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Low hanging or ground-dragging testicles caused by collagen dysplasia in non-neutered male rabbits ?

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Low hanging testicles are occasionally observed by rabbit breeders in so called "economic" breeds like the Zealand rabbit, but also in big spotted, Rex or Belgian hares rabbits.

Breeders refer to this problem as low hanging or ground-dragging testicles, "hängende Hoden" or "Schlepphoden" in German or "testicules pendants" and

"testicules traînants" in French (Figure 1, 5, 8, 9). In breed rabbit competitions, judges penalize this defect: a penalty for drooping testicles and a disqualification for testicles



Figure 1: Big spotted male rabbit suffering from testicles hanging down to ground level. Picture: MediRabbit

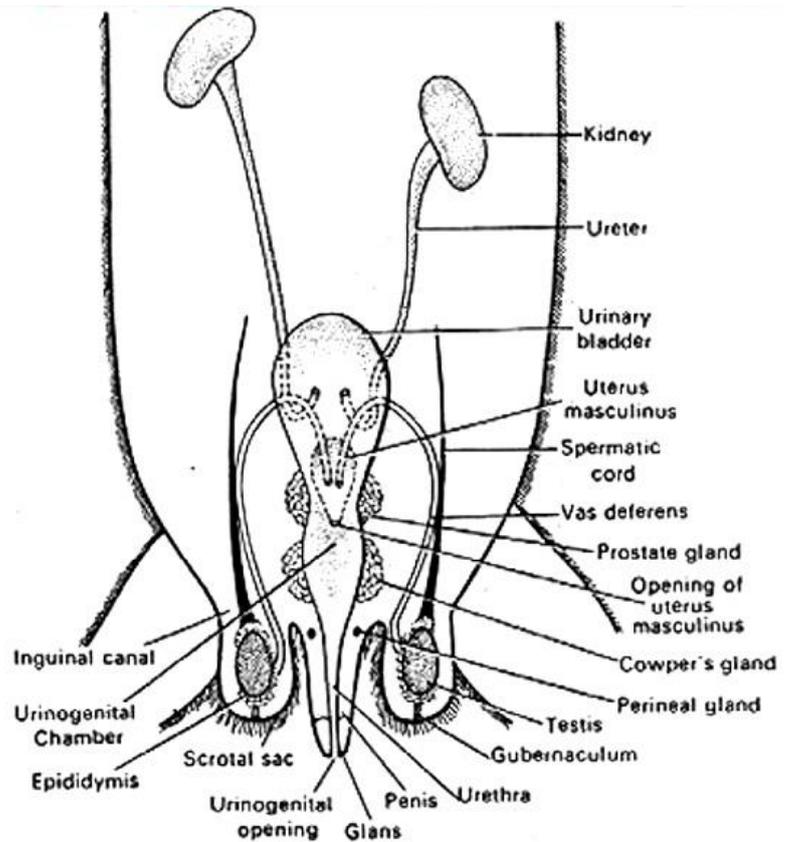
touching the ground. Indeed, the testicles of a male rabbit are held close to its body. Nonetheless, no scientific or medical information seems to exist about low hanging testicles in this animal.

Organogenesis of the male reproductive system

Differentiation of the male reproductive apparatus occurs during the embryonic phase. It is formed from the primitive ancestors of the mesonephric duct and mesonephric nephrons, except for the testicular lobules and the *vasa recta*. The blood vessels providing blood to the testicles and surrounding tissues originate from the kidney.

The testicles of a newborn rabbit are located in the abdominal cavity. Their growth is slow, slower than that of the body. An acceleration of the growth rate is observed around the 45th day of its life. It corresponds to the beginning of spermatogenesis (between 40 and 50 days). Growth and development of the testicle is, furthermore, influenced by external factors such as diet, temperature of the environment and seasonal changes.

Testicular descent from the abdomen into the scrotum sac takes place a few months later only, at the age of 2 or 3 months. Communication between the scrotal sacs and the abdomen remains open throughout the life of the male. A rabbit can, thus, retract his



Ventral view of reproductive system of male rabbit.

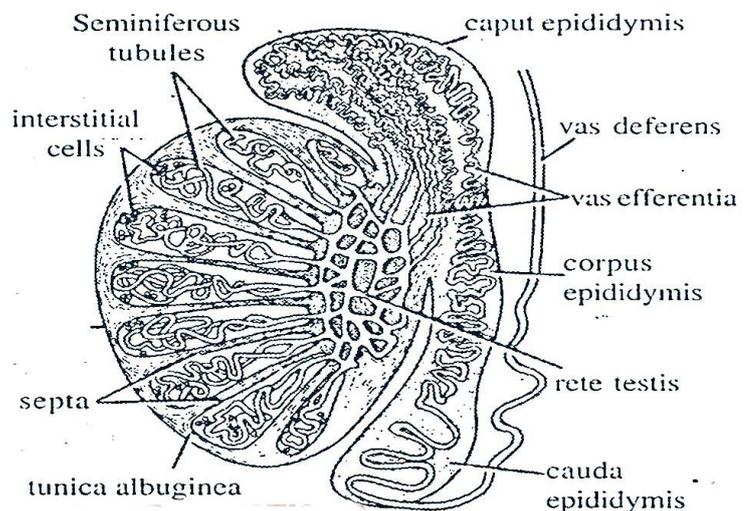


Figure 2: Reproductive system of the male rabbit and detail of the testicle.

http://www.expertsmind.com/CMSImages/2213_male%20reproductive%20system%20rabbit.png

<http://www.biozoo.com/2014/12/male-reproductive-system-of-rabbit.html>

testicles in the abdomen through the inguinal canal when he is not reproducing, when there is a fight with another male or with a female during reproduction, during a clinical examination of the perianal region or during an extreme fright.

Male reproductive system

The anatomy of the reproductive organs of male rabbits shows many similarities with that of other mammals, but has also differences (Figure 2).

The penis is part of the exterior accessory structure of the reproductive apparatus. It is short and its diameter decreases from the base to the tip (Figure 3). It is directed obliquely to the back. During an erection, the foreskin opens, which enables the penis to move forward and externalize.



Figure 3: Penis of a young rabbit externalized from the foreskin. Picture: MediRabbit

The 2 scrotal sacs (scrota) are located in the perineal region, ventrally to the anus (Figure 4). They are composed of skin, fibro-muscular tissue, connective tissue, and parietal vaginal tunic. Their main function is to keep the testicles at a temperature slightly lower than body temperature. The musculo-fibrous fibers (*Tunica dartos*) allow relaxing or contracting the surface of the skin. This way the scrotum is close to the body when temperatures are cool or looser when temperatures are summer-like. The



Figure 4: Scrotal pouches that are still covered with some hair in a young male three colored. The pouches are still empty; the testicles have not descended. Picture: MediRabbit

musculo-fibrous fibers are, moreover, susceptible to the androgen hormone testosterone.

The scrotum also contains:

- Two ovoid and flaccid testicles measuring 15 mm wide and 35 mm long. The gland contains tubular structures, lobules and a central tubular plexus (*vasa recta*). The tubular lobules contain germ cell lines that will form the sperm through a process of meiotic cell divisions and maturation. The sperm is then brought to the tubular plexus (*vasa recta*). The latter also contains endocrine cells secreting testosterone. The testicles are surrounded by the cremaster muscle. Its function is to lift or lower the scrotal sac.
- The spermatic tube is a tubular structure that contains nerve fibers and the nerve innervating the testicle, blood vessels (deferent artery, spermatic artery, and spermatic veins) and lymphatic vessels. It also contains the *vas deferens*, which transports the sperm from the testicle to the penis. The spermatic cord is protected by the internal and external spermatic fascia and the cremaster muscle attached to the testicle. Rarely, the cremaster muscle is weakened. As a



Figure 5: Hanging testicles with lesions in a male intact New-Zealand rabbit. Picture: Michel Gruaz

consequence, the scrotum is hanging low rather than near the body.

- The epididymis is a coiled tube located at the surface of the testicles.

Numerous glands are present. A pair of preputial glands is located laterally and slightly backwards to the penis.

There are also numerous annex glands:

- A unique bilobated seminal vesicle is present. The numerous deferent ducts merge with the ejaculatory duct. The latter opens into the prostatic urethra, at the level of *seminalis colliculus*. When pressure increases in this gland, ejaculation becomes possible.
- The vesicular gland is an exocrine gland that is located dorsally to the urethra (front portion) and the seminal vesicle. Its excretory ducts open on the side of

colliculus seminalis. The excreted waxy mucus will obstruct the vagina of the female rabbit after mating. This gland is present in wild and domestic European rabbits (*Oryctolagus cuniculus*), but not in the American wild rabbit (*Sylvilagus* sp.).

- The prostate gland is located dorsally to the urethra. It consists of two lobes: anterior and posterior. Many ducts (4 to 6) extend from the gland and open into the wall of *colliculus seminalis*.
- The paraprostatic glands are located on the side of the deferent ampulla.
- The bilobated bulbourethral gland or Cowper's gland. It is located in the back of the prostate and behind the urethra, and opens into the latter. The various excretory ducts secrete a lubricant liquid just before ejaculation. This will reduce

the ambient acidity of the urethra and, consequently, protect the spermatozoa.

Production of spermatozooids

Several studies suggest that spermatogenesis begins around the age of two months or starting around 40-50 days in young male rabbits. This coincides with the production of testosterone and the increase of fructose and citric acid concentrations in the seminal gland and prostate. Male sex cells, spermatozoids, are not present in the epididymis until the 112th day and in the ejaculate around day 120.

Spermatozoids are produced from sperm germ cells and are kept inside the rabbit testicles till they will be transported into the epididymis with the spermatic fluid. Their journey within the testicular tubules to the deferent duct (*vas deferens*) may take up to a week.

When the adult male rabbit is sexually stimulated, the sperm continues its journey through the *vas deferens* and prostatic utricle (*masculus uterus*) to the penis. The amount of semen varies between 0.5 ml and 1.5 ml.

The changes from reproductive germ cells (spermatogonia) to mature spermatozoids take between 38 and 41 days.

The accessory glands of the male reproductive system grow more slowly and take up to a year to reach a full secretory activity.

The development of genital organs is accompanied by the onset of sexual behavior. Its definition varies across studies. However, nowadays, it is admitted that the reproductive organs are functional starting at the age:

- 4 months for small breeds (2 à 3 kilos), e.g., Polish, Dutch or small Russian rabbits.

- 5 to 7 months for middle-sized breeds (3 to 5 kg), e.g., Californian, white New-Zealander, Champagne silver, Fauve de Bourgogne, Vienna blue or white, Chinchilla rabbits.
- 5 to 8 months in big or giant breeds, e.g., French lop, the Flemish Giant or the Bouscat Giant rabbits.

Table 1: Characteristics of rabbit sperm.

N° spermatozoids / testicle	350 millions
N° spermatozoids produced / day	170 millions
Volume ejaculate	0.6-1 ml
N° ejaculate / week	6
N° spermatozoids per ejaculate	200 millions
N° de spermatozoids / ml of sperm	10 à 1000 millions
Moving spermatozoids	80%
Normal spermatozoids	80%

Low hanging or ground-dragging testicles

In a small number of rabbits, scrotal skin relaxes around the age of 1 year, causing the drooping of testicles (Figures 1, 5, 8, 9). Depending on the severity of the drop, the testicles are described as low hanging or ground-dragging when they touch the ground. This defect is observed more particularly in breeds called "economic" such as New Zealand rabbits, Chinchillas and, more rarely, in the Belgian hare and Rex rabbits. In German giants spotted rabbits, males suffering from drooped testicles often have a very masculine head and suffer from ocular discharge. In practice, male rabbits with low hanging

testicles often have loose skin all over their body. Finally, there is a loosening of the skin of the scrotum in older breeding males (Figure 8).

The defect is inherited. Indeed, rabbit breeders in Switzerland and in the US have established that this problem occurs in the offspring belonging to a same lineage.

Breeding males do not seem to suffer from a decrease in fertility as compared to other males of the same breed that do not suffer from this defect.

Finally, a handful of male rabbits were operated under anesthesia to undergo a "facelift of testicles" in order to tighten the skin of the scrotum. After a few months, the skin relaxed again, with a drooping of the testicles.

Disease ?

Diseases associated with low hanging testicles in animals and humans include scrotal hernia (Figure 6), hydrocele with an fluid accumulation in the scrotum (Figure 7), or varicocele related to a varicose dilatation of the veins of the spermatic cord.

Disease ?

All diseases mentioned above could be ruled out.

Endocrine disease ?

Testosterone is a sex hormone that allows the differentiation into a male fetus and the masculinization of certain cells of the hypothalamus, in the brain, after birth. When the male rabbit becomes "pubescent", the testosterone hormone permits the start of spermatogenesis, the development of secondary male characteristics (large head, broader chest, strong limbs with a well visible musculature) and the appearance secondary sexual behavior (spraying of the environment with urine, sexual mating with objects and other).



Figure 6: Scrotal hernia (arrow) in a rabbit belonging to the Belgian hare. This problem is often linked to a structural defect of the collagen. Picture: Michel Gruaz

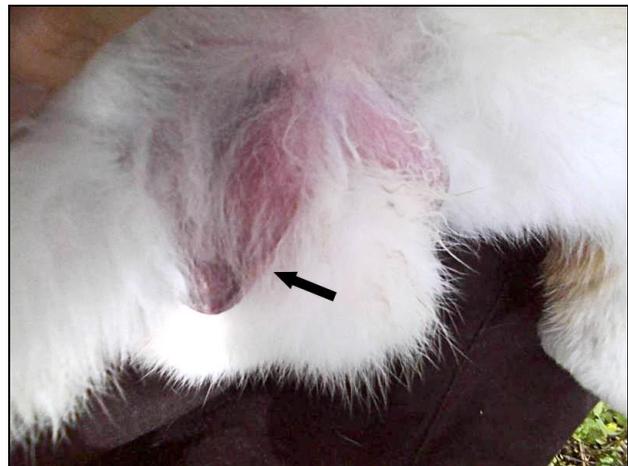


Figure 7: Enlarged scrotal sac (arrow) in a rabbit. The scrotal skin is stretched out but without redness. This is suggestive of an accumulation of fluids (hydrocele) rather than an inflammation of the epididymis (epididymitis). Picture: <http://rabbittalk.com/these-aren-t-normal-testes-t7703.html>

Testosterone also affects other parts of the body and stimulates the basal metabolism. The skin is tonic and close to the body. A low testosterone level is accompanied by a loosening of the skin from the body and gives a potbellied appearance with fat hips. The scrotal skin is slightly stretched and causes a slight sagging of the testicles.

Low level of testosterone ?

Unlikely. Neutered rabbits have a low blood level of testosterone. While their sexual behavior is gone, their skin is normal. Rabbits with low hanging testicles present a normal reproductive behavior and a normal fertility. They just have a loose skin on the body and on the scrotum, causing a drooping of the testicles.

Muscular degeneration ?

In man, roughly 20% of adult male individuals suffer from a congenital weakness in the cremaster muscle. Over time, the scrotal skin relaxes more and more, and the testicle starts to hang low. The Dartos loses muscle tone in older individuals, which also leads to low hanging testicles. There is no information available about such a syndrome in rabbits.

Other than a cosmetic issue, this defect does not modify fertility or sexual behavior nor does it lead to loose skin on the rest of the body. A "testicular lifting" helps removing the excess skin. This surgical procedure has few complications, and preserves all of the functions of the reproductive organ. Usually, there are no relapse and new relaxation of the scrotal skin.

Muscular degeneration ?

Unlikely.

Collagen dysplasia

Collagen is a protein present in the skin in the form of fibrils. Dysplasia of collagen is



Figure 8: Old reproductive Rex male suffering from one low hanging testicle. This male transmitted the defect to its offspring, son and grandson. A testicular lifting surgery caused a relapse and skin relaxed again. Picture: Pamela Alley

associated with a mutation in the gene encoding for the pro-collagen I aminopeptidase. This mutation is hereditary and is transmitted as an autosomal dominant mode. Similar cutaneous syndromes have been observed in different animal species. They have been named cutaneous asthenia in dogs and cats dermatosparaxie in horses, cattle, goats and sheep or Ehlers-Danlos syndrome in humans. All are characterized by a defective collagen production, a decreased production of normal collagen or a combination of both.

The syndrome can also be caused by the degradation of proteoglycans that form the fundamental substance of the connective tissue. It is caused by a mutation of the gene encoding for the core protein of proteoglycans. The hereditary syndrome is transmitted by autosomal dominant or



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Thank you

polygenic genetic
determinism.

Either one or the other cause leads to structural abnormalities of the connective tissue. Depending on the subtype of dysplastic collagen, the condition can affect one or more structures of the body: elasticity of the epidermis and/or the dermis (Figure 9), hyper-extensibility of joints, ocular or vascular frailness.

The syndrome worsens with age.

The percentage of rabbits affected by this rare syndrome is unknown. Rabbits belonging to the New-Zealand are particularly affected.

Structural abnormality of the connective tissue ?

Likely cause: loose skin on the body, elasticity of the skin of the scrotum and a relapse a few months after surgery to remove the excess skin of the scrotum, intact fertility and inheritance of the defect to the male descendants. This diagnosis must, of course, be confirmed by microscopic analysis of skin samples in order to rule out or confirm the abnormal structure of the skin in these rabbits

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Figure 9: Low hanging testicles « at rest ». The skin of both scrota is very elastic et stretches easily. Picture: MediRabbit

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