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## **Belgian Bearded Rabbit: history of the breed, consanguinity and observed malformations**

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**The Belgian Bearded rabbit has a very high coefficient of consanguinity. Anomalies are relatively common, like an abnormally long and tortuous small intestine. To our knowledge, this observation has never been mentioned before in rabbits.**

The origin of the Belgian Bearded rabbit of Ghent remains obscure and incredible (Figure 1). This rustic breed has been

discovered in 1956, when Belgian merchant Raoul Verwulgen traveled in Limousin (France) with his family. During a break in a



**Figure 1:** Belgian bearded rabbit crowned European Champion 2018 in Henning (Denmark), pride of Michel Gruaz



**Figure 2:** One of Raoul Verwulgen's daughters carrying a Belgian Bearded rabbit in her apron. Photo early 1960s.

wooded area, he was attracted by the smell of honey and followed the flight of bees to the grounds of a hermit. After a few exchanges, he heard a rustle and saw animals that look like muskrats. In fact, they were rabbits living freely in burrows. Their body is sturdy and elongated, with a slightly curved dorsal line. The rump is bony but has a rounded optical effect. The chest is well developed. The front and back limbs are strong, muscular and proportional to the body. The shape of the head is typical, with forehead and chamfer forming a straight line. The nasal region is relatively wide, with large nasal openings. Jaws are strong. Ears are broad, robust and hairy, with rounded tips. The male's head is stronger than that

of the female. In addition to a characteristic head, the Belgian Bearded rabbit has an unusual fur pattern, with a mane of long hair around the head, dewlap and along the flanks. The hermit gave a young male and a young female to the merchant.

### **First exposed Belgian Bearded Rabbits**

Once back in Belgium, the merchant let his couple of rabbits live free in his garden and multiply (Figure 2). A selection of weight and length of the long hairs is nevertheless started. The offspring weighs between 4.5 and 6 kilos, sometimes more. The litters have an average of 5 youngsters. After much hesitation, Raoul Verwulgen agrees to expose one older male and 4 young females at the animal show "Het Neerhof" in Ghent (1961) under the name "Gentse Baarde" or "Barbus de Gand". Our merchant would have preferred the name of "Lions of Flanders". Rabbit experts of that time were hardly impressed by this unusual rabbit, asserting it is a cross between a rabbit with normal hair and a long-haired Angora. Another expert states that the breeder has not taken the "mane" surrounding the head into consideration when selecting his animals, ignoring the fact that this mane changes with age. Despite the success of his Belgian Bearded rabbits, Raoul Verwulgen is disappointed by the remarks of the judges and refuses offers from Germany and from Japan to purchase his animals for sizable amounts of money. Frightened by this success, he retires from exhibitions and never presents his rabbits to the public anymore. Over the years, he persists in his refusal to sell animals to interested people. Due to an increased work schedule, his interest in the Belgian Bearded rabbit decreases. He leaves his rabbits in the back of his garden, and gives a few to members of his family and some breeders in the region, who are not too much interested in this breed.

### **Breed preservation**

Almost 20 years later, in the late 1970s, Ronny de Clerck, representative of the Association for the Preservation of Ancient Breeds (Vereniging voor het Behoud van Zeldzame Huisdieren) found some breeders who own Barbus. He bought a first rabbit from a woman breeder in Zingem, a Dutch-speaking municipality near Ghent (Belgium). Males with the characteristics of the Belgian Bearded rabbit ensure the offspring. Thanks to a strict selection, the peculiarities of fur color and body structure of this breed are preserved and stabilized, but the high coefficient of consanguinity results in weak animals (Figure 4). Further females with a similar body shape and fur structure are introduced into the breeding program. In 1990, Ronny de Clerck published an article about this particular breed of rabbits.

### **Breeding and selection of the Bearded Belgian rabbit**

In the early 1980s, Erik Meeus, a breeder from Duffeln, in the province of Antwerp, bought three Belgian Bearded rabbits from Ronny de Clerck (Figure 3). He obtains offspring with fur in different colors: agouti, black and yellow. His selection criteria include weight and long hairs around the head and along the body. His does have litters with an average of 6 to 7 pups. He leaves some females free in the hope that they will mate with wild rabbits in order to reduce inbreeding and, thus, obtain healthy animals. Some of the descendants are admitted in his breeding line. Despite all his efforts, Belgian Bearded rabbits remain unpopular. Over the years, he reduces his livestock to a few agouti colored animals: 5 young males, 1 old male and 4 older females. These few rabbits form the origin group of the Belgian Bearded rabbit, as it has gradually spread in Europe.

The Belgian Bearded rabbit gained

notoriety in the early 2000s only, after a televised presentation of the breeder Erik Meeus and his protégés. Thanks to his enthusiasm, the breed has been preserved and has become popular among breeders in Belgium, Germany, Austria and Switzerland but also among the owners of pet rabbits.

### **Successful Rescue !!!**

In 1990, Ronny de Clerck contacted Dr. Jürgen Güntherschulze, director of the animal Warder's Park in Schleswig-Holstein (Germany), informing him that there is only one other breeder of Belgian Bearded rabbit and himself. This old Franco-Belgian rabbit breed is in danger, with a risk of extinction if no action is undertaken. Dr. Jürgen Güntherschulze is fascinated by



**Figure 3:** Erik Meeus with one Belgian Bearded rabbit. Photo : Hans Ringnalda



**Figure 4:** Angora rabbit, with long woolly fur almost all over the body.

the special appearance of these rabbits, and imports 2 breeding pairs in Germany in 1992. He establishes a rescue plan for the breed. In collaboration with Ronny de Clerck and Fritz-Günther Röhrssen, he imports more Belgian Bearded rabbits. The descendants are distributed to different animal "Archehöfe" parks and their breeding stations, in order to reduce any risk of extinction by disease.

Despite a difficult start, the breed is now saved and many Belgian Bearded rabbits have been exported to other countries like Austria and Switzerland. The breed is officially recognized in 2005 in Germany, in 2007 in Belgium, thanks to the efforts of Bert Driessen, then in Luxembourg, in 2008 in Austria and in 2019 in Switzerland.

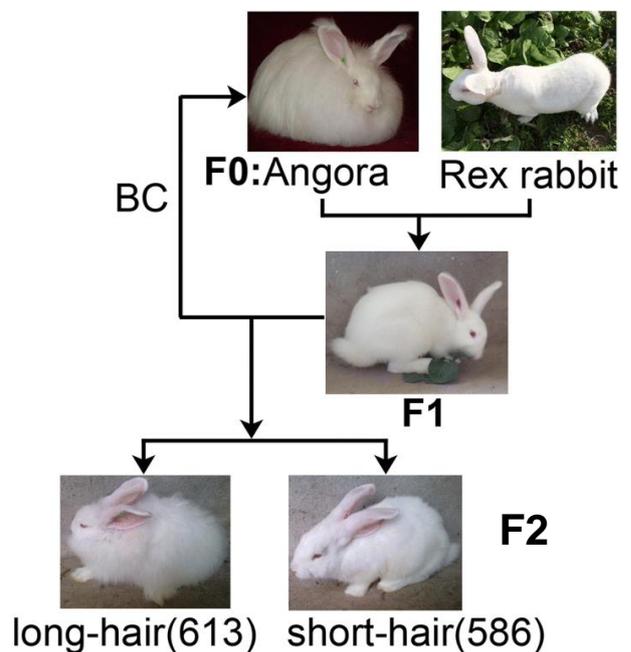
**Belgian Bearded rabbits are not Angora**

The fur of the Belgian Bearded rabbits is particular. Depending on the regions of the body, it consists of fur of different lengths: normal and long (Figure 1, 10). The fur of Belgian Bearded rabbits is, thus, composed of 2 types of hair, a rarity in the animal world:

- Normal and short, with guard hairs and

normally developed undercoat hair;

- Woolly and long, up to 8 cm long, with no hair support and wavy undercoat hair. Their color shade is darker. They are



**Figure 5:** Cross between a long-haired Angora rabbit and a short-haired Rex rabbit. Individuals of the first F1 generation all have a short-haired coat. The next generation (F2), a cross between the F1 generation and the Angora F0 rabbit, has about 50% long-haired and 50% short-haired individuals. Photo: Ding et al., 2019.

found on the thighs, flanks, neck, around the head and dewlap/chest. In females these hairs are slightly longer than in males.

Depending on the regions of the body, the fur is made of hairs of different lengths:

- Normal fur on the back;
- Long hair on the ventral side of the thorax and the abdomen;
- Relatively short hair on the ears, the chamfer and the legs;
- Angora type coat, thin and can reach a length of max. 8 cm.

The characteristic fur is most developed in animals aged between 6 months and one

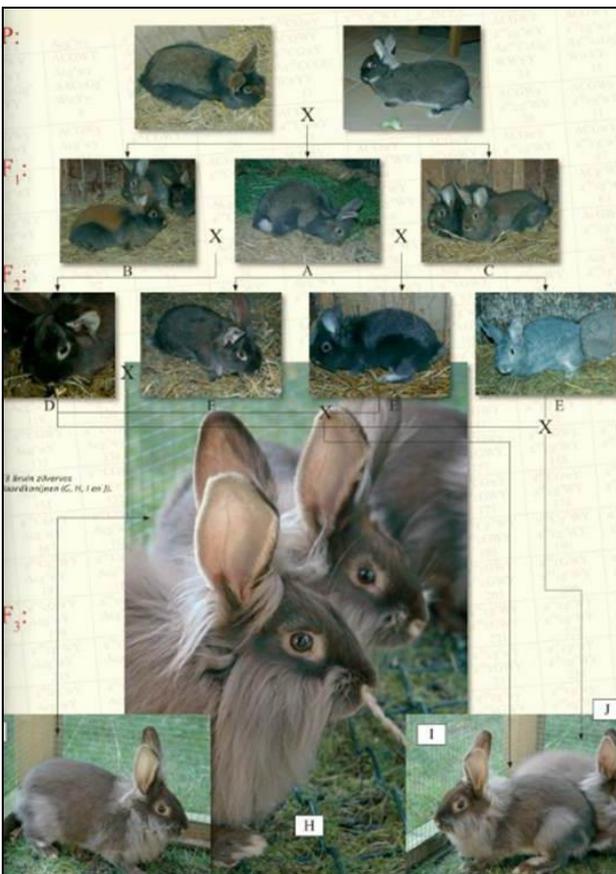
year, then the long hairs tend to molt (Figures 10). Guard hair and undercoat hair may grow back instead. In females these hairs are slightly longer and denser than in males. Regrowth of wooly hair is sometimes observed in older females.

For a long time, rabbit experts have asserted that the Belgian Bearded rabbit is the result of a cross between an Angora rabbit and a rabbit with a normal coat. The Angora mutation is, however, monogenic, recessive and autosomal. As a result, the offspring of the F1 first generation will all have a normal short fur (Figure 5).

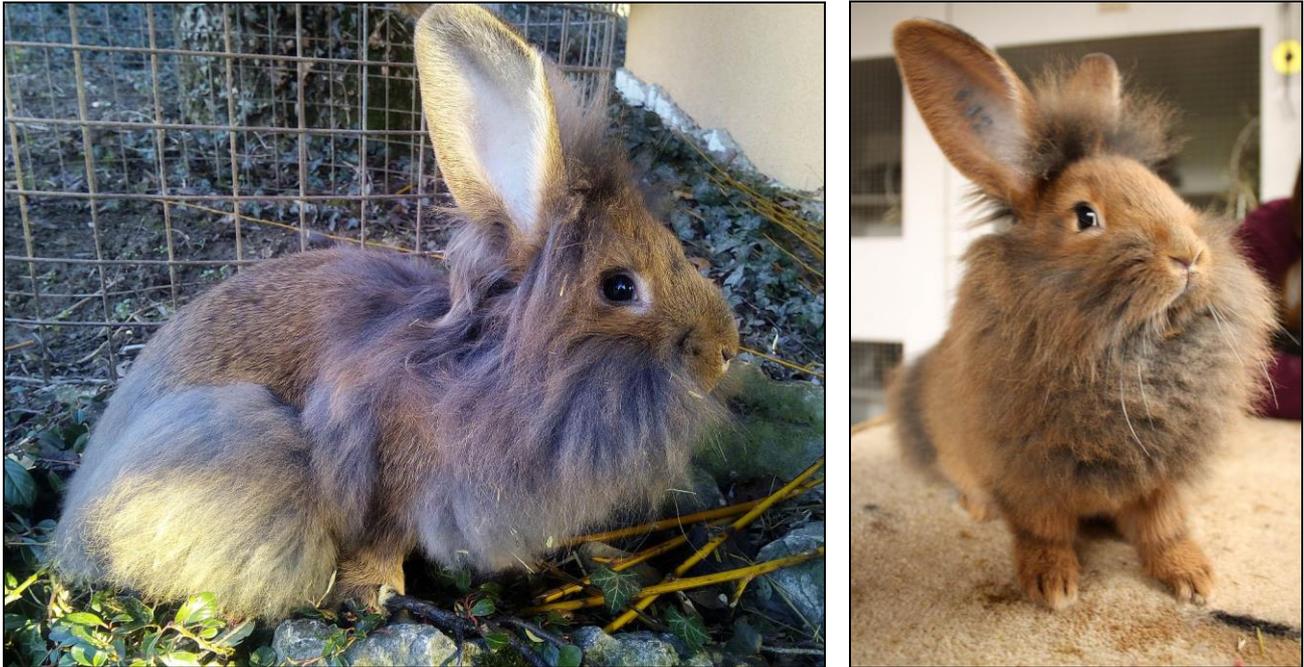
In Belgian Bearded rabbits, the particular structure of the fur is due to a dominant type mutation. Several genes are likely to be involved simultaneously in the "bearded" type, one determining the length of the hairs, another for the fur density, and further factors, such as the number of kits per litter. The characteristics of the long hairs are, thus, transmitted to the offspring when mating with a colored rabbit with normal/short hairs (Figure 6, 7). Another distinction with the Angora rabbit is the fact that the long hairs of the Belgian Bearded rabbit are less likely to form knots, as compared to Angora fur, except in young animals. Belgian Bearded rabbits can be kept on a natural flooring with straw and hay, without those intermingling with the fur. This is a major difference with other longhaired breeds, such as Angora rabbits (Figure 5).

Another peculiarity of this breed is its very calm and sociable temperament, its patience and near-absence of aggressiveness. This makes it an ideal rabbit for children and elderly.

The Belgian Bearded gene seems to influence the number of newborn per nest. In the original type, they are small, with roughly 5 kits, which is small compared to



**Figure 6:** Cross between a bearded rabbit and a short-haired silver tan rabbit. The F1 first generation has a coat with both types of fur: short on the back and long around the head, on the flanks and thighs. This particular hair structure remains marked in the next generations. Photo : Ringnalda H., 2008.



**Figure 7:** F1 first-generation rabbits from the cross between Harlequin and Belgian Bearded rabbits (left), and between a Fauve de Bourgogne and a Belgian bearded rabbit (right), showing the dominant character of the Belgian Bearded mutation in offspring.

those of colored rabbits or of commercial breeders, with up to 12 newborn per nest. Nowadays, the number of newborn per nest seems to have increased, and some Belgian Bearded females have up to 12 live fetuses. Health problems can appear at the end of gestation due to a depletion of body reserves

accompanied by the sudden onset of pregnancy toxemia (Figure 8). Other causes of pregnancy toxemia include a poor diet or environmental stress like a sudden change in temperature, resulting in a hormonal imbalance, lack of exercise or the presence of a mass of hair in the digestive tract. An

individual sensitivity of the females is suspected, possibly a hereditary factor related to prolificacy, insufficient blood circulation in the uterus due to insufficient development of this organ during gestation. Compression of blood vessels by the fetuses in prolific females is also suspected.



**Figure 8:** Very pale liver of a prolific Belgian Bearded doe that died from pregnancy toxemia. She had 11 fetuses.



**Figure 9:** Belgian Bearded rabbit that is a few days old, with a characteristic pleated skin. The location of the long hairs on the body and the head can be clearly distinguished.

Belgian Bearded females are good nursing mothers. Newborn grow fast and the mortality rate is low. In newborn kits, it is possible to distinguish the location of long hairs after a few days already (Figure 9). At the age of a few weeks, the long hairs can be easily distinguished from the short hairs on the back (Figure 10). The density of long hairs continues to increase up to the age of 5 months, after which it increases in fullness. In females, the fur is longer and

more pronounced than in males.

**Anomalies in newborn**

Frontal cephalocele

A rare malformation has been observed in two Belgian Bearded newborn: an incorrect closure of the skull bones or frontal cele (Figure 11). The causes seem to result from a combination of factors. A failure to close the bones of the skull may, however, also be related to a genetic predisposition in some



**Figure 10:** Both few weeks old young rabbits and a 3.5 months old female have a strong appetite for fresh greenery.



**Figure 11:** Left: One day old Belgian Bearded newborn with an encephalocele. Right: Another newborn with a frontal cephalocele (arrow). His mother has 50% Fauve de Bourgogne blood and 50% Belgian Bearded while his father is a Belgian Bearded.

lines. In pigs and Burmese cats, an autosomal recessive gene expresses itself either as *spina bifida* in the spinal cord or as a brain cele on the head

It may also be the result of toxins or teratogenic molecules for the fetus such as the antifungal griseofulvin or certain corticosteroids. Viral or bacterial infections are also suspected.

Finally, a deficiency of vitamins and minerals, especially folic acid, in pregnant does during gestation increases the

incidence of neural tube defects in the fetus.

Epileptic attacks

An epileptiform attack may be an isolated phenomenon occurring suddenly and lasting from a few seconds to a few minutes (Figure 12). It is often a reaction to a medication, hyperthermia due to fever or heat stroke, lack of oxygen due to respiratory distress, excessive itching caused by skin parasites or excessive pain. Some rabbits are susceptible to fur rubbing from tail to head and may have an attack.



**Figure 12:** Young rabbit that is about 30 days old during an epileptiform seizure. The bluish color of the eye is due to a late opening of the eye and an eye infection. Its mother belongs to the Belgian Bearded breed and its father has 25% Fauve de Bourgogne.

An epileptiform seizure may become chronic when it is associated with changes in the brain following a disease, injury or head trauma, parasitosis, or tumor.

### **Anomalies in adult rabbits**

The high consanguinity of Belgian Bearded rabbits predisposes them to various health problems or malformations. In fact, an inbreeding coefficient as high as 35% is reached in certain lines. While this high coefficient does not affect other breeds of rabbits much, this is not the case of the Belgian Bearded rabbit. Breeders are the first to observe the consequences in their animals. Abnormalities are more common and may be accompanied by a loss of vitality and/or sudden death around the age of one year, despite good care, good hygiene and good nutrition. These rabbits should normally live up to 7 or 8 years.

### **Skeleton**

At the level of the skeleton, vertebrae of the tail may be fused ("wire tail"). Some breeds are more affected, including the Belgian Bearded rabbits. To the point that this

malformation is not considered as a breed defect during judgments.

### **Digestive tract**

#### Small intestine

Two adult Belgian Bearded rabbits showed an abnormally long and particularly tortuous intestine at autopsy (Figure 14). To our knowledge, a natural appearance of this anomaly has not been described in rabbits to date. The affected rabbits have never had any health problems.

The presence of multiple dilated loops suggests an incomplete atresia of the small intestine of type III, referred to as "apple peel". They can be multiple throughout the small intestine. These congenital occlusions are very rare and are usually sporadic. They appear during the development of the fetal viscera, but may also be associated with an autosomal recessive disease such as mucoviscidosis in man. During the tunneling phase of the digestive tract, any change in blood flow will lead to irreversible damages of the intestinal tissue. It may be the consequence of a blockage of blood vessels located in the mesentery (fold of the



**Figure 13:** Particularly tortuous and long small intestine (arrows) found in two healthy Belgian Bearded adult rabbits, and not suffering from digestive problems.

peritoneum connecting the loops of the small intestine (jejunum, ileum) to the posterior wall of the abdomen) or a mechanical accident such as volvulus or intussusception.

Depending on the location of the blood blockage – in the mesenteric artery or branches thereof, ischemic lesions are localized or generalized. The episode of ischemia and intestinal infarction will profoundly affect the structure of the intestine on a longer or shorter portion: aseptic coagulation necrosis and stenosing healing.

Liver

A pregnant female suffered from a prolonged twisting of a liver lobe after giving birth (Figure 14, 15). She survived for weeks, nursing her offspring. Gestation does not seem to be the cause of hepatic torsion,



**Figure 14:** Belgian Bearded female suffering from a prolonged caudal liver lobe torsion with massive weight loss and long hairs loss on the flanks, neck and head.

either in rabbits or other animals.

Torsion of a liver lobe is a sporadic and non-hereditary occurrence whose cause is not well elucidated. Most likely is an abnormal dilatation of the stomach and intestine



**Figure 15:** Liver with torsion of the caudal lobe as observed during the autopsy of the Belgian bearded pregnant and, then, lactating doe.

following an intestinal obstruction. Ligaments retaining the liver in the abdomen are distended and weakened, facilitating the twisting of a lobe. Other causes include an external trauma, a bacterial or parasitic infection, or a congenital absence of ligaments.

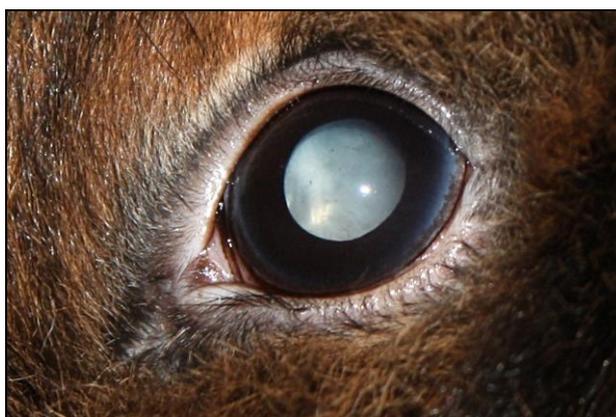
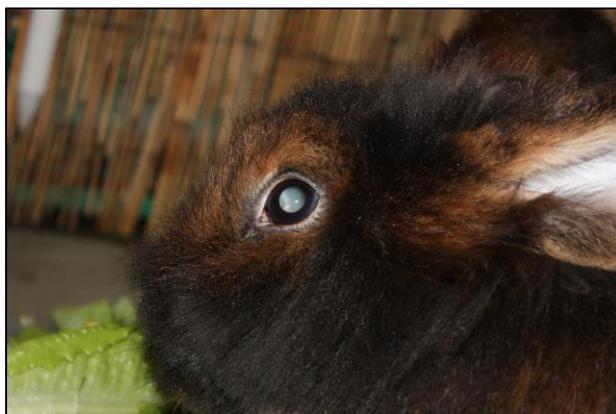
Torsion of the caudal lobe is observed in 63% of affected rabbits. This lobe is attached to the liver on a very small surface only, enabling its movement in the abdominal cavity or torsion. Blood circulation is hindered, causing atrophy of the lobe. Its consistency becomes hard and it takes a dark color. This condition is painful and leads to a decreased appetite, shock and death after a few days. If the lobe ruptures, the resulting hemorrhages lead to a rapid death. A minority of rabbits survive when they receive supportive care.

As all the treatments remained ineffective with this female, she was humanely put to sleep, to shorten her suffering. Torsion of a liver lobe was observed at the autopsy (Figure 15).

## **Eyes**

### **Cataract**

Cataract is an uncommon visual impairment in rabbits and is often age-related. It occurs when the lens gradually loses its transparency. The amount of light passing through the lens is decreased and the ability to focus objects and eye acuity decreases over time. This is accompanied by a decrease in contrast sensitivity. The ability to see an object when light is intense is also reduced and it is not uncommon to observe a rabbit suffering from this disease bumping into objects that are on its path. Other contributing factors include food, drugs, exposure to light, head trauma or food deficient in carotenoids, or the presence of the parasite *Encephalitozoon cuniculi*. Belgian Bearded rabbits are more susceptible to this parasite of the nervous



**Figure 16:** Cataract in a one year old female.

system than other rabbit breeds. Young rabbits can also develop hereditary juvenile cataracts when they are a few weeks or months old. Two types are observed in rabbits. One is a simple recessive mutation. The lens of newborn rabbits has darkened areas on its posterior surface. The opacification of the lens is progressive and complete by the age of 9 weeks. The other type is transmitted by a recessive gene with incomplete penetrance. In the Belgian Bearded rabbit, the first signs of cataracts appear around the age of 1 year (Figure 16).

### **Glaucoma**

Glaucoma is a multifaceted optic neuropathy that develops gradually. Increase of the internal pressure of the eye causes functional impairment of the retinal ganglion cells and axons transmitting cell pulses to

the optic nerve. The increase in pressure is due to changes in the *trabeculum*. This tissue is composed of collagen fibers and is located in the iridocorneal angle. It contains the trabecular meshwork at the base of the iris and openings thanks to which the aqueous humor – a transparent fluid that fills the space between the cornea and the lens, is filtered and removed. When this liquid can no longer be removed, the pressure in the eye increases and causes the development of glaucoma. Two forms of glaucoma are observed in rabbits: juvenile and secondary to trauma.

Juvenile glaucoma affects young rabbits as early as 6 weeks of age, with changes or compression of the intertrabecular spaces. The development of juvenile glaucoma is often insidious and remains unnoticed until the appearance of the first specific signs of the disease around the age of 5 to 7 months. At this age, the development of the white and opaque membrane forming the "white" of the eye (sclera) is not fully completed. Its resistance to any increase in the internal pressure of the eye is therefore limited. The volume of the eyeball increases and the cornea becomes prominent (uni or bilateral buphthalmia)

Juvenile glaucoma is associated with a high coefficient of consanguinity in rabbits. In New Zealand rabbit inbred lines, the mutation type of juvenile glaucoma is autosomal recessive, with incomplete penetrance. In the Belgian Bearded rabbit, the visible stage of glaucoma appears around the age of 1 year (Figure 17).

#### Prolapse of the Harder's gland or cherry eye

The Harderian gland is relatively developed in rabbits. It is located in the rostral orbital space, surrounding the eye bulb. The Harderian gland is composed of two lobes of unequal size: a small whitish dorsal lobe and a larger ventral lobe, separated by ventral oblique muscle. In male rabbits, this gland is particularly developed and its volume



**Figure 17:** First signs of glaucoma in a 1 year old Belgian Bearded female (top) with opacification of the cornea. Hypertension leads to buphthalmia, destruction of ciliary bodies and other ocular structures. The pupil appears depressed (down). The rabbit becomes blind.

increases during the breeding season.

When the ligament retaining the gland is weakened or damaged, prolapse of the ventral lobe is possible, accompanied by inflammation of the third eyelid (Figure 18). The gland starts to move, which causes an increased irritation. Irritation leads to tissue inflammation, tearing, or even bacterial infection. The third eyelid becomes bloody and ulcerated and develops follicular conjunctivitis. The causes of prolapse are not well understood. A weak connective tissue surrounding the gland is suspected, as is chronic inflammation of the nasal passages, conjunctivitis associated with an abscess of the Harder's gland or a tooth



**Figure 18:** Prolapse of the Harderian gland may be hereditary in a Belgian Bearded rabbit line, followed by death a few weeks later.

abscess. A tumor of the Harderian gland is accompanied by exophthalmia, which is not the case in the affected Belgian Bearded rabbits (Figure 18). In some breeds of rabbits, it seems that this problem is hereditary. In some Belgian Bearded rabbit lines, rabbits died shortly after developing prolapse of this gland.

### **Immune system**

It seems also that the Belgian Bearded rabbit has an increased sensitivity to a parasite of the nervous system: *Encephalitozoon cuniculi*, with appearance of a head-tilt.

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