



Deformities of the spine are also observed in rabbits

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Spine deformities may have a genetic origin, be congenital, with malformed vertebrae (e.g., hemivertebrae), be acquired during the first months of life due to e.g. lack of exercise, or occur with age (spondylosis).

The vertebral column (spine) of rabbits provides key functions. Its role as a supporting bone structure allows the spine to support the whole rabbit skeleton and play a decisive role in the posture of the

animal. It also ensures its mobility. Indeed, the curvature of the back will absorb the stress caused by body movements, shocks due to hopping or jumps, and gravity (Figure 1). The bony structure of the spine



Figure 1: The natural curvature of the rabbit's back helps absorb shocks caused by hopping, jumps or movements.

protects the spinal cord, nerve roots, and nerve connections that link organs, muscles, joints, and other body tissues to the central nervous system. When the spinal cord or a nerve root is compressed or damaged, it results in pain or gradual or sudden sensory and/or motor deficits. These range from mild to severe, from limb weakness to total paralysis.

Morphology of the spine

The spine is divided into several regions: neck, thorax, lower back and tail. Each region is formed by individual or fused vertebrae whose shape varies according to the region, by intervertebral discs, muscles and other elements that provide some mobility to the spine. The vertebrae are subdivided into:

- Cervical vertebrae (7), they are characterized by transverse processes and have an opening – the transversal foramen, which allows the passage of the vertebral artery.
- Thoracic vertebrae (12), their size is larger than the other vertebrae. They are characterized by the presence of a spinous process and articular processes (zygapophyses) that articulate with the ribs. The nerve roots emerge from the spinal canal by the foramen. The anticlinal vertebra, whose bone growth (spinous process) is perpendicular to the body, is the T₁₀ thoracic vertebra in 56.4% of rabbits and the T₁₁ vertebra in 42.4% of them.
- Lumbar vertebrae (7), these are the largest vertebrae of the spine. They have long and thick transverse processes (diapophysis). The spinal cord ends at the level of the first lumbar vertebrae. The different nerve roots are sheltered within the spinal canal until they exit the lumbar and sacral spine.

- Sacral vertebrae (4), they are fused and form the sacrum, which articulates with the pelvis at the level of the 1st sacral diapophysis.
- Caudal vertebrae (16), they are small. The complexity of their structure and their size gradually decreases at the end of the tail. The last 9 vertebrae are full, and not innervated. In some rabbits, some of the caudal vertebrae can be fused. Some breeds are more affected than others, like the Giant Flemish rabbits and the Belgian Bearded Rabbit.

A study of 330 rabbits (164 males and 166 females) revealed, however, that the morphology of the vertebral column varies in this animal, with disparities in the number of vertebrae. Rarely, an animal has 11 or 13 thoracic vertebrae instead of 12. Other rabbits have only 6 lumbar vertebrae instead of 7 (normal) or, sometimes, 8. The number of sacral vertebrae (4) can increase to 5 or 6 in some individuals. Finally, this phenomenon is also observed in the tail, with only 14 vertebrae, instead of 16.

Deformities of the vertebral column

Congenital deformities of the spine are caused by an abnormality, a malformation (reduced vertebra), an absence of one or more vertebrae or the presence of an extra half vertebra. In some rabbits the deformation of the vertebral column has a costal part caused by fused concave ribs. In some rabbit breeds or lineages, abnormalities are observed rather at the cervicothoracic, thoracic or lumbar level. In these cases, transmission of these abnormalities would appear to be under the control of polygenic inheritance.

Transitional vertebrae, which are located at the junction of different segments of the spine, are often concerned. Malformations caused by transitional vertebrae are



Figure 2: Young Harlequin rabbit with a severe congenital malformation of the spine accompanied by a twist in the lumbar region

essentially observed at the are at the thoracolumbar junction, more rarely at the lumbosacral junction. Abnormally shaped vertebrae (hemi-vertebra) have also been noted in rabbits. This malformation can cause a deformity of the spine, such as scoliosis or cervical kyphosis.

A fusion defect of the cervical vertebrae in the sagittal plane, on the ventral side of the vertebra, is sometimes present: the cervical butterfly vertebra. Conversely, when this type of fusion defect is located on the back side of the vertebra, it will lead to an opening in the spine (*spina bifida*) (Figure 3). This abnormality is occasionally observed at the lumbar level in rabbits.



Figure 3: Rabbit fetus with two *spina bifida* caused here by the anti-metabolite 6-mercaptopurine (Tuchmann-Duplessis et Mercier-Parot, 1966).

In rare cases, rabbits suffer from a combination of congenital defects, such as a too short vertebra resulting in abnormalities of the natural curvature of the spine such as lordosis, kyphosis or scoliosis. Others suffer from a thoracolumbar transitional vertebra associated with lordo-scoliosis, wedge vertebrae with kyphoscoliosis, or lordo-scoliosis with a twisted pelvis (Figure 2).

Other spinal problems may be acquired during the life of a rabbit and can also lead to damage or structural changes to the spine:

- Heredity degenerative diseases,
- Infectious diseases

- Traumatic conditions
- Neoplasia.

These deformities range from a mild and barely visible form to a severe form that may be accompanied by an abnormal gait and bladder disorders and/or compression of internal organs.

Curvature of the spine

Three main deformities of the spine are observed in rabbits:

- Scoliosis, excessive S or C lateral curvature of the spine (Figure 4);
- Lordosis, excessive inward concave curvature of a part of the vertebral column (Figure 5);
- Kyphosis, excessive convex curving of the spine, usually at the thoracic level, with a bulge (arching) towards the outside of the body (Figure 6);

The causes of these congenital or acquired deformities are not well understood. Severe scoliosis, related to the absence or presence of a hemi-vertebra, seems to be hereditary in some rabbit breeds or some lineages. Two recessive genes, transmitted in the autosomal recessive mode, are thought to be responsible for abnormal growth of the vertebral body or malformation of a vertebra (hemi vertebra). Deformities of the spine can also have a metabolic origin, e.g. lack of calcium in food, intestinal calcium malabsorption or nutritional deficiencies leading to poor calcium metabolism. Mechanical causes include an abnormal spinal development of the fetus in the uterus (congenital kyphosis), the sliding of a vertebrae in front of or behind the vertebra situated above or below (spondylolisthesis), osteoporosis that weakens the vertebrae and renders them fragile, inflammation or infection of an intervertebral disc, or a poor posture due to a cage that is too small as

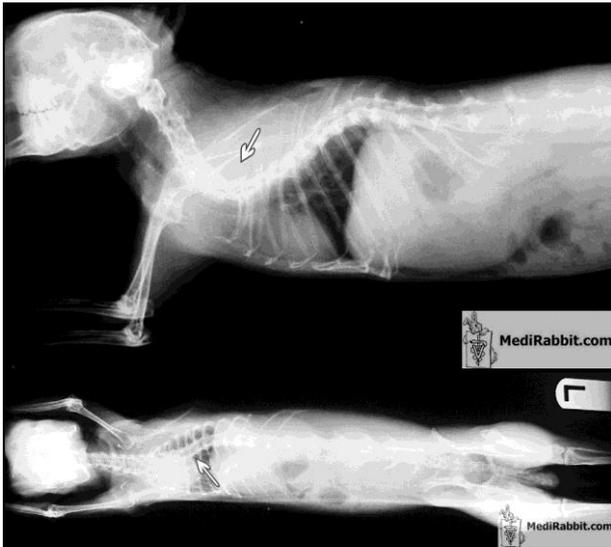


Figure 4: Radiography showing severe thoracic scoliosis in a rabbit.

compared to the size of the rabbit. Other factors include lack of exercise, resulting in poor bone mineralization or decreased bone density and/or quality, or, also, obesity. Female rabbits are more prone to suffer from deformities of the spine than males. This seems to be related to higher calcium demands by the body, especially during pregnancy and the lactation period.



Figure 5: A rabbit belonging to the Fauve de Bourgogne breed, with an inward deformation of the spine at the thoracic level.

Consequences of spinal deformities

The consequences depend on the type of deformation and its severity. In general, rabbits affected by lordosis, scoliosis or kyphosis also suffer pain. As a result, the rabbit is reluctant to groom its coat, which takes a poorly cared appearance. The accumulation of urine burns the skin and



Figure 6: Rabbit suffering from thoracic kyphosis. Its gait became more and more difficult rapidly and it was unable to urinate.

causes alopecia in the perineal region. A rabbit with such an abnormality is reluctant to move and its gait may be affected. It may develop paresis of the hind limbs, which progresses with time. The degeneration of vertebral discs (spondyloarthropathy) contributes to difficulties to move. The rabbit will have trouble to collect caecotrophes directly from the anus. Its appetite can also be reduced.



Figure 7: Severe inward curvature of the spine at thoracic level (arrow) in a young silver bunny of Champagne. The spinal deformity is accompanied by congestion of the liver, a possible consequence of compression of the blood vessels from the heart to this liver.

A severe inward curvature of the spine, e.g. thoracic lordosis, may cause pressure on the thoracic and abdominal organs (Figure 7) and lead to breathing difficulties and shortness of breath after an exercise. When blood vessels draining blood from the heart to the internal organs and vice versa are compressed by the weight of lungs, the functioning of organs like the liver can be hampered. The liver and kidneys are mainly concerned. In the liver, blood flow from the inferior *vena cava* is restricted, resulting in

reduced hepatic activity. The secretion of bile into the intestine is decreased or blocked, leading to a poor digestion of the ingesta. As a result, toxins accumulate in the liver, which takes on a congested appearance with a dark red color, a slightly larger size than normal, and rounded and rough edges (Figure 7). Passive congestion of the liver may also be secondary to heart failure.

Diagnosis and treatment

A physical examination and palpation of the spine helps to detect deformities or abnormalities in the chest, abdomen and pelvis regions. X-rays will confirm the diagnosis.

There is no treatment for spinal deformities in rabbits. Palliative care can relieve pain, e.g. the administration of non-steroidal anti-inflammatory analgesics such as meloxicam or carprofen.

Skin lesions caused by urine and feces should be cleaned and disinfected daily. Soiled fur is gently removed. A disinfecting cream or Vaseline can be applied to the clean skin to protect it from moisture. If a secondary bacterial infection develops, antibiotics should be given to the rabbit.

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