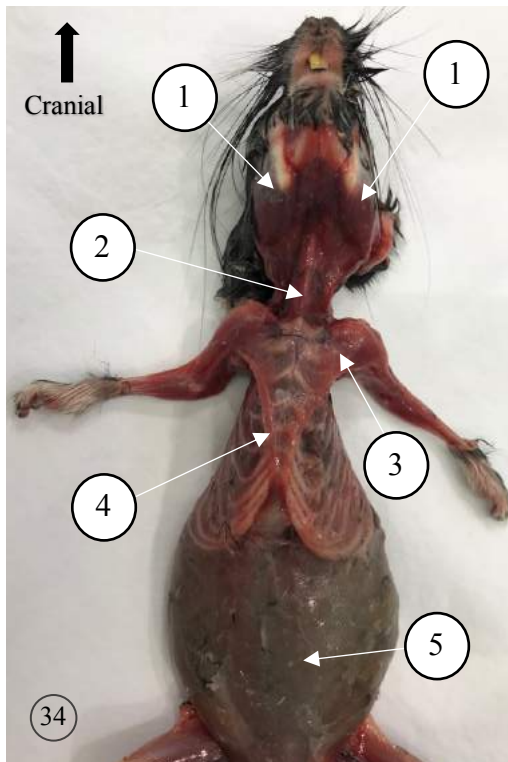


Figure 34 : Overview of the body in ventral view of an adult chinchilla

1 : M. digastricus
2 : M. sternohyoideus
3 : M. pectoralis superficialis
4 : M. pectoralis profundus
5 : M. obliquus externus abdominis

FORELIMB

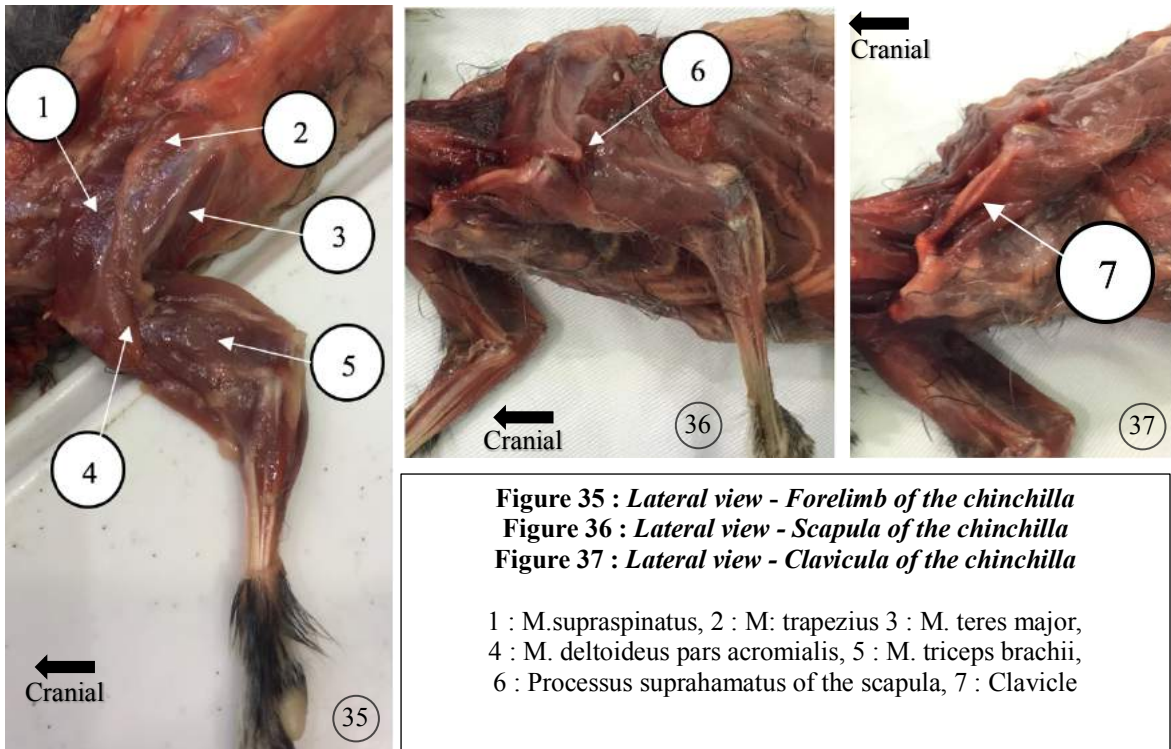


Figure 35 : Lateral view - Forelimb of the chinchilla
Figure 36 : Lateral view - Scapula of the chinchilla
Figure 37 : Lateral view - Clavicula of the chinchilla

- 1 : M.supraspinatus, 2 : M: trapezius 3 : M. teres major,
 4 : M. deltoideus pars acromialis, 5 : M. triceps brachii,
 6 : Processus suprahumeral of the scapula, 7 : Clavicula

HINDLIMB

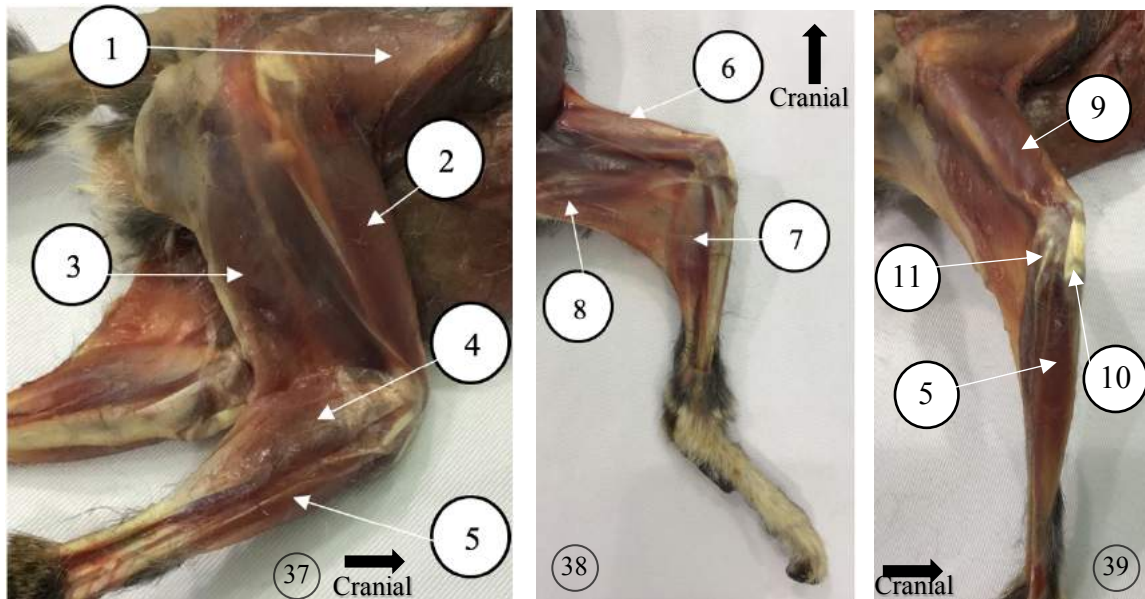


Figure 37 : Muscle of the Hindlimb lateral view
Figure 38 : Muscles of the Hindlimb medial view
Figure 39 : Stifle joint of the chinchilla

- 1 : M. gluteus medius, 2 : M. sartorius pars cranialis, 3 : M. biceps femoris, 4 : M. gastrocnemius caput lateralis, 5 : M. tibialis cranialis, 6 : M. sartorius pars caudalis,
 7 : M. gastrocnemius caput medialis, 8 : M. gracilis,
 9: M.quadriceps femoris, 10: Patellar ligament, 11 : Lateral collateral ligament

e. Anatomy of the thorax: general aspect, description of the different organs and vessels

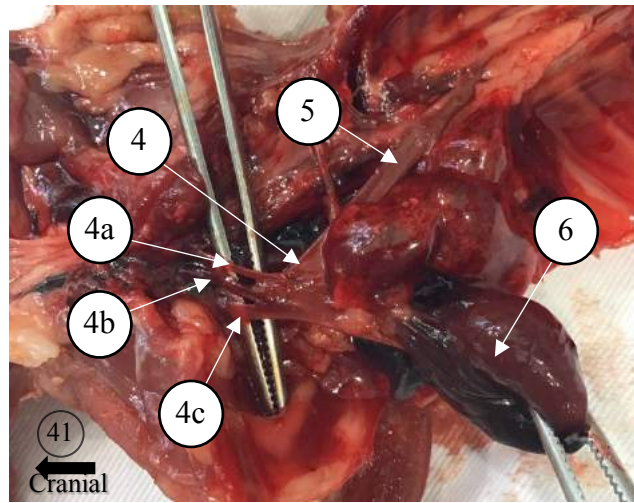
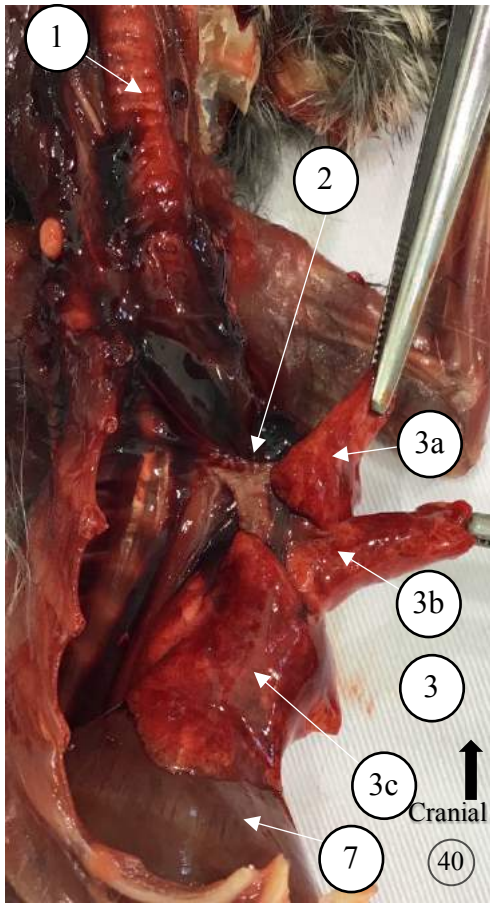


Figure 40 : Thorax, left, ventral view

Figure 41 : Thorax, left, lateral view

1 : Trachea, 2 : Bronchus principalis sinistra, 3 : Lobes of the left lungs; 3a : Cranial lobe cranial part, 3b : Cranial lobe caudal part, 3c : Caudal lobe, 4 : Aortic arch, 4a : Arteria subclavia sinistra, 4b : Arteria carotis communis sinistra, 4c : Arteria brachiocephalica, 5 : Aorta descendens 6: Heart, 7 : Diaphragm

The **right lung** is divided in 4 lobes: the cranial, middle, caudal and accessory lobes. The **left lung** is composed of 3 lobes: cranial (cranial, caudal part) and caudal.

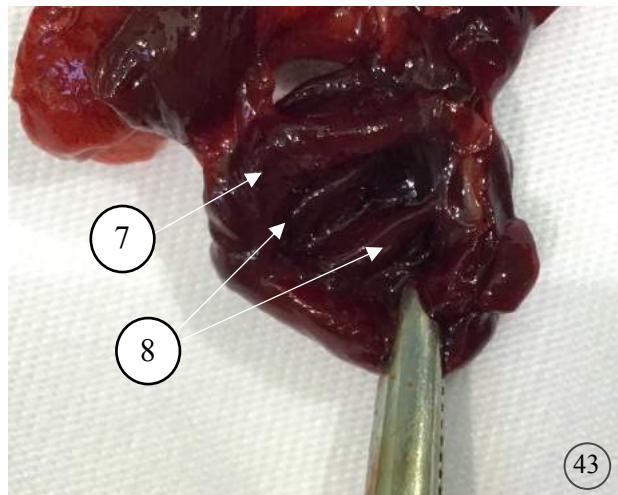
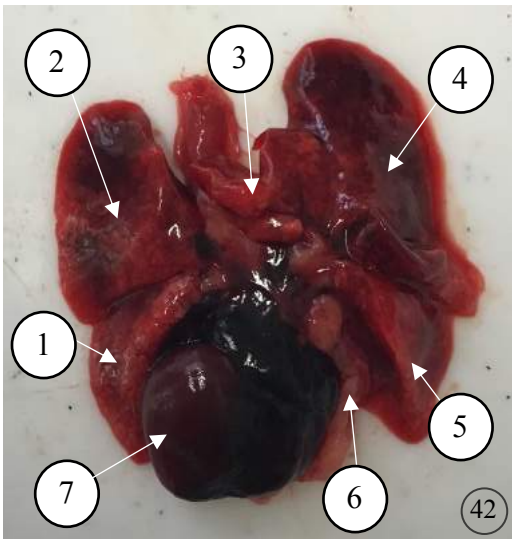


Figure 42 : External examination of the heart and the lungs

Figure 43 : Dissection of the cardiac valve in left ventricle of the heart

1 : Left cranial lobe, 2 : Left caudal lobe, 3 : Right accessory lobe, 4 : Right caudal lobe, 5 : Right middle lobe, 6 : Right cranial lobe, 7 : Heart, 8 : Papillary muscle of the left ventricle

In the chinchilla, the **right coronary artery** is **absent**, only the left coronary artery is supplying the heart. Cardiac ganglias are situated on the ventral surface of the right atrium.

f. Anatomy of the digestive system: general aspect, description of the organs and vessels

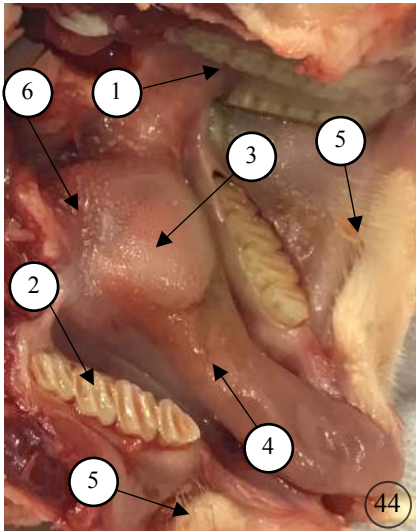


Figure 44 : Oral cavity of the chinchilla
 1 : Teeth of the upper jaw, 2 : Teeth of the lower jaw,
 3 : Torus linguae, 4 : Tongue, 5 : Inflexum pellitum,
 6 : Papillae conicae
 The **tongue** is “trapezoidal” in transverse section. As other rodents, chinchillas have the torus linguae (3), which moves the food towards the esophagus. There is no lysa but instead they have a circular fat plug. The dorsal side of the tongue is covered by filiform papillae, and close to the radix there are papillae conicae. Fungiform and vallate papillae are also present, which bear taste buds. Inflexum pellitum is the fur extending into the oral cavity.

Figure 45 : Topography of abdominal organs, ventral view
 1 : Diaphragm
 2 : Liver
 3 : Large intestine
 4 : Testis
 5 : Penis
 The chinchilla is a herbivorous animal. They are plant feeders and digest plants using hindgut fermentation. They are monogastric type with a simple, one-chambered stomach. Chinchillas house the bulk of their beneficial bacteria in the caecum. The **gastro-intestinal** tract is around 2,5-3m long. The stomach and caecum are relatively large. Ascending colon has a unique arrangement.

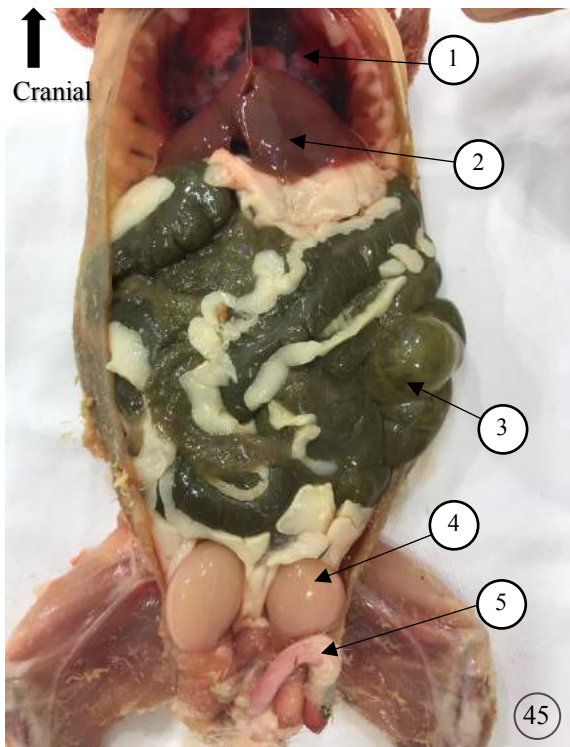


Figure 46 : Gastro-intestinal tract, ventral view
 1 : Stomach
 2A : Descending duodenum
 2B : Transverse duodenum
 2C : Ascending duodenum
 3 : Jejunum
 4 : Ileum
 5 : Caecum
 6 : Transverse colon
 7 : Descending colon forming loops
 8 : Rectum
 A,B,C,D : Ascending colon

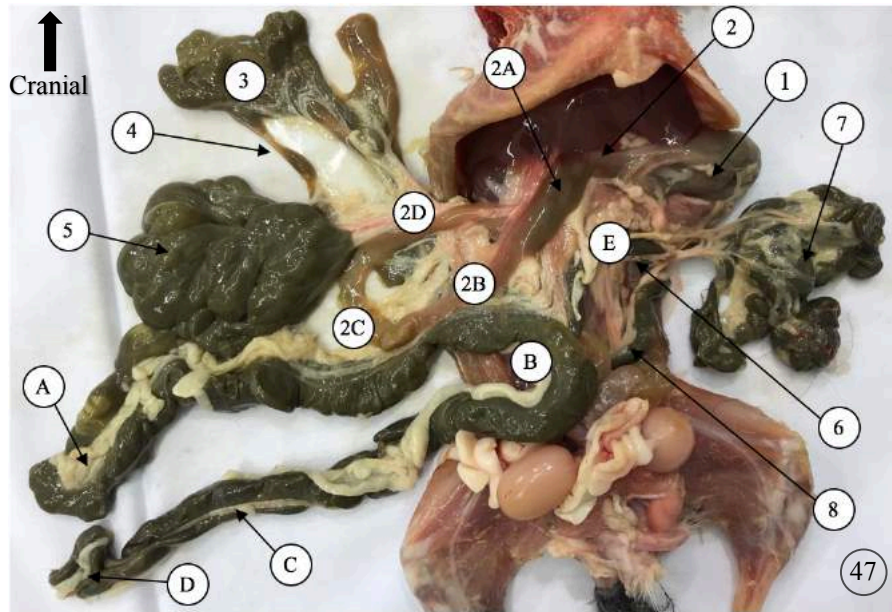


Figure 47 : Gastro-intestinal tract, ventral view

1 : Stomach, 2 Duodenum: 2A Ampulla duodeni, 2B : Descending duodenum, 2C : Transverse duodenum, 2D : Ascending duodenum, 3 : Jejunum, 4 : Ileum, 5 : Caecum 6 : Transverse colon 7 : Descending colon with loops, 8 : Rectum A : Ansa proximalis coli, B : Pars intermedia , C : Ansa distalis coli, D: Flexura apicalis
E : Flexura coli sinistra,

The ascending colon has three parts. The first one, starting from the cecum presented sacculations (taeniae) on its external part. This is the proximal loop (Ansa proximalis coli) with two parts running parallel to each other. The second part of the ascending colon was simple (Pars intermedia). The last part of the ascending colon (Ansa distalis coli) extended from the intermediate part to the right colic flexure. The distal ansa is again formed by two parts parallel to each other and joined by an apical flexure and the ascending mesocolon. The descending duodenum was fixed to the pars intermedia of the ascending colon by a peritoneal fold named accessory duodenocolic fold.

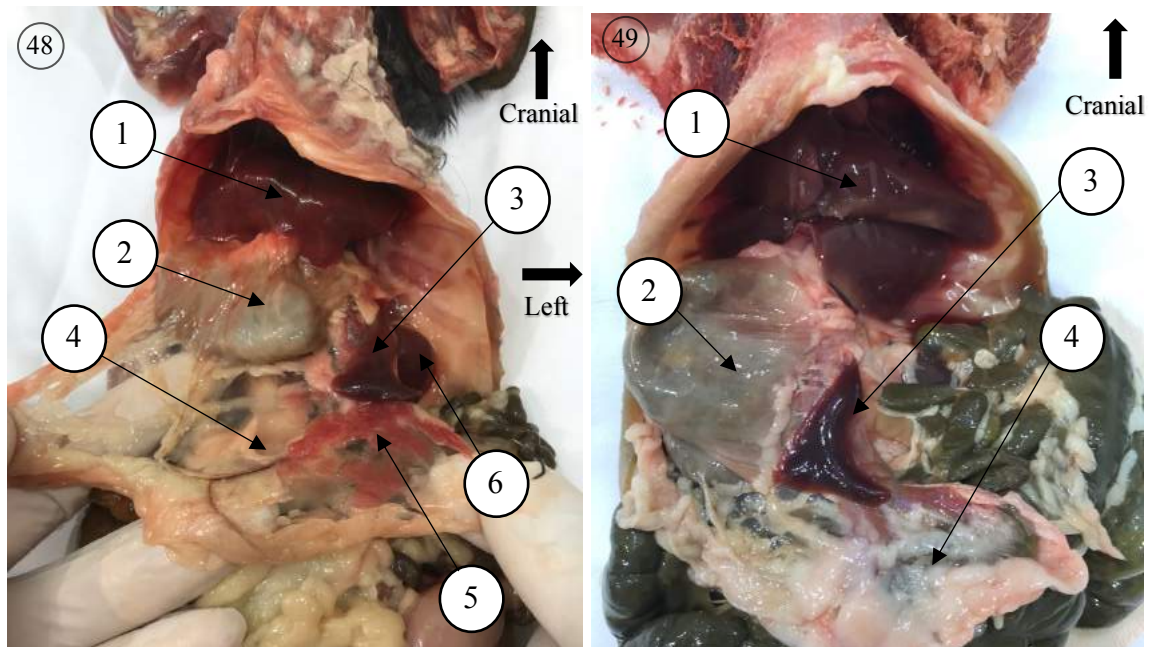


Figure 48 : Abdominal cavity of an adult chinchilla, ventral view
Figure 49 : Spleen and abdominal organs of an adult chinchilla, ventral view

1 : Liver, 2 : Stomach, 3 : Spleen, 4 : Greater omentum,
5 : Pancreas embedded by omentum majus, 6 : Left kidney
Spleen: located next to the right kidney, in triangular shape

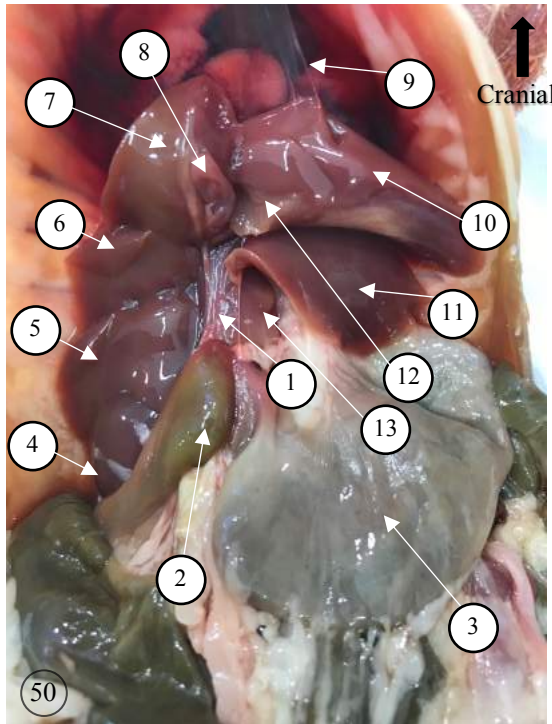


Figure 50 : In situ liver in the abdominal cavity, ventral view

- 1 : Bile duct
- 2 : Ampulla duodeni
- 3 : Stomach
- 4 : Right kidney
- 5 : Caudate process
- 6 : Right lateral lobe
- 7 : Right medial lobe
- 8 : Gallbladder
- 9 : Triangular ligament
- 10 : Left medial lobe
- 11 : Left lateral lobe
- 12 : Quadrate lobe
- 13 : Papillary process

Liver is located intraabdominally, its weight is around 10g in an adult chinchilla. The **gallbladder** is situated between the medial right lobe and quadrate lobe of the liver and is 1 cm long. The liver is composed of left and right lateral and medial lobes, quadrate lobe, caudate lobe, with caudate and papillary processes. The medial lobes are situated more cranially than the lateral lobes.

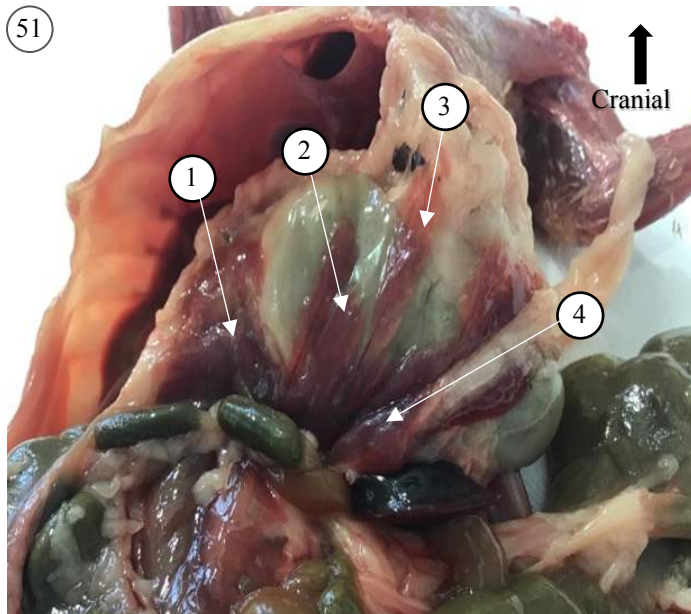


Figure 51 : Pancreas configuration ventral view

- 1 : Duodenic lobe of the pancreas, 2 : Gastric lobe of pancreas, 3 : Extensive branch of the gastric lobe, 4 : Splenic lobe of the pancreas
- The **pancreas** is strongly lobulated. Divided in duodenal lobe (right lobe) which is the biggest, the splenic lobe and the gastric lobe which has a strong network of extensive branches towards the stomach. The pancreas is situated at the beginning of the duodenum embedded by the deep layer of the omentum majus. I left out a sentence here. The **liver's** caudate process is connected to the right kidney and the suprarenal gland.

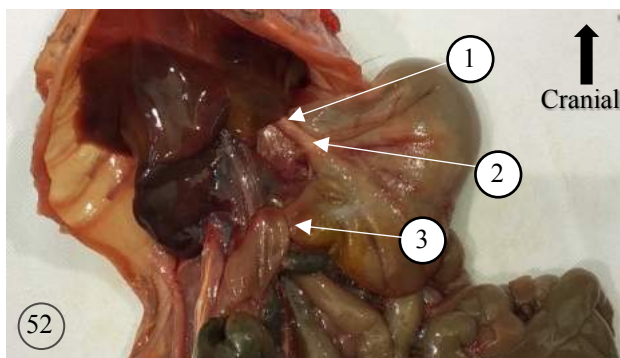


Figure 52 : In situ stomach of the chinchilla ventral view

- 1: Oesophagus, 2 : Pylorus 3: Cardia

Location of the **stomach**: caudal to the diaphragm and liver. Pylorus is defined by a slight constriction. The stomach is simple, unilocular. Located transversally and caudally situated to the rib cage in left side.

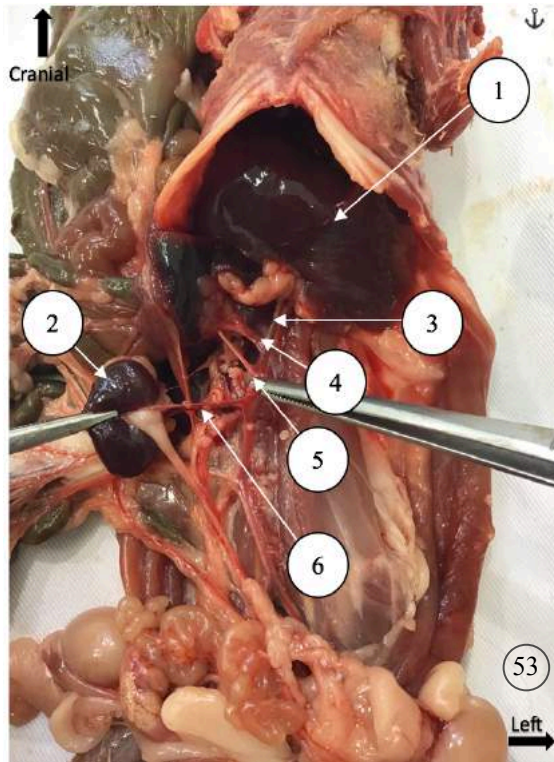


Figure 53 : Organs and blood vessels of the abdomen, ventral view

1 : Liver, 2 : Left kidney, 3 : Aorta abdominalis, 4 : Arteria celiaca, 5 : Arteria mesenterica cranialis, 6 : Arteria renalis sinistra

Celiac artery is divided in 4 branches: left gastric artery, hepatic artery, splenic artery and gastrolial artery.

The **cranial mesenteric artery** is the second unpaired branch coming from the abdominal aorta, and it is situated caudal to the celiac artery. It's branches: the caudal pancreatico-duodenal artery, jejunal arteries (up to 6), dorsal caecal artery, medial caecal artery and ileo-caecal artery.

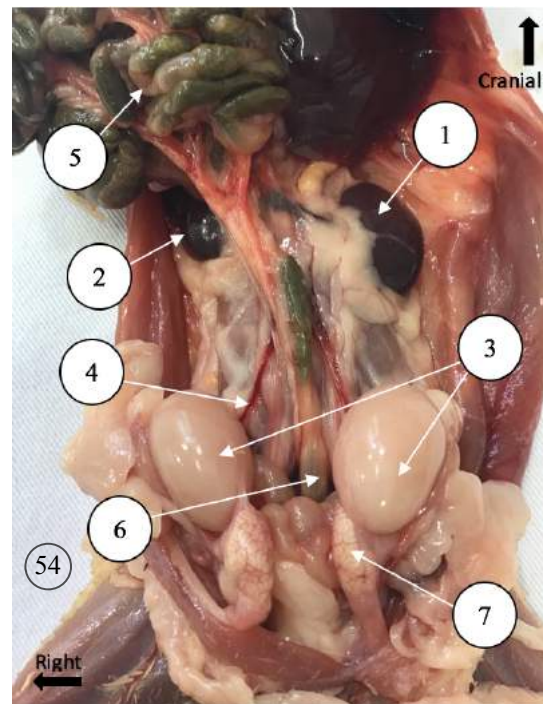
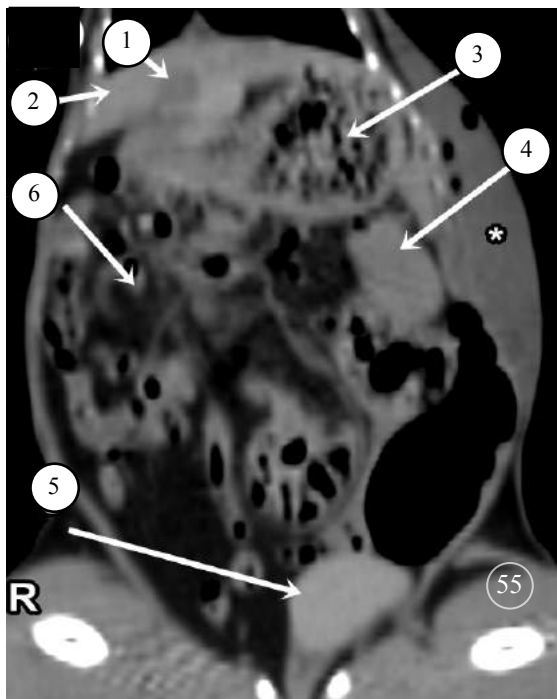


Figure 54 : Blood vessels and organs in the abdomen, ventral view

1 : Left kidney, 2 : Right kidney, 3 : Testis, 4 : Vena testicularis dextra, 5 : Descending colon with loops, 6 : Rectum, 7 : Epididymis

The **caudal mesentery artery** is the last unpaired branch of the abdominal aorta.

The **left testicular/ovarian vein** enter the left renal vein which joins the caudal vena cava, the right testicular/ovarian vein enter the vena cava caudalis directly.



CT images of an adult chinchilla. (100mA, 120kV, 1,25mm slice thickness, standard kernel, helical mode, prone position)

Figure 55 : Dorsal reconstruction image of the abdomen (WL60, WW400)

1 : Gallbladder
2 : Liver
3 : Stomach
4 : Left kidney
5 : Urinary bladder
6 : Intestines (unidentified)
* : subcutaneous edema after subcutaneous infusion

g. Anatomy of the genital apparatus male and female

FEMALE

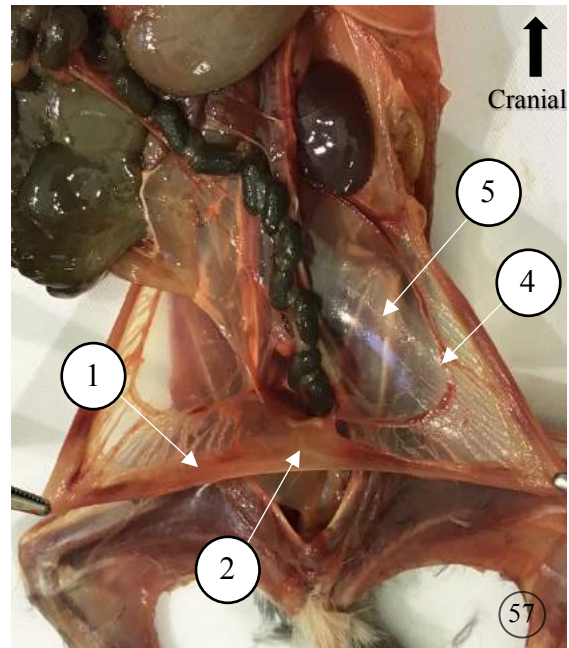
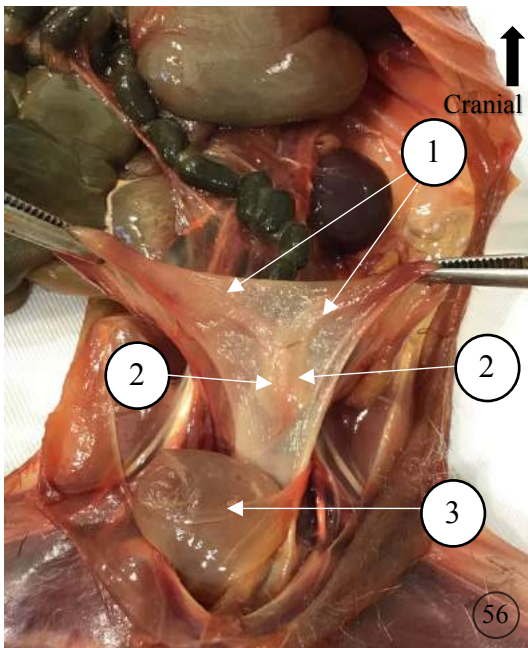


Figure 56 : Genital tract focus on uterine horn of the female chinchilla, ventral view

Figure 57 : Genital tract of the female chinchilla, ventral view

1 : Uterine horns, 2 : Cervicis, 3 : Urinary bladder, 4 : Arteria/vena uterina, 5 : Ligamentum latum artery
The suspension of the uterine horns and the uterine arteries is visible on the picture: the ligamentum latum utery.

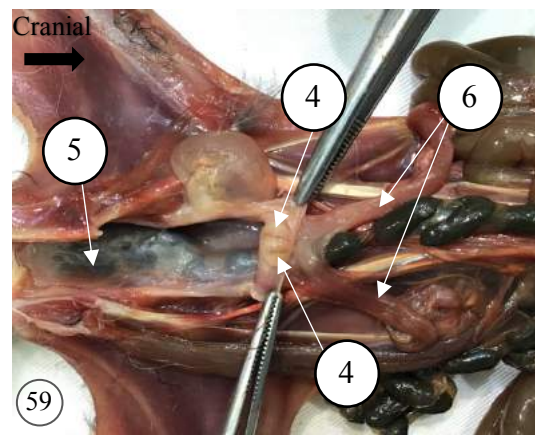
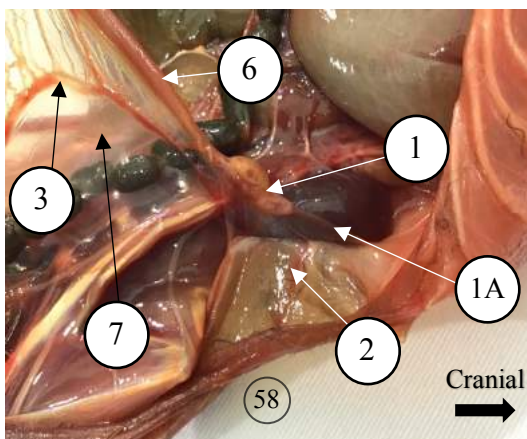


Figure 58 : Genital tract of the female chinchilla

Figure 59 : Genital tract of the female chinchilla vagina opened

1 : Ovary, 1A : Lig.suspensorium, 2 : Tuba uterina, 3 : Arteria uterina, 4 : 2 portio vaginalis (cervicis),
5 : Vagina (opened), 6 : Uterine horns, 7 : Ligamentum latum utery

As seasonal polyestrous animal, the female chinchilla has a **duplex uterus** with **double cervicis**. They have 3 pairs of **mammary glands** situated on the inguinal region and 2 other pairs laterally to the thorax. The uterus has uterine horn which are up to 6cm descending caudally to the mesenteric cavity. In the **vagina** there are 2 openings of the cervicis (2 portio vaginalis projects into the vagina), as they are not fused. The vagina is up to 15mm. Compared to other mammals, in female the urethra terminates outside of the vagina.

MALE

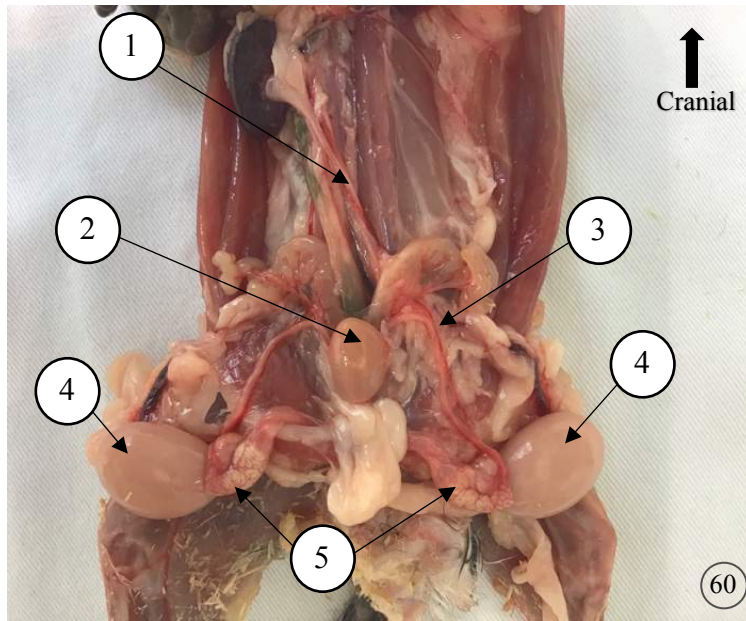


Figure 60 : Genital tract of the male chinchilla, ventral view

- 1 : Arteria/vena testicularis
- 2 : Urinary bladder
- 3 : Ductus deferens
- 4 : Testis
- 5 : Epididymis

The **testis** are not always situated inside the scrotum. As the inguinal canal does not constrict after the testicle has descended into the scrotum, they can be pulled back into the abdomen. Inside the abdomen and stay close to the large intestine and the caecum.

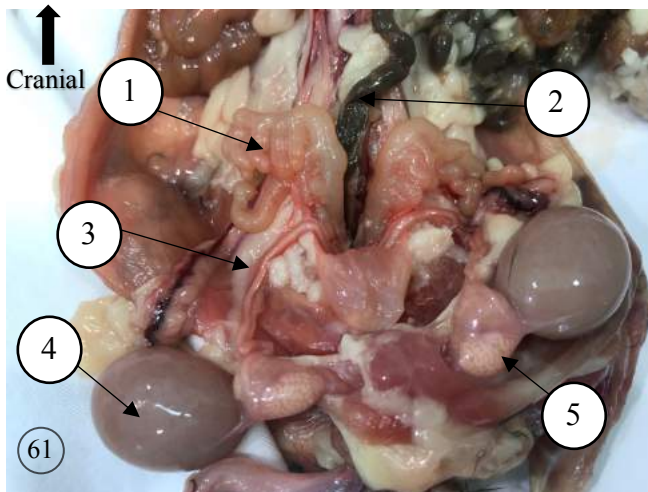


Figure 61 : Genital tract and accessory glands of the male chinchilla, ventral view

- 1 : Glandula vesicularis
- 2 : Rectum
- 3 : Ductus deferens
- 4 : Testis
- 5 : Epididymis

The chinchilla owns **3 pairs of accessory sex glands**: glandula vesicularis (vesicula seminalis), glandula bulbourethralis (Cowper gland), and prostate gland.

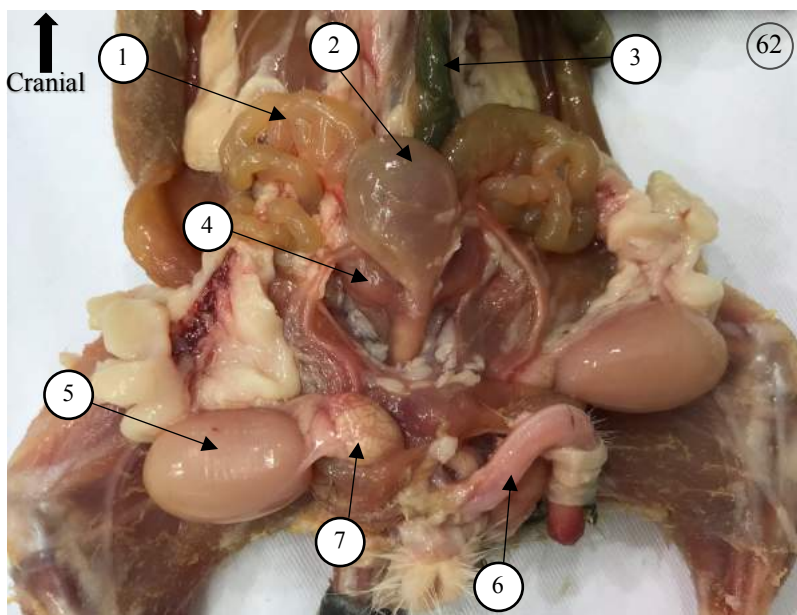


Figure 62 : Sex gland of an adult chinchilla, ventral view

- 1 : Glandula vesicularis
- 2 : Urinary bladder
- 3 : Rectum
- 4 : Prostate gland
- 5 : Testis
- 6 : Penis
- 7 : Epididymis

The characteristics of the **penis** is the shape. It has an S-shape form. Penis and preputium have frequent disorders in chinchilla. Like phimosis which is the impossibility to protrude the penis.

h. Nervous system, brachial plexus, sacral plexus
FORELIMB

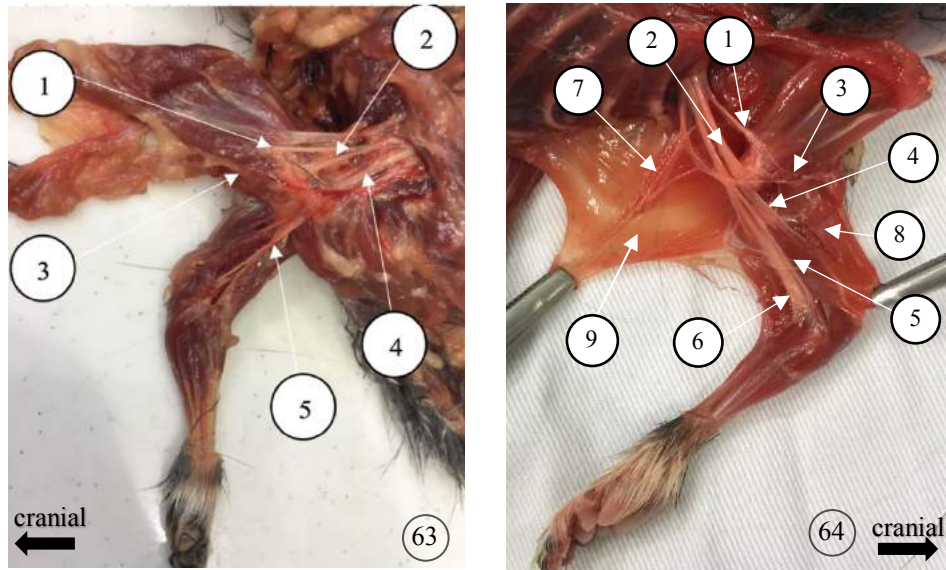


Figure 63 : Brachial plexus of adult chinchilla

Figure 64 : Brachial plexus of adult chinchilla

1 : Nervus subscapularis, 2 : Nervus axillaris, 3 : Nervus/Arteria/Vena thoracodorsalis 4 : Nervus radialis, 5 : Nervus ulnaris, 6 : Nervus medianus, 7 : Nervus thoracicus lateralis, 8 : M. latissimus dorsi
 9 : M. pectoralis profundus

The **brachial plexus** of the chinchilla is composed from C5 to C8, T1 and T2. All the branches are coming from 1 single trunk. Subscapular nerve is coming from C5 and C6 together. Axillary nerve is coming from C6 and C7. The radial nerve is coming from C8, T1 and T2. But the thoracodorsal nerve is originating only from C8. The ulnar nerve is coming from T1 and T2.

HINDLIMB

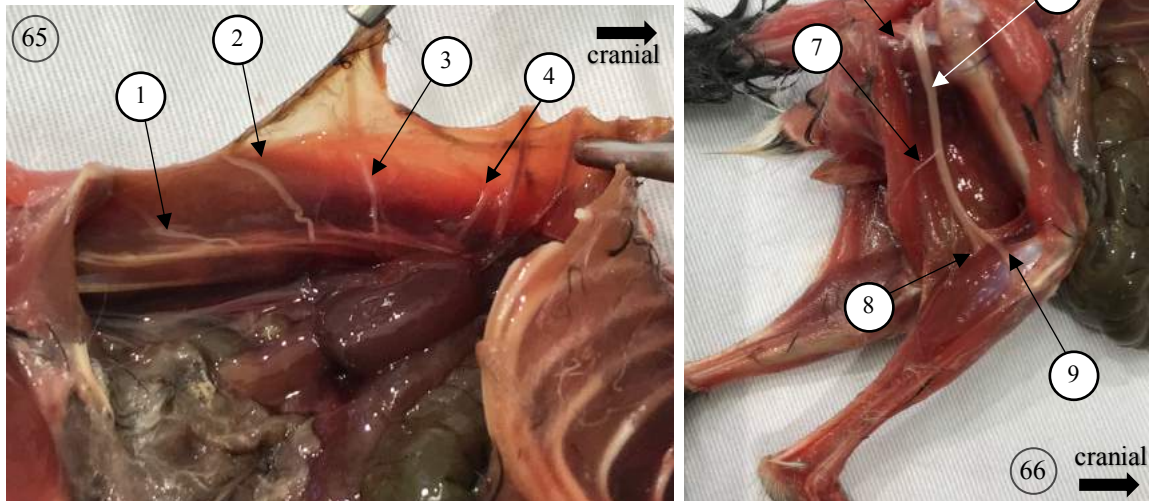


Figure 65 : Lumbal plexus

Figure 66 : Sacral plexus

1 : Nervus cutaneus femoris lateralis , 2 : Nervus ilioinguinalis, 3 : Nervus iliohypogastricus caudalis, 4 : Nervus iliohypogastricus cranialis, 5 : Nervus ischiadicus, 6 : Nervus cutaneus femoris caudalis,
 7 : Nervus cutaneus surae lateralis, 8 : Nervus tibialis, 9 : Nervus peroneus communis

The plexus sacral of the chinchilla does not own differences compared to other rodents. L4 to L6 and S1 to S3 spinal nerves formed a complex called “LPS” meaning **plexus lumbosacralis**. This plexus innervate the hindlimb, abdominal , inguinal, perineal and perianal regions.

6. *Summary*

The chinchilla is a fur pet animal coming from the breeding between the *Chinchilla lanigera* and *Chinchilla brevicaudata*. Nowadays, exotic animal like rabbit, rat, guinea pig are considered more as a pet by the population and the focus on these animal by the veterinarians is increasing year after year. The chinchilla also became very popular in the 21st century as a pet animal and it gained focus thanks to the fur farming industry as well. Few literature is found about the anatomy of the chinchilla. The studies were given information about different systems of the animal, like the gross anatomy of the liver, dissection of the femoral artery, or ear as a model in research. However a complete review, or atlas were not found until now.

During our dissection work, we discovered similarities of the chinchilla with other species. For example, this exotic animal, the chinchilla owns a *torus linguae*, like other rodents and ruminants, and this structure helps the food to be sent into the esophagus. There is *inflexum pellitum* in the oral cavity like in rabbits. The ascending colon is similar to the loops of the ascending colon of the horse. We showed as well that the chinchilla has a double cervix and a double uterus like rabbit, and rat for example. Chinchilla is a unique species that combines similar morphological systems of different species.

The chinchilla as an ear model for human diseases has been really important, since the end of 1970s. The easy access of the tympanic bulla and the anatomical size can help for the research. We also tried to focus on the ear and show a proper access to the anatomy of it. X-ray can help to see this large tympanic bulla. On the other hand, with the use of the CT scan, dental diseases can be detected easily.

I think the chinchilla will become more and more popular in the following years. Exotic animals are considered to be as important as dogs and cats in the veterinarian practice. That is why veterinarians need to be more confident with the anatomy of the chinchilla.

The purpose of this study was writing an Atlas, showing the macroscopical anatomy of the chinchilla, together with X-ray and CT scan pictures. We hope that this work can help vets and researcher to find answers regarding the anatomy of the chinchilla.

Anatomical atlas of the chinchilla

A csincsilla anatómiai atlasza

Author: **Hélaudais Adeline**, University of Veterinary Medicine Budapest, vet school, 6th year

Supervisor: Hazai Diana, lecturer (University of Veterinary Medicine Budapest, Department of Anatomy and Histology)

The aim of the present work was to create an atlas that shows the anatomy of a chinchilla. The macroscopic anatomy of the animal is presented with images taken at autopsy and X-rays and CT scans of a live animal to provide veterinarians and researchers with a well-detailed clinical approach to the anatomy of the chinchilla.

Chinchilla is a special animal in many ways. The first is an economic aspect, because in Hungary the breeding of chinchillas for the use of their fur is very important. The second aspect is the use of chinchilla as a model animal in medical research. This is because the tympanic bulla of the chinchilla (in the middle ear) has a similar structure to that of humans, which is why it is widely used in research on human deafness, for example. The last aspect was the spread of chinchilla as a pet and therefore its appearance in veterinary practice.

It is therefore important to have adequate knowledge of the structures of the chinchilla's body, so we aimed to make an easy-to-use anatomical atlas of it.

A study of the literature revealed that although there are detailed descriptions of chinchillas, they only cover certain organ systems of the animal, and a comprehensive presentation that we designed and prepared proved to be a fill.

In the course of our work over the past year, we dissected the bodies of several dead male and female chinchillas and documented the dissection with photographs. The completed images were then processed, labeled based on our anatomical knowledge, and inserted into the dissertation, supplemented by an explanation of the structures shown in the image. In the meantime, we managed to take CT and X-rays of a live chinchilla. With the completed X-rays, we focused more on the head and teeth, as their examination is the most common in veterinary practice, so presenting a healthy animal can help with healing.

We hope that the completed work will benefit all those who want to learn more about the anatomy of chinchilla.

A csincsilla anatómiai atlasza

Anatomical Atlas of the chinchilla

Szerző: **Hélaudais Adeline**, Állatorvostudományi Egyetem, állatorvos szak, VI. évfolyam

Témavezető: Dr. Hazai Diana, egyetemi adjunktus (Állatorvostudományi Egyetem, Anatómiai és Szövetani Tanszék)

A jelen munka célja egy atlasz létrehozása volt, amely a csincsilla anatómiáját mutatja be. Az állat makroszkópos anatómiáját a boncolás során készített képekkel, valamint egy élő állatról készített röntgen- és CT-felvételekkel mutatjuk be, hogy az állatorvosok és kutatók egy jól részletezett klinikai megközelítést kapjanak a csincsilla anatómiájáról.

A csincsilla több szempontból is különleges állat. Az első egy gazdasági szempont, mivel Magyarországon a csincsilla tenyésztése a szőrméjének felhasználása céljából igen nagy jelentőségű.

A második szempont a csincillának, mint modell-állatnak a felhasználása az orvostudományi kutatásokban. A csincillának ugyanis a dobürege (a közép-fül területén) hasonló felépítésű, mint az emberé, ezért például az emberi süketséggel kapcsolatos kutatásokban elterjedt a használata.

Az utolsó szempont pedig a csincsilla házi kedvencként való elterjedése és emiatt az állatorvosi praxisban való megjelenése volt.

Fontos tehát, hogy a csincsilla testének felépítéséről megfelelő ismeretekkel rendelkezzünk, ezért célul tűztük ki, hogy egy könnyen és praktikusán használható anatómiai atlaszt készítsünk el róla.

A szakirodalmat tanulmányozva az derült ki, hogy a csincilláról vannak ugyan részletes leírások, de ezek csak az állat bizonyos szervrendszerére terjednek ki, és egy olyan átfogó bemutatás, amit mi terveztünk meg és készítettünk el, hiánypótlónak bizonyult.

Az elmúlt évben lezajlott munka során több elhullott hím és nőivarú csincsilla testét boncoltuk fel és fényképekkel dokumentáltuk. Az elkészült képeket ezután feldolgoztuk, feliratoztuk az anatómiai ismereteink alapján és a dolgozatba illesztettük be, kiegészítve a képeken látható struktúrák magyarázatával. Közben egy élő csincillán sikerült CT- és röntgenfelvételeket készítenünk. Az elkészült röntgen-felvételekkel inkább a fejre és a fogakra koncentráltunk, mivel ezeknek a vizsgálata fordul elő leggyakrabban az állatorvosi gyakorlatban, ezért egy egészséges állat bemutatása segíthet a gyógyításban.

Reméljük, hogy az elkészült munka hasznára válik majd mindazoknak, akik a csincsilla anatómiájáról többet szeretnének megtudni.

7. Bibliography

- Alworth, L.C., Harvey, S.B., 2012. *Anatomy, physiology, and behavior*. In: Suckow, M.A., Stevens, K.A., Wilson, R.P. (Eds.), *The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents*. Academic Press/Elsevier, London; Waltham, MA, 955-966.
- Ashdown, R.R., Webb, R.A., Cooper, J.E., 1967. *The Anatomy of the Abdominal Muscles of the Chinchilla*. *Res. Vet. Sci*, 8, 227-233.
- Brenner, S.Z.G, Hawkins, M.G., Tell, L.A., Hornof, W.J., Plopper, C.G., Verstraete, F.J.M., 2005. *Clinical Anatomy, Radiography, and Computed Tomography of the Chinchilla Skull*. *Compendium on continuing education for the practicing veterinarian*, 933-944.
- Cabrera, A., 1961. *Catalog de los mamiferos de America del Sur. II*. *Revista del Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Ciencias Zoológicas* 4, 309-732.
- Călămar, C.D., Pătruică S., Dumitrescu G., Bura M., Bănăţean Dunea I., Nicula M., 2014. *Morpho-histological study of the digestive tract and the annex glands of Chinchilla laniger*. *Scientific Papers: Animal Science and Biotechnologies* 47, 269-274.
- Çevik-Demirkan, A., Özdemir V., Türkmenoğlu İ., Demirkan İ., 2007. *Anatomy of the Hind Limb Skeleton of the Chinchilla (Chinchilla lanigera)*, *Acta Vet. Brno* 76, 501-507.
- Cevik-Demirkan, A., Ozdemir, V., Demirkan, I., Turkmenoglu, I., 2007. *Gross morphological features of plexus brachialis in the chinchilla (Chinchilla lanigera)*. *Journal of the South African Veterinary Association*, Volume 78, Issue 1, 21-24.
- Chende, A., Irimescu, I., Ghiurco, F., Damian, A., 1967. *Comparative Anatomical Study of the Pelvic Limb Skeleton in the Chinchilla (C. Lanigera) and in the Domestic Rabbit (O. Cuniculus)*. *Bulletin UASVM Veterinary Medicine* 71, 506.
- Corbet, G.B., and Hill, J.E., 1980. *A world list of mammalian species*. British Museum (Natural History), London, United Kingdom.
- Hoefler, H.L., 1994. *Chinchillas*. *Vet Clin North Am Small Anim Pract*, 24, 113-120.
- Irimescu, I., Bob, D., Pop, C., Damian, A., 2014. *Comparative Anatomical Study of the Thoracic Limb Skeleton in the Chinchilla (C. Lanigera) and in the Domestic Rabbit (O. Cuniculus)*. *Bulletin UASVM Veterinary Medicine* 7, 504.
- Johnson-Delaney, C.A., 2006. *Anatomy and Physiology of the Rabbit and Rodent Gastrointestinal System*. *Proceedings*, 9-16.

- Martinez-Pereira, M.A., Rickes, E.M., 2011. *The spinal nerves that constitute the lumbosacral plexus and their distribution in the chinchilla*. *Tydskr. S. Afr. vet. Ver.* 82, 150-154.
- Trevino, M., Lobarinas, E., Maulden, A.C., Heinz, M.G., 2019. *The chinchilla animal model for hearing science and noise-induced hearing loss*. *J. Acoust. Soc. Am.* 146 (5), 3710-3732.
- Osgood, W.H., 1943. *The mammals of Chile*. *Field Museum of Natural History, Zoology Series* 30, 1-268.
- Pérez W., Vasquez N., Jerbi H., 2011. *Gross anatomy of the intestine and their peritoneal folds in the chinchilla (chinchilla lanigera)*, *J. Morphol. Sci.*, vol 28, no 3, 139-153.
- Riggs, S.M., Mitchell, M.A., 2009. *Chinchillas*. In: Mitchell, M.A., Tully, T.N. (Eds.), *Manual of Exotic Pet Practice*. Saunders, St. Louis, MO, 474-492.
- Stan, F., Damian, A., Gudea, A., Dezdrobotu, C., Bob, D., Martonos, C., Bochis, I., Pogana, B., 2014. *Comparative anatomical Study of the Large Intestine in Rabbit and Chinchilla*. *Bulletin of University of Agricultural Sciences and Veterinary Medicine*, 71 (1), 208-212.
- Stan, F.G., 2018, a. *Comparative Study of the Liver Anatomy in the Rat, Rabbit, Guinea Pig and Chinchilla*. *Bulletin of University of agricultural Sciences and Veterinary Medicine*, 75 (1).
- Stan, F.G., 2018, b. *Macroscopic anatomy of pancreas in rats, guinea pigs, chinchilla and rabbits*. *Scientific Works. Series C. Veterinary Medicine. Vol. LXIV (1)*.
- Spotorno, A.E., Zuleta, C.A., Valladares, J.P., Deane, A.L., Jiménez J.E., 2004. *Chinchilla laniger*. *Mammalian Species* 758, 1-9.
- THE CHINCHILLA. Published: 2003, updated:2013. URL: <http://www.chinchilla-lexikon.de/index.php/the-chinchilla-english> Accessed:19/07/2021.
- Wang, X., Gan, R.Z., 2016. *3D finite element model of the chinchilla ear for characterizing middle ear functions*. *Biomech Model Mechanobiol* 15, 1263-1277.
- Woods, C., 1993. *Suborder Hystricognathi in Mammal species of the world: a taxonomic and geographic reference (Wilson D.E., and Reeder D.M., eds.)*. Second edition. Smithsonian Institution Press, Washington, D.C, 771-806.

8. Acknowledgement

I would like to thank and express my sincere gratitude to my wonderful supervisor Dr. Hazai Diána. For all the help, the continuous support and advices during this project since 1 year. For her patience and motivation. The completion of this work could not have been accomplished without her knowledge. I would like to thank the Anatomy and Histology department for gave me the opportunity to work with them.

Besides my supervisor, I would like to deeply thank Dr. Papp and Dr. Arany-Toth who help me to collect information. To Dr. Papp for help me to accomplish the X-rays images and his kindness to guide me for write this paper. And to Dr. Arany-Toth for the possibility to made the CT-scan images, the reading of the pictures and for choose the best photography for the project.

Finally, I am thankful to everyone who took part and follow me inside this work. To Dr. Reinitz who help me to find a project and gave me advices. And to my family and friends who support me throughout the beginning.

HuVetA

ELECTRONIC LICENSE AGREEMENT AND COPYRIGHT DECLARATION*

Name: *HELAUDAIS Adeline*.....
Contact information (e-mail): *Adeline.helaudais@gmail.com*.....
Title of document (to be uploaded): *Anatomical atlas of the chinchilla*.....
.....
.....
Publication data of document: *2021*.....
Number of files submitted: *1 copy*.....

By accepting the present agreement the author or copyright owner grants non-exclusive license to HuVetA over the above mentioned document (including its abstract) to be converted to copy protected PDF format without changing its content, in order to archive, reproduce, and make accessible under the conditions specified below.

The author agrees that HuVetA may store more than one copy (accessible only to HuVetA administrators) of the licensed document exclusively for purposes of secure storage and backup, if necessary.

You state that the submission is your original work, and that you have the right to grant the rights contained in this license. You also state that your submission does not, to the best of your knowledge, infringe upon anyone's copyright. If the document has parts which you are not the copyright owner of, you have to indicate that you have obtained unrestricted permission from the copyright owner to grant the rights required by this Agreement, and that any such third-party owned material is clearly identified and acknowledged within the text of the licensed document.

The copyright owner defines the scope of access to the document stored in HuVetA as follows (mark the appropriate box with an X):

- I grant unlimited online access,
- I grant access only through the intranet (IP range) of the University of Veterinary Medicine,
- I grant access only on one dedicated computer at the Ferenc Hutýra Library,
- I grant unlimited online access only to the bibliographic data and abstract of the document.

Please, define the **in-house accessibility of the document** by marking the below box with an **X**:

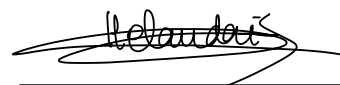


I grant in-house access (namely, reading the hard copy version of the document) at the Library.

If the preparation of the document to be uploaded was supported or sponsored by a firm or an organization, you also declare that you are entitled to sign the present Agreement concerning the document.

The operators of HuVetA do not assume any legal liability or responsibility towards the author/copyright holder/organizations in case somebody uses the material legally uploaded to HuVetA in a way that is unlawful.

Date: Budapest, 13...day 10.....month.....2021...year



Author/copyright owner
signature

HuVetA Magyar Állatorvos-tudományi Archívum – Hungarian Veterinary Archive is an online veterinary repository operated by the Ferenc Hutýra Library, Archives and Museum. It is an electronic knowledge base which aims to collect, organize, store documents regarding Hungarian veterinary science and history, and make them searchable and accessible in line with current legal requirements and regulations.

HuVetA relies on the latest technology in order to provide easy searchability (by search engines, as well) and access to the full text document, whenever possible.

Based on the above, HuVetA aims to:

- *increase awareness of Hungarian veterinary science not only in Hungary, but also internationally;*
- *increase citation numbers of publications authored by Hungarian veterinarians, thus improve the impact factor of Hungarian veterinary journals;*
- *present the knowledge base of the University of Veterinary Medicine Budapest and its partners in a focussed way in order to improve the prestige of the Hungarian veterinary profession, and the competitiveness of the organizations in question;*
- *facilitate professional relations and collaboration;*
- *support open access.*