

Benefits of osteopathic approach for horses with Equine Complex Vertebral Malformation

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3.03.2025

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1. Introduction

1.1. Description of Equine Complex Vertebral Malformation

Equine Complex Vertebral Malformation (ECVM), formerly known as the Congenital Malformation of the 6th and 7th Cervical Vertebrae in Horses, was first described by Sharon May-Davis in 2014. In 2023, based on ongoing research and the conclusion that these malformations are more complex and can extend further, the name was changed to Equine Complex Vertebral Malformation (ECVM). This term refers to a congenital anomaly affecting the costal and muscular systems of the cervical-thoracic junction, specifically involving the cervical vertebrae C6 and C7, the 1st and 2nd ribs, as well as the soft tissue surrounding these structures (May-Davis, Dzingle, Saber, and Blades Eckelbarger, 2023). The primary issue associated with ECVM is the malformation of C6, which causes absence of the caudal ventral tubercle (CVT) and presents several variations, sometimes also including C7:

- unilateral malformation of C6 (CVT absent on one side),
- unilateral malformation of C6 and C7,
- bilateral malformation of C6 (CVT absent on both sides),
- bilateral malformation of C6 and C7

In some cases, malformation or absence of the 1st or/and 2nd ribs (either unilateral or bilateral) may occur along with transposition of caudal ventral tubercles from C6

to C7. Most research is related to post-mortem findings or retrospective analyses and reveals numerous variations in cervical-thoracic junction malformations, including the well-studied CVT transposition, as well as differences in conformation of first two sternal ribs and the surrounding soft tissues (May-Davis, 2014; Santinelli, Beccati, Arcelli, Pepe, 2016; Veraa, Bergmann, van den Belt, Wijnberg, Back, 2016; May-Davis, 2017; May-Davis, Hunter, White, 2023; Zimmermann, Ros, Pfarrer, Distl, 2023). As the complex is wide and collected data shows variety, there is no consensus in the community whether ECVM is a variation or a condition, and how it truly affects horse's life and ability to work (DeRouen, Spriet, Aleman, 2016; May-Davis, Walker, 2015; Veraa, de Graaf, Wijnberg, Back, Vernooij, Nielen, Belt, 2020; Beccati, Pepe, Santinelli, Gialletti, Di Meo, Romero, 2020; Dyson, Phillips, Zheng, Aleman, 2025). Sharon May-Davis, Robert Hunter and Richard White (2023) describe the analysis of 83 specimens of extinct and extant species. The results indicate that the absence of CVT did not occur in the wild ancestors of horses, leading to the conclusion that ECVM may be a post-domestication change and provide further questions about the source and etiology of ECVM. Current knowledge indicates that it is a genetic abnormality, and research is being conducted on DNA components, while pedigree data is being collected to provide greater clarity (Zimmermann et al., 2023; www.ecvmallbread.com).

Possibilities to diagnose living animals have increased in recent years due to specialized protocols of xrays and more popular CT scanning in horses (Gee, Small,

Shorter, Brown, 2020; Ros, Doveren, Dreessen, Pellmann, Beccati, Zimmermann, Distl, 2023), what gave an opportunity to exam more horses and to observe their symptoms in real-time, leading to research on quality of life and ability to work. Although many studies have shown a higher prevalence of ECVI abnormalities in warmbloods and thoroughbreds, no correlation between gender or breed has been proven. Findings have been reported in horses from various geographical regions and continents, suggesting a more widespread occurrence of ECVI in modern horses than previously suspected. In addition to bone abnormalities, muscular and nerve pathway abnormalities have also been identified, particularly in the longus colli muscle (May-Davis, Walker, 2015; Satinelli et al., 2016; May-Davis, 2017; May-Davis, Eckelbarger, Dzingle, Saber, 2024).

As modern horses are primarily used for leisure riding or sport, questions about the influence of bone abnormalities on soft tissue, and consequently on the ability of horses to use their bodies correctly and comfortably, become significant. Rombach, Stubbs and Clayton in the article about gross anatomy of the deep perivertebral musculature in horses (2014), suggested that changes in the biomechanics of the lower neck can increase the risk of degeneration and pain in that region. DeRouen (2016) concluded that abnormalities in the C6/C7 region can lead to further changes in the cervical-thoracic junction, with biomechanical implications. Sue Dyson (2011, 2020) indicated possible connection between neck pathologies, nerve root injury, and forelimb lameness, suggesting the possibility of biomechanical

and performance issues for horses with ECVM, even though the bone abnormalities themselves have not yet been proven to cause pain (Veera, de Graf et al., 2020; Beccati et al., 2020; May-Davis, Dzinge et al., 2023; Dyson, Philips, Zheng, Aleman, 2024).

From an anatomical perspective, the neck of a horse is one of the most mobile regions of the body, allowing for a wide range of flexion, extension, and rotation. Additionally, the neck provides support function for the head and stability during movement (May-Davis, Hunter et al., 2023). A specific feature of the C6 vertebrae is the presence of ventral tubercles (cranial and caudal), which create space for the attachment of muscles and tendons of the longus colli, one of the deep neck muscles that provides intersegmental stabilization and co-activation for neuromotor control. The cranial ventral tubercle (CrVT) gives the attachment for cervical portion of the longus colli, while the caudal ventral tubercle (CVT) - insertion point for its thoracal tendon, which attaches at T5/T6. This tendon extends through the belly muscle till T2 and gives the additional support for the directional transition of vertebrae in the cervical-thoracic junction (Rombach et al., 2014). Biomechanically, movements of the head and neck begin from a resting, s-shaped position of the cervical vertebrae and going in the sagittal plane, limited by the spinous process on C2 and the ventral tubercles on C6 (Arnold, 2021). According to the fact that the caudal cervical spine and cervical-thoracic junction cooperate in postural and locomotive functions for the head and neck, and considering Brainbridge's commentary that the CVT of C6

is a site of redirection of forces during muscle contraction (May-Davis, Dzinge et al., 2023), any degeneration or deficit in this region can lead to lack of stability and changes in movement.

The first sternal rib connects to the C7 and T1 vertebrae and, via costal cartilage, to the manubrium of the sternum. This egg-shaped connection creates the thoracic inlet, which serves as a passage for the longus colli muscle, trachea, esophagus, nerves (e.g., phrenic nerve), large blood vessels (e.g., carotid artery and jugular vein), lymphatic vessels, and lymph nodes. The function of the thoracic inlet is not clearly defined, but since it is part of the cervical-thoracic junction and structures that pass through it, it may play a significant role in the protection, nutrition, and management of organs (May-Davis, 2017). The relationship between the thoracic sling and the entire thoracic musculature in locomotion and respiration has been well described, thus absence or degeneration of the first rib, along with abnormalities in the surrounding soft tissue, can lead to further problems with nerve response, mobility of the thoracic limb, respiratory issues, and proprioceptive deficits. In 2015, Sharon May-Davis described research that correlated abnormalities in the first rib, identified through scintigraphy, with clinical signs such as front limb abduction, decreased extension in walk, lameness, muscle atrophy, neurological gait deficits, and abnormal behavior while tacking up or riding. In the same paper, the author presented post-mortem findings in horses exhibiting these issues, which included postural and muscle asymmetry, displacement of scalenes muscles, narrowing of the thoracic inlet

due to different attachments of muscles, compression of sympathetic nerves, different pathway of the phrenic nerve. Notably, this research indicated that abnormalities of the first rib were only observed in conjunction with C6 malformation.

The cervical-thoracic junction plays a significant role in the proper functioning of horse's body, not only when considering performance capabilities but also proper physiological and neurological processes. This complexity involves more than just bone malformations; any considerations regarding this phenomenon require a broad holistic perspective.

1.2. Osteopathy as an integrative medical and philosophical system of care.

The origins of osteopathy date back to the mid-19th century when Andrew Still introduced a new mindset into the medical world. He sought to develop a more effective system with fewer side effects, using the knowledge of traditional medicine, his manual skills, and a strong desire to understand the underlying causes of health issues. The main postulat of this philosophy is to place the patient in the center of care. Still stated that proper structural alignment leads to optimal body functions, therefore he prioritized the musculoskeletal system. In his principles of patient care, he emphasized that a person is the result of a dynamic interaction

among body, mind, and spirit, which is unique to each individual (Still, 1902). Still believed that the musculoskeletal system significantly influences a patient's ability to restore balance and resist disease processes. Therefore, proper anatomical alignment is crucial for effective blood and lymph circulation, nerve transmission and joint mobility. A balanced body leads to optimal mental health and sustains the natural healing process.

Classical osteopathy was conceived as a medical system encompassing three key aspects: science, philosophy and art. Grounded in anatomical and physiological knowledge and understanding of structure and function, osteopaths seek for the best solutions for specific problems by questioning current models of explaining the system (Mae-Gean Ching, 2009). Osteopathy strongly emphasizes treating the human organism as a perfect mechanism and facilitating its return to homeostasis. It also refers to natural rhythms of any being and their environment, which can disturb balance (Wernam, 1996). The connection between academic knowledge and a broad perspective allowed osteopaths to build strong philosophy and a diverse toolkit, including techniques for working with joints, soft tissues, and the deep rhythms of fluids in organism. The core principles - the unity of the body, the relationship between structure and function, the self-regulation of the system and the supreme role of artery are still the foundation of any osteopathic treatment.

There are five models of osteopathy that provide the framework for diagnosing and treating patients. The philosophy of osteopathy considers that all systems must

be balanced, using these models as tools to identify the most efficient treatment methods to restore the proper functions of the organism. Consequently, the models of disease also contain the belief that a well-balanced organism can defend itself against stressors and diseases; illness is viewed as the result of the accumulation of stressors that overwhelm the organism, making its natural protective potential ineffective (Seffinger, 2017).

The biomechanical model concentrates on structure and posture to remove restrictions in muscles and joints. The neurological model is focused on restoring proper nerve supply, which increases nutrition and balance response of structures and organs. The circulatory - respiratory model refers to artery's supreme role and impact of circulation on immune response, nutrition and proper waste management in organism. The metabolic - energy model concentrates on endocrine glands and organs and energetic efficiency of physiological processes like digestion, reproduction and hormones production. The behavioral-psychological model connects the physical state with mind and taking into consideration all mental and environmental factors that can influence homeostasis and distract process of healing.

Even though osteopathy was primarily developed for humans, its principles apply to all forms of life, making it possible to successfully adapt the practice to the animal world. The origins of this adaptation date back to the mid-20th century. Initially focused on physical issues, the animal branch of osteopathy adapted human techniques, but as the overall knowledge of animals expands, it is clear that all models

of osteopathic treatment can be used to improve well-being of animals (Nevin, Collers, Tozzi, 2020). The primary aim of osteopathic treatment is to help each organism to become the best version of itself, taking into consideration wide range of factors and a holistic perspective. This approach makes osteopathic treatment particularly beneficial for complex issues, which ECVM definitely is.

2. Osteopathic approach to horses affected by ECVM

As long as there is no clarity regarding the etiology, the chances of reducing the number of affected horses appear to be challenging. The main aim of professionals working with horses should be to find ways to enhance their ability to cope with restrictions. Since it is not possible to restore the correct structure of the lower cervical spine, supporting proper movement around malformations is critical for maintaining the horse's comfort. Given that ECVM is a congenital condition, the assumption that each being is a complete mechanism paves the way for supporting its ability to sustain this state. Due to the unchangeable nature of ECVM, it is essential to find a solution that minimizes the impact of the compensatory system to a level that supports functionality without causing deeper restrictions.

2.1. Osteopathic manual treatment on horses affected by ECVM based on models of health and disease.

The role of osteopathic manual treatment is to identify the most effective methods to support the organism and remove restrictions, enabling the patient to maintain balance in the best possible way for their specific case. Vast number of tools that an osteopath can apply, along with various perspectives that can be considered, make this approach highly beneficial for horses experiencing symptoms of ECVM.

The classical, and often represented in animal osteopathy, biomechanical model can be helpful in restoring proper movement throughout the spine and appendicular skeleton. This approach aims to maintain the strength of associated structures to support damaged ones. Although the function of the cervical-thoracic junction may be partially compromised, limiting the proper lift of the ribcage, correct movement of the hindquarters allows the horse to shift more weight to the hind end, effectively relieving pressure from the front.

Changes in the structure of bone and muscle lead to functional pathologies. However, as long as an organism has ability to adapt and maintain homeostasis, there is potential to develop an effective support system for changed tissue. The principle of body unity claims that every system in organism relies and coordinates with others to sustain vitality and body integrity. As May-Davis (2015) points out, there is a decreasing amount of data regarding biomechanical or behavioral pathologies,

as well as the correlation between transposition CVT and relocation of the longus colli muscle. Such changes can affect weight bearing, biomechanics of the forelimbs, and ability to bend or perform lateral movements, especially if the transposition is unilateral (May-Davis, Eckelbarger et al., 2024).

Although the variety of damage that ECVM can cause is highly individual, there are increasing documented cases in which ECVM (especially replacement of the insertion and tract of the longus brachii due to the absence of the first rib) can cause malformations in related structures such as the serratus ventralis, scalene, phrenic nerve of the brachial plexus, or trachea (May-Davis, 2014; May-Davis & Walker, 2015; Gee et al., 2020; May-Davis, Eckelbarger et al., 2024). Any co-existing compensations or blockages caused by this, can lead to further damage in other parts of the body. Therefore, maintaining a smooth functioning of the nervous system seems to be crucial if any neurological symptoms are evident. The absence of the first rib can cause changes in the neural pathways or compression and narrowing of the thoracic inlet, which can affect well-being and the ability to work. It is therefore crucial to support the nourishment of the nerves and release the co-occurring restrictions that can increase the problems with blood, lymph and air circulation. This view clearly corresponds with the neurological and respiratory-circulatory osteopathic models of health and disease.

2.2. Osteopathic techniques in work with horse affected by ECVM

Even though it is not possible to work directly on the underlying causes, the mobility and strength of surrounding tissues, such as the associated muscles in the neck, thoracic sling, and back, as well as the proper functioning of the myofascial system and nerves in the region, can provide more than just palliative assistance. This approach supports the horse's awareness of its body, enhances its understanding of biomechanical potential and strength development. Osteopathy offers a rich toolbox that can help the patient achieve the most comfortable and effective version of itself.

The Osteopathic Articular Balancing technique allows to assess joint and muscle function. It increases the range of motion, balances biomechanics, and facilitates proprioceptive changes, which can be very beneficial for horses with ECVM, as they can present both balance and proprioception issues. This technique is very gentle, enabling practitioners to adjust the strength and range of motion of each joint individually and to target specific regions without directly affecting compromised areas. The articulation of other cervical vertebrae can restore range of motion and nerve supply, which improves proprioception and nutrition. Manipulations of the thoracic and lumbar spine can eliminate compensations that arose from inadequate movement in the neck region. Applying Osteopathic Articular Balancing to the limbs can also be highly beneficial due to the distribution of forces, which can become compromised and lead to restrictions in distal joints. By restoring the full range

of motion and alignment of the limb column, the affected cervical-thoracic junction can be relieved with proper weight distribution. OAB treatment on the hindquarters can enhance movement under the saddle and improve weight-bearing capabilities.

The soft tissue techniques can be particularly beneficial, especially when there is pathology in the ribs and associated muscles. Both massage and myofascial release can enhance nutrition, mobility, and muscle proprioception, which are essential for developing the proper strength to support damaged areas. Furthermore, these techniques can assist with nerve response and relief the compensatory patterns.

Craniosacral therapy, which originated from osteopathy, allows for non-invasive balancing of cerebrospinal fluid flow, which not only protects the central nervous system but also contributes to the transport, nutrition, and waste management throughout the body. It is connected to the circulatory and lymphatic systems, flowing around the brain and spinal cord, serving as a communication pathway. The use of craniosacral therapy can also be beneficial for deep structures that cannot be treated directly, as well as for the release of mental tension.

The Balanced Ligamentous Tension (BLT) technique can provide significant changes in the tension and position of the ribcage, shoulders and pelvis. By supporting tense ligaments and following the body toward a comfortable position, this method facilitates the release of tension and change proprioception, which can limit and prevent wrong compensatory patterns and further damage. In line with the

osteopathic principle of body unity, there is an opportunity for the body to achieve its own balance around malformed tissue. Furthermore, both techniques assist in releasing and calming the neural responses of nerve receptors in specific body areas, as well as calming the entire system, which can reduce alterations, fight-or-flight responses, and pain. They also allow for gentle manipulation of the diaphragm, which can be very beneficial due to potential imbalances at points of attachment, pathways of the phrenic nerve, nutritional supply to internal organs, and breath capacity.

According to osteopathic philosophy, organism has the ability to maintain health and manage stressors. Therefore, even addressing compensations rather than the primary cause can enhance both the range and quality of movement, enabling the organism to discover the best way to balance itself. The role of deep neck muscles and nerves in movement, balance, and proprioception is undeniable; however, the holistic perspective of osteopathy facilitates the improvement of other structures involved in movement and notices deeper connections that may require attention.

3. Conclusions

Even though ECVM is not yet fully understood and research does not provide an unambiguous answer about disorders and consequences for the life and work of affected horses, it is essential to consider it from a holistic perspective. Since it is specific to certain cervical and thoracic vertebrae, which are crucial for horse's

coordination, the osteopathic approach can offer various techniques and methods to improve the well-being and work potential of these horses.

The variety of potential complications and individual responses necessitates that working with affected horses requires extensive knowledge, awareness, a holistic approach, openness, and persistence to find the best solution for each specific case, reflecting the principles of classical osteopathic philosophy. As DeRouen (2016) concluded, malformations of the lower neck vertebrae can lead to further pathologies, especially changes in biomechanical forces in the region, which may cause changes in range of motion or dynamic pain that can be difficult to detect during a traditional veterinary examination. Therefore, careful observation and adjustment of techniques and treatment strategies to the current state of the horse are critical for effectiveness. This implies that a specific and broad knowledge are essential to understand what can be modified, what needs to remain in compensation, and what depth of change is possible for each individual body. The goal of osteopathic care is to optimize health based on the organism's overall health potential and has been proven to be beneficial in chronic pathologies, which ECVM is. The most significant evidence that ECVM belongs to the field of osteopathy is the philosophy behind it.

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