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## Wobbler and equine cervical vertebral malformation

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**Abstract.** Seven horses, including three females and four males, were found to present compressive spinal cord lesions in the cervical region (Wobbler syndrome) between segments C1 and C7, as well as morphological alterations (cervical vertebral malformations) in the affected vertebrae. These horses were housed in stalls and had no history of trauma. In all animals examined clinically and radiographically, equine cervical vertebral malformation (ECVM) was found in association with Wobbler syndrome, indicating a strong correlation between the two findings and suggesting a possible etiological role of ECVM in non-traumatic cases of Wobbler syndrome.

**Keywords:** Equine ataxia, myelography, tracheal rings.

## *Wobbler e malformação vertebral cervical em equinos*

**Resumo.** Foram detectadas, em sete equinos, distribuídos em três fêmeas e quatro machos, alterações compressivas medulares na região cervical (síndrome de Wobbler), entre os segmentos C1 e C7, bem como alterações morfológicas (malformações vertebrais cervicais) nas referidas vértebras. Os animais eram mantidos em baia e não apresentavam histórico de trauma. Em todos os equinos examinados clínica e radiograficamente, foi identificada, associada à síndrome de Wobbler, a malformação vertebral cervical equina (MVCE), indicando forte correlação entre os dois achados e sugerindo uma possível participação etiológica da MVCE em casos não traumáticos de Wobbler.

**Palavras-chave:** Anéis traqueais, ataxia equina, mielografia.

## Introduction

The horse was likely first hunted for food and was later domesticated around 2200 BC in the steppe region of the North Caucasus, between the Volga and Don rivers in what is now southern Russia. Genetic studies indicate that these horses spread rapidly, replacing wild populations across Eurasia and profoundly transforming transportation and warfare. Current evidence suggests that horses did not originate in Kazakhstan 3,500 years ago, as previously proposed. Rather, DNA studies indicate that the ancestors of modern domestic horses emerged in the region described above during the Bronze Age. These animals were used by the Sintashta culture initially for meat and milk production and later for transport and warfare ([Daley, 2018](#); [Lewis, 2015](#); [Nodjimbdem, 2016](#); [Osborne, 2022](#); [Vasconcellos, 2019](#)).

The first reports of congenital malformations affecting the caudal cervical vertebrae in horses (C6 and C7) were published in the 19<sup>th</sup> century. However, these findings are no longer considered merely incidental, particularly in light of studies reporting prevalences of up to 38% in certain breeds. In recent years, the equine cervical vertebral malformation complex (ECVM) has become an important concern within the equine community, and several studies have identified a wide range of associated morphological variations. ECVM is characterized by morphological alterations involving C6 and C7, in which the ventral lamina of C6 is partially absent and transposed to the ventral surface of C7. In some cases, these abnormalities may extend to the first thoracic vertebra and the first pair of ribs, and have also been associated with tracheal alterations ([Beccati et al., 2016](#); [Haussler, 2026](#); [May-Davis, 2014](#); [May-Davis et al., 2024](#); [May-Davis & Walker, 2015](#); [Ros et al., 2023](#); [Vasconcellos, 2024](#)).

However, the clinical relevance of congenital variations involving the ventral laminae of the sixth (C6) and seventh (C7) cervical vertebrae, as well as their relationship with other radiographic abnormalities, remains controversial. Some authors argue that these findings may be clinically insignificant and that the vertebral dimensions and morphological alterations described in their studies, including changes in vertebral size, shape, and cervical asymmetry, do not necessarily imply clinically relevant cervical dysfunction ([Dyson et al., 2025](#); [Veraa et al., 2020](#)).

An even more controversial issue is the apparent correlation between cervical malformations and deformities of the tracheal rings. Some studies have reported that horses with neurological disease associated with cervical vertebral deformities also presented alterations in the tracheal rings, such as the presence of a tracheal crest, as illustrated in [figures 1A](#) and [1B](#), which contrast this abnormality with the normal tracheal appearance observed in a filly with cervical trauma. In these horses, neurological examination findings associated with cervical vertebral deformities, whether or not initially confirmed by laterolateral radiography, were subsequently corroborated by contrast myelography, which demonstrated spinal cord compression and cervical vertebral malformation consistent with Wobbler syndrome. This finding may contribute to the identification of possible carriers of cervical vertebral malformations. In addition, deviations in the cervical vertebral axis may increase pressure on the dorsal articular facets, potentially leading to significant lesions depending on the type and intensity of activity performed by the horse ([May-Davis et al., 2024](#); [Vasconcellos, 2024](#); [Wong & Hanner, 2008](#)).



**Figures 1 A:** Deformities in the tracheal rings of an adult horse with ataxia. **B:** Normal tracheal rings and a C3–C4 dislocation of traumatic origin.

Morphological variations affecting the vertebrae have been documented from the occipital region to the cranial thoracic region. Malformations involving the caudal cervical vertebrae may include unilateral or bilateral transposition of the ventral lamina of C6, variations in the size and shape of the spinous process of C7, and the presence of additional ribs or costal processes. These abnormalities may create an imbalance in the positioning of muscles and ligaments over the anomalous bony surfaces, predisposing the region to altered biomechanical forces. This association has become increasingly evident as advances in diagnostic imaging have enabled better visualization of these areas, thereby improving our understanding of the clinical relevance of such malformations.

Although their clinical significance remains debated, horses with C6 laminar transitional anomalies may present with neck pain and reduced range of motion, likely secondary to altered insertion of the thoracic musculature or even stenosis of the cervical intervertebral foramen ([Figure 2A](#)), resulting in nerve root compression or, in more severe cases, spinal cord compression ([Derouen et al., 2016](#); [Mayhew et al., 1978](#); [Ricardi & Dyson, 1993](#); [Veraa et al., 2016, 2020](#)).

These malformations may disrupt the functional harmony among muscles, ligaments, tendons, joints, and the altered bony surfaces, leading to biomechanical dysfunction. Consequently, affected horses may develop neck pain (cervicalgia), cervical stiffness, and lameness of the forelimbs and hindlimbs, either due to nerve root compression or cervical spinal cord compression (Wobbler syndrome).

It is also recognized that radiographic evidence of osteoarthritis in the caudal cervical articular processes may be present in high-level jumping horses without associated clinical signs. However, other

studies have reported a low prevalence of radiographic abnormalities, such as inflammation or degeneration, in the caudal articular processes of C6–C7 or C7–T1 in mixed populations of low-performance horses, raising questions as to whether these findings are truly responsible for the observed poor performance.

Finally, when comparing radiographic evidence of remodeling of the articular processes and facets, possibly indicative of vertebral misalignment and altered harmony among the caudal cervical vertebrae, with clinical signs, the results remain conflicting. This inconsistency appears to stem, at least in part, from the lack of a standardized method for the clinical evaluation of both affected and control horses. Therefore, inflammatory processes, congenital malformations, and even idiopathic factors may alter the cervical vertebral axis and potentially contribute to the development of fractures or osteoarthritis in the dorsal articular or facet joints of the vertebrae, as illustrated in [Figure 2B](#) ([Derouen et al., 2016](#); [Koenig et al., 2020](#); [May-Davis & Walker, 2015](#); [Ricardi & Dyson, 1993](#); [Ros et al., 2023](#); [Vasconcellos, 2022](#)).

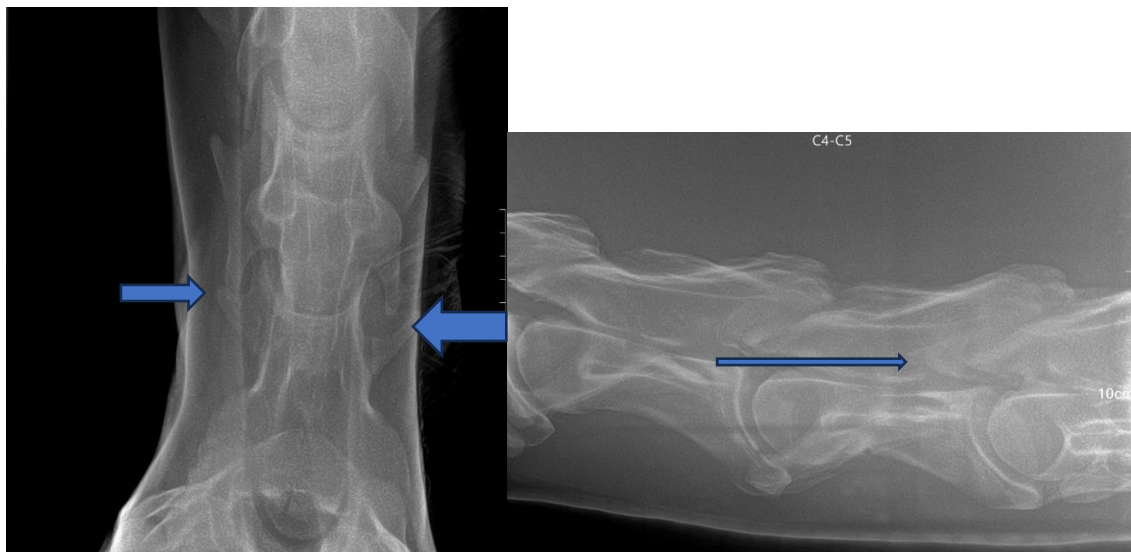


**Figure 2.** A: The blue arrows indicate clear evidence of cervical vertebral asymmetry highly consistent with congenital cervical vertebral malformation and figure B: A case of cervicgia resulting from an inflammatory process in the caudal articular facet of C4 and cranial facet of C5 (blue arrow).

## Materials and methods

Seven horses with ataxia and suspected compressive cervical vertebral myelopathy (Wobbler syndrome) were included in this study. The animals comprised three females—two Quarter Horses (1.8 and 11 years old, respectively) and one Brasileiro de hipismo mare (9 years old); three castrated male Brasileiro de hipismo horses (4, 7, and 12 years old, respectively); and one intact Mangalarga foal (20 months old). All horses tested negative for infectious neurological diseases, including viral, bacterial, and protozoal disorders.

All animals underwent a complete clinical examination, with all physiological parameters recorded, followed by a thorough neurological evaluation ([Vasconcellos, 2022](#)). When Wobbler syndrome was clinically suspected, radiographic examination of the cervical region was performed using right and left lateral projections without angulation. The animals were selected from routine clinical cases attended between November 2025 and April 2026, originating from different locations. This study was conducted on breeding farms in the state of São Paulo, Brazil, with the aim of investigating radiographic findings, with or without traumatic origin, that could be associated with equine cervical vertebral malformation (ECVM).

Clinically, all animals (7/7) exhibited signs compatible with Wobbler syndrome, including ataxia, muscle atrophy, weakness, reduced tail tone, and dysmetria. However, in the males (4/7), radiographic findings alone, without myelography, were consistent with the clinical presentation, whereas in the females (3/7), the diagnosis of Wobbler syndrome was only confirmed after contrast myelography ([Figures 3](#)).

In the males, the suspicion of Wobbler syndrome was more readily confirmed both clinically and radiographically, without the need for contrast myelography. These lesions were easily identified in the three castrated Brasileiro de hipismo horses and in the intact Mangalarga foal. Two of these animals were young (both under 26 months of age) and showed similar clinical signs despite differences in origin and management, as well as comparable radiographic findings ([Figures 4](#)).

In the vast majority of cases, no history of trauma, falls, or other events that could explain the clinical findings was identified during anamnesis. Consequently, it was not possible to associate the clinical and radiographic findings with any specific antecedent event, as all animals were already ataxic at the time of examination and showed no cervical skin lesions, local or regional swelling, or any other evidence suggesting previous injury to the cervical region.

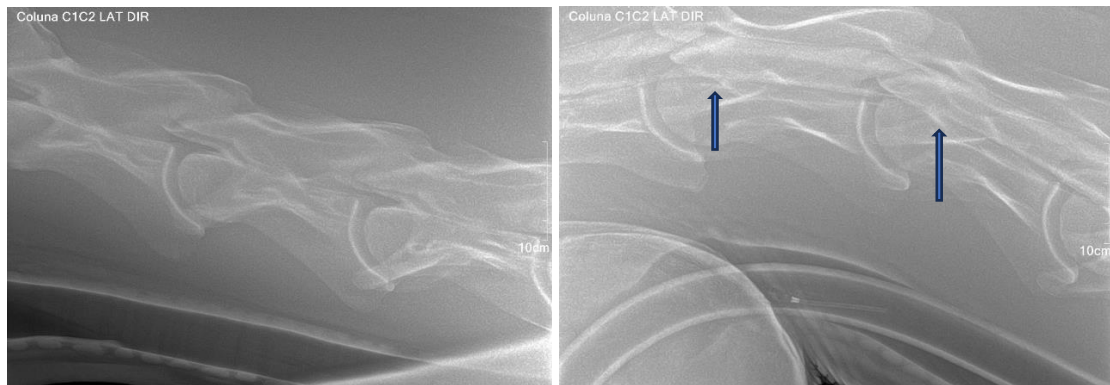
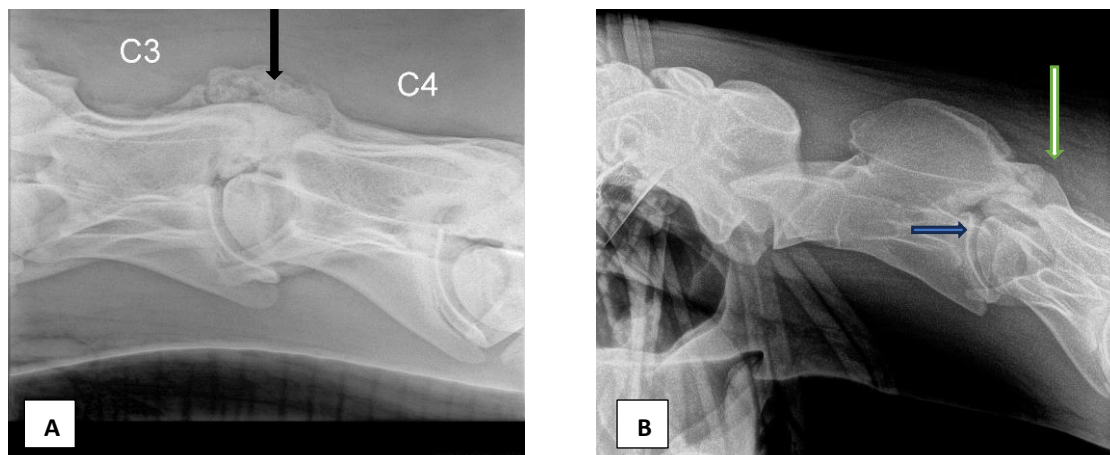


**Figure 3.** The same radiograph without contrast and with contrast plus neck flexion showing points of stenosis (blue arrows), justifying the clinical picture of ataxia and confirming it in the Quarter Horse female.

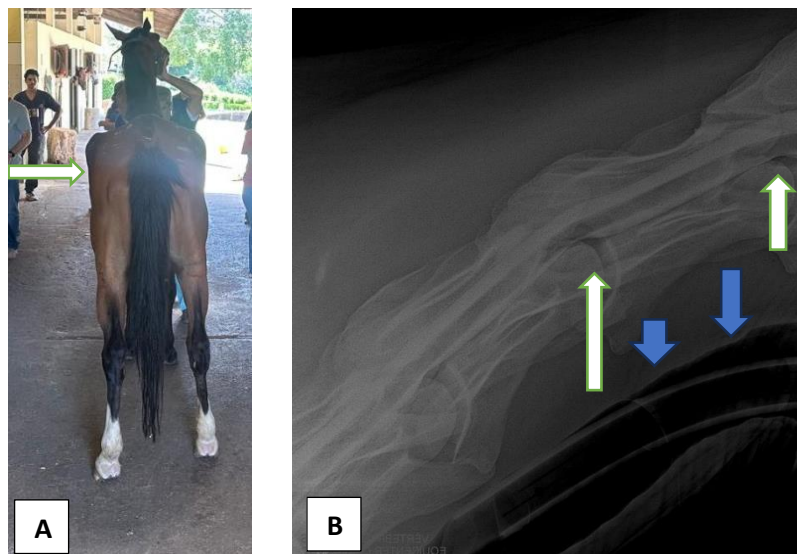


**Figures 4.** In radiograph **A** we observe an inflammatory process in the anterior dorsal facet at C4 (black arrow) and in fig. **B**, the blue arrow shows a clear subluxation between C2-C3, where both images confirm spinal cord compression in both vertebral segments marked by the blue arrow and joint disease in the posterior dorsal facet at C2 and anterior at C3.

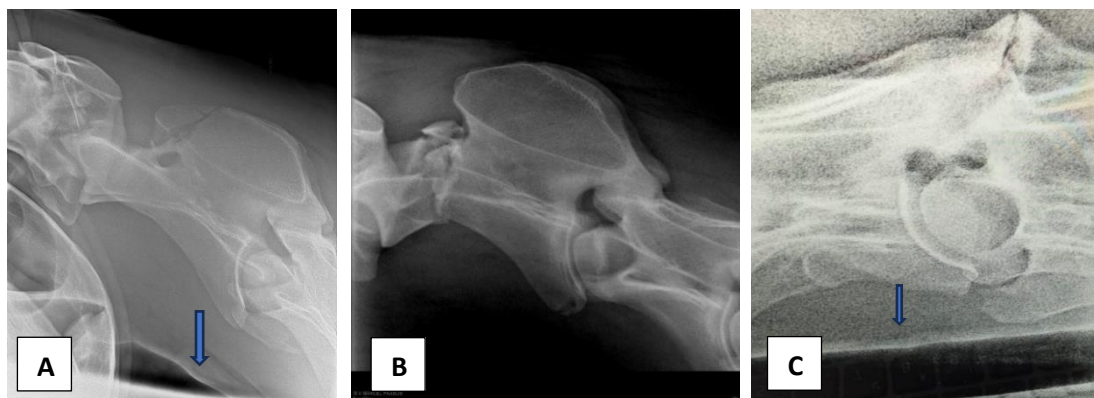
There was a case of a Brasileiro de hipismo mare, which, after clinical and neurological examination, ruling out all possibilities of infectious disease, was indicated, even before simple lateral profile radiography (left and right), for myelography because there was strong evidence of cervical spinal cord compression (Wobbler) with focal muscle atrophy in the left croup region ([Figure 5](#)), and the clinical suspicion was confirmed after the aforementioned examination.

In the group of males, 3 cases of Brasileiro de hipismo stood out, as neurological examination revealed the same condition of hind limb ataxia. The 12-year-old male, with signs of cervical injury (Wobbler), was found to have a severe complete fracture of the dorsal cranial border at C2, but after clinical treatment with only anti-inflammatory drugs, he had a very good outcome without sequelae. Another 7-year-old male, with a severe C2 articular fracture, died one day after clinical and imaging examinations (radiography only). The third, an 8-year-old male, with an inflammatory process in the posterior dorsal facet at C3 and cranial facet at C4 ([Figure 6](#)) with radiographic signs of spinal canal

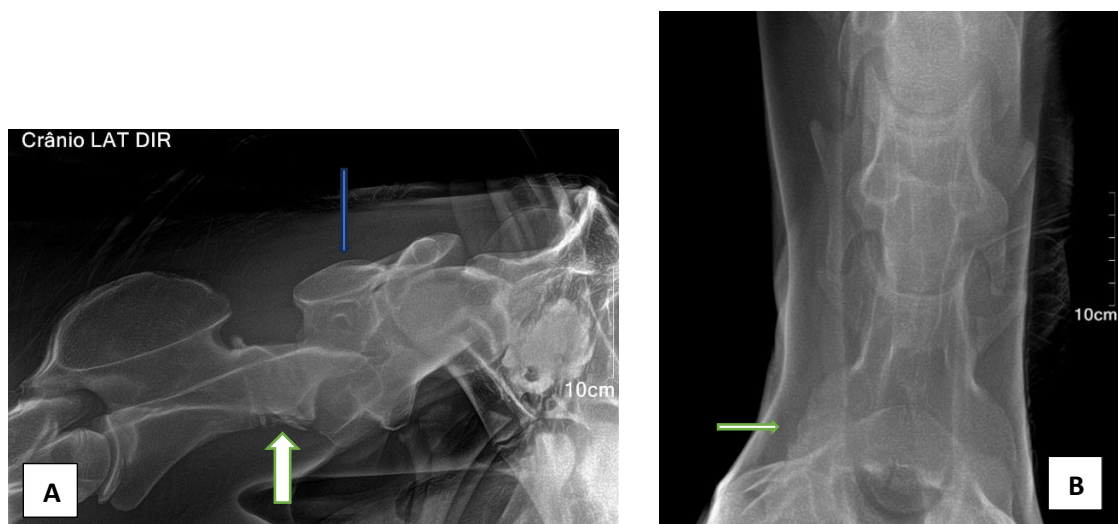
stenosis in the same segment, was not authorized to proceed with myelography, remaining only with clinical suspicion and radiographic evidence.



**Figures 5.** In figure A, the white arrow indicates focal atrophy in the rump musculature, and in figure B, the myelography of the mare in question indicates, with white arrows, points of spinal cord compression and blue arrows indicating "ridges" in the tracheal rings, findings compatible with cervical malformation ([Vasconcellos, 2024](#)).



**Figures 6.** In the first image A, this horse had a positive evolution with the use of anti-inflammatory drugs alone, while the animal in figure B died one day after the radiography, and the animal in figure C was not authorized to undergo a myelography to confirm spinal cord compression in the segment shown by the radiography, but there are indications of vertebral malformation stenosis (as indicated by the blue arrows) ([Vasconcellos, 2024](#)).



**Figures 7.** Radiographic findings in lateral profile and dorsoventral views, showing only bone fragmentation (sequester, white arrows) and anatomical deformity in C1 (malformation - blue arrow).

When we analyzed the radiograph of the Quarter Horse filly, the clinical picture, which was only of head torsion to the left, did not match the clinical findings, since the neurological examination showed a high bilateral cervical hypoesthesia (between C1-C4) and slight dysmetria in the hindquarters. The only image that stood out was the deformity in C1 and only small splinters on the left cranial periarticular ventral face of C2 ([Figures 7](#)). Specifically for this animal, we did not have authorization for myelography; therefore, we can state that it has the clinical picture of Wobbler syndrome, but we could not confirm it.

In all radiographed animals, some sign of cervical vertebral malformation was found, either in the vertebral body itself or an indicator such as the presence of a "crest" in the tracheal rings, which indicated animals with cervical vertebral malformation ([Vasconcellos, 2024](#)).

## Discussion

Morphologically, the animals included in this study were overweight, showed fat accumulation over the flanks, reduced muscle definition, and clear evidence of excessive feed intake associated with poor athletic condition. This profile was likely related to management conditions, as most horses were kept in stalls for the majority of the day, with very limited access to fresh forage, sunlight, and adequate ventilation. Radiographic examination revealed skeletal abnormalities in nearly all animals. In particular, the cervical vertebrae showed radiolucent cystic areas suggestive of osteochondral lesions, which may have weakened the bone structure and reduced its ability to withstand the mechanical forces acting on the cervical region, as illustrated in [Figures 2](#). These figures demonstrate the coexistence of multiple lesions within the same vertebra, which may help explain the neurological signs and/or cervical vertebral instability observed in these horses.

It is important to emphasize that equine cervical vertebral malformation (ECVM) may have a genetic basis, but its development or clinical expression may also be aggravated by skeletal disorders associated with excessive energy intake (grain/concentrate feeding), low sun exposure, inadequate mineral supplementation, limited physical activity, and insufficient fiber intake. The horses evaluated in the present study closely matched this profile ([May-Davis, 2014](#); [Vasconcellos, 1995, 2022](#)).

An additional aggravating factor identified in this group was vertebral malformation detectable on plain radiographs ([Figures 2](#), [5B](#) and [7A](#)), including asymmetry between the right and left sides of the same vertebra. Such abnormalities may explain the improper accommodation of muscles, ligaments, and tendons over altered bone surfaces, resulting in asymmetrical biomechanical forces and vertebral misalignment. This, in turn, may predispose to subluxation or even dislocation, changes that may be detected on plain radiographs in males, but that in females may require contrast radiography or myelography for confirmation. Computed tomography (CT) was not available in this study because, in Brazil, this modality is not routinely accessible for diagnostic evaluation of the equine cervical region and remains largely restricted to smaller animals. A more detailed assessment of the lesions only partially characterized by plain radiography would be highly relevant, as CT would likely provide more comprehensive information than standard radiographic examination.

We disagree with the interpretation proposed by [Dyson et al. \(2025\)](#), who suggested that deformities of the more caudal cervical vertebrae, such as the absence of ventral and/or dorsal laminae or crests in the C6–T1 region, would not have clinical significance. In our view, these structures may play an important biomechanical role. By analogy, just as a train depends on proper alignment between the rails and the wheels for coordinated movement, the cervical vertebrae rely on harmonious interaction between osseous structures and the muscles attached to them. The longus colli muscle, which lies ventral to the cervical vertebrae and contributes to ventral flexion and stabilization of the neck, may be particularly affected by the absence or hypoplasia of the ventral lamina. In such cases, muscular traction may occur without adequate directional support, potentially contributing to vertebral instability, subluxation, or even dislocation. This hypothesis may help explain why some horses were already ataxic despite being housed in stalls and having no history of trauma, but still showed radiographic evidence of cervical vertebral malformation and associated findings such as crest-like changes in the tracheal cartilaginous rings ([May-Davis & Walker, 2015](#); [Vasconcellos, 2024](#)), among other abnormalities described above ([Figs. 5B](#), [6B](#), and [6C](#)).

Based on the clinical findings, the female horses required additional imaging methods, including plain radiography and contrast myelography, to confirm spinal cord compression. In these cases, there was no evidence of trauma, abrasions, wounds, or any other type of injury, nor was there a clinical history compatible with the neurological presentation. This led us to question the etiology of spinal cord compression in these animals, and we concluded that it may have been associated with the cervical vertebral malformations identified on imaging.

In the male group, there was likewise no history of trauma in any of the animals. However, the combination of neurological findings and radiographic abnormalities allowed a more straightforward diagnosis, although the etiology of these lesions remained similarly uncertain. These observations are in agreement with previous reports indicating a higher frequency of Wobbler syndrome in males ([Mayhew et al., 1978](#); [Vasconcellos, 1995, 2022](#)).

In both groups, the radiographic findings revealed evidence of abnormal skeletal development, including subtle vertebral malformations, signs suggestive of nutritional imbalance, and possible management-related factors. A common feature among all animals was prolonged stabling without regular access to sunlight, grazing, adequate ventilation, or appropriate mineral supplementation. When these factors are considered together with a likely genetic component, although not assessed in the present study, they may help explain the neurological manifestations observed in all horses included in this report.

At the same time, it must be emphasized that the radiographic evaluation performed in this study was limited to lateral projections and did not constitute a complete assessment of vertebral morphology, such as that provided by computed tomography. We believe that CT could substantially improve lesion characterization in animals from both groups and contribute to a more complete understanding of the abnormalities observed ([May-Davis et al., 2024](#); [May-Davis & Walker, 2015](#); [Vasconcellos, 2024, 2025](#); [Veraa et al., 2020](#)).

## Conclusions

The higher frequency of Wobbler syndrome in male horses was confirmed in this study, corroborating previous observations, although the reasons for this sex-related difference remain poorly understood. Female horses were also affected; however, in the present study, they showed a greater degree of diagnostic complexity.

We believe that there is an association between cervical spinal cord compression (Wobbler syndrome) and the presence of equine cervical vertebral malformation (ECVM), a topic that remains highly controversial regarding its relationship with neurological disease. In the present study, we consider this correlation plausible because all animals showed neurological abnormalities together with subtle vertebral defects on radiographic examination, in addition to the presence of crest-like alterations, even if discreet, in some tracheal rings. These findings were observed across horses of different breeds, ages, sexes, uses, management systems, breeding facilities, and geographic origins, and may represent a common point of intersection among the cases evaluated.

One finding is unequivocal: the neurological examination was fundamental for the identification and characterization of cervical spinal cord compression. It represented a decisive step in qualifying, grading, and topographically localizing the neurological deficits, thereby guiding the diagnosis of Wobbler syndrome and the probable site of spinal cord compression.

It should also be emphasized that this study included only a small number of horses. During the same period, we had access to more than 200 additional cases in which only radiographic examinations were performed; however, authorization for complete neurological examination was not obtained in those cases. Inclusion of these animals could have contributed substantially to case characterization and to a broader understanding of this complex and controversial condition. Therefore, future studies involving a larger number of horses are warranted.

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