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A CASE OF CONGENITAL FLEXOR DEFORMITIES OF THE THORACIC LIMBS IN A 3-YEAR-OLD HORSE

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ABSTRACT

The subject of this study is a 3-year-old horse with a contractual flexor deformity of both thoracic limbs with a predominance of the left limb. Infrared thermography was conducted, and the radiographs regarding the musculoskeletal system assessment were reviewed. Congenital flexural limb deformities are a well-known group of developmental orthopedic diseases that can be effectively treated if diagnosed early. Our study aims to evaluate the degree of permanent changes in a patient not promptly treated and to compare thermography results to x-ray findings. The radiograph analysis revealed extensive pathological changes in both the passive and active locomotor systems. Thermography also showed some changes but was unable to predict whether the affected limbs would be able to recover.

Key words: contractual flexor deformity, developmental orthopedic disease, infrared thermography, x-ray examination.

Introduction

Flexor deformities in horses are associated with postural abnormalities, lameness, and weakness. There is a deviation, expressed as hyperextension or hyperflexion in articulation, in the sagittal plane of the limb (Kidd and Barr, 2002; Auer, 2006). Digital part of the horse's leg consists of three phalanges – proximal (P1), middle (P2) and distal (P3) which articulate in a straight line from the fetlock joint down to the hoof. The superficial digital flexor tendon assists the suspensory apparatus by providing tendinous support extending from the radius above the fetlock joint to the proximal and middle phalanges. The deep flexor tendon and its accessory ligament provide added support from the caudal aspect of the carpus to the distal phalanx (Budras *et al.* 2012). Their normal alignment allows for a smooth, even weight-bearing surface and a balanced, upright hoof-pastern axis. The tendons and ligaments maintain stability and flexibility, allowing for efficient movement. In contrast, the abnormal angulation or deviation of the joints, caused by flexor deformities, lead to an altered hoof-pastern axis, with the hoof often being excessively upright (Fails, 2020). This condition is easily treated either with conservative methods such as dietary changes (Huntington, 2008) and oxytetracycline administration (Arnoczky *et al.*, 2012; Wintz *et al.*, 2012), or surgical procedures – desmotomy if acted early (Adams and Santschi, 2000). When left untreated, it progressively develops, and irreversible damage occurs.

In our study, we utilized the potential of infrared thermography. It is a non-invasive method that provides accurate information about surface body temperature, which depends on the metabolic processes in the tissues beneath the skin and blood circulation. Thus, every change in the physiological process will lead to changes in the surface body temperature (Soroko-Dubrovina and Morel,

2023). Findings of higher surface temperature areas indicate an overload or an inflammatory process (Kim and Cho, 2021), showcasing the promising role of thermography in diagnosis.

Materials and methods

The horse is a 3-year-old mare representing the Shagya Arabian breed. The clinical examination of rectal temperature, pulse, and respiration showed no abnormalities. However, the thoracic limbs showed a deviation from the sagittal plane, manifested by hyperflexion of the metacarpophalangeal, proximal, and distal phalangeal joints.

Infrared thermography

A *Thermovision XP thermographic camera* (*Laserliner, Germany*) with an emissivity of 0.98 was used to measure the surface body temperature of the mare. The thermographic examination was held in the stable with an ambient temperature of 12℃. First, the horse was thermographically scanned bilaterally at full height from a distance of 6 m. The distal parts of the thoracic and pelvic limbs were thermographed from 1 to 1.5 m in the dorsal, lateral, and palmar/plantar projection. Infrared radiation is displayed as a thermogram, an image where color gradients represent surface temperature distributions. The software used for assessing the results was *Quick Reporting- Editor*.

X-ray examination

An *Xpect Vision portable X-ray system* and an *iRay Mars flat-panel detector* were used for X-ray imaging and processing.

Results

Thermographic imaging

The bilateral thermography showed a normal surface temperature distribution of the horse body, with the warmest areas being the nostrils, eyes, inguinal region, and thigh. In the lateral projection of the thoracic limbs, a significantly high surface body temperature is observed in the area of the common digital extensor and lateral digital extensor tendons (20.13°C). On the lateral aspect of the fetlock joint of the right limb, a local body surface temperature of 22,43℃ is measured, which is higher than the temperature of the coronary band of the same limb (20.60°C) (Fig. 1).

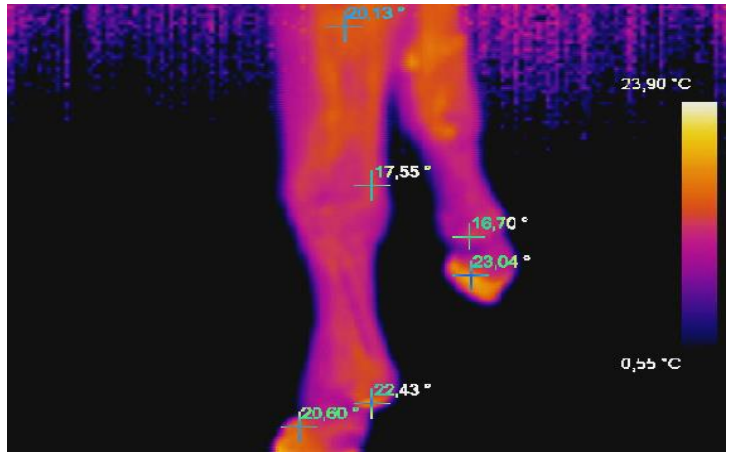

Figure 1: Right lateral and medial view of the distal thoracic limbs

A local body surface temperature of 21.17°C is measured on the right limb's dorsal aspect of the fetlock joint, which is almost identical to the temperature of the coronary band of the same limb (21.57°C) (Fig. 2).

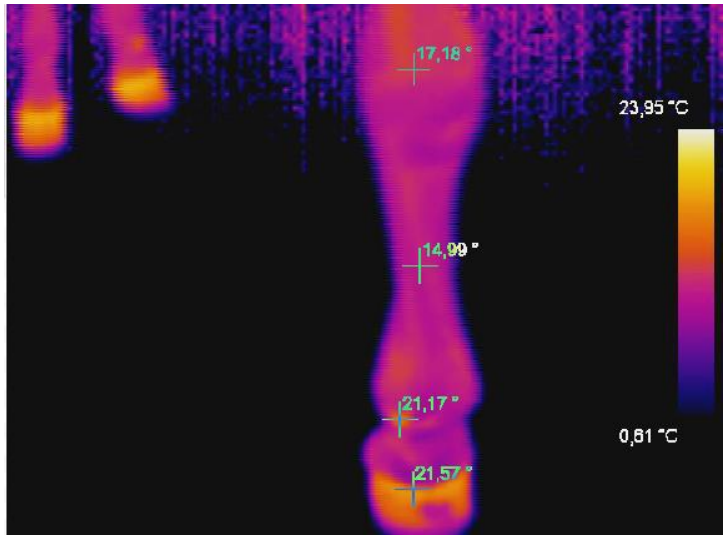

Figure 2: Dorsal view of right thoracic limb

The surface body temperature of 16.11°C is measured at a localized area in the palmar region of the fetlock joint on the left forelimb, significantly lower than and the same area on the right forelimb (Fig. 3).

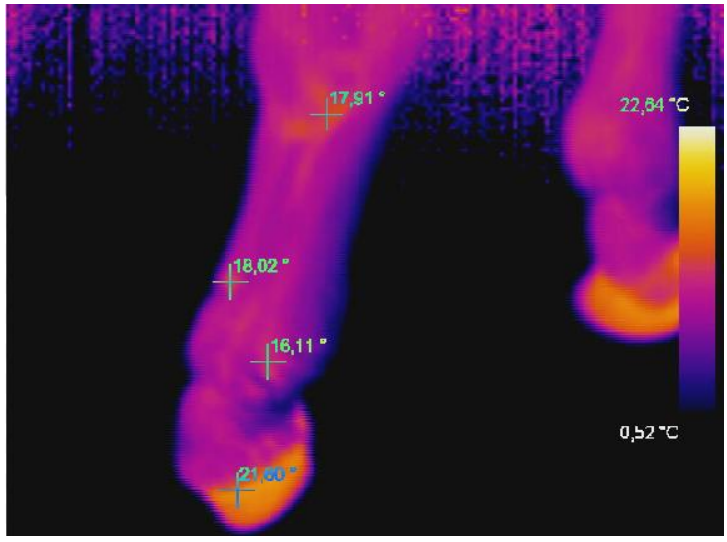

Figure 3: Dorsolateral view of the left thoracic limb

X-ray findings

The lateral X-ray images of both thoracic limbs show deviations in the shape of the phalanges, the sesamoid bones, and the articulation cavities. The measurements of the palmar angle show a

significant deviation from the norm – in the left thoracic limb, this angle is 44°, and in the right limb, it is 20° (fig. 4).

In the lateral radiograph of the right thoracic limb, a radiopaque shadow is observed at the dorsal surface from the distal epiphysis of the proximal phalanx (exostosis). The position of the middle phalanx relative to the proximal and distal phalanges is abnormal. There are indications for caudal luxation that are especially evident in the proximal interphalangeal joint (Fig. 4).

The left thoracic limb's proximal phalanx and the proximal sesamoid bone do not make good contact, which could result from axis displacement and low-grade luxation. The distal sesamoid bones have an irregular shape, which is more prominent on the left limb. In both distal sesamoid bones, there is a low-grade periosteal reaction (Fig. 4).

A narrowing in the articulation space is also observed in the metacarpophalangeal and proximal interdigital joint of the left limb and the interdigital joints of the right thoracic limb. In the palmar region of the thoracic limbs, a radiopaque shadow with soft tissue intensity is observed, which indicates the thickening of the deep and superficial flexor tendons (Fig. 4).

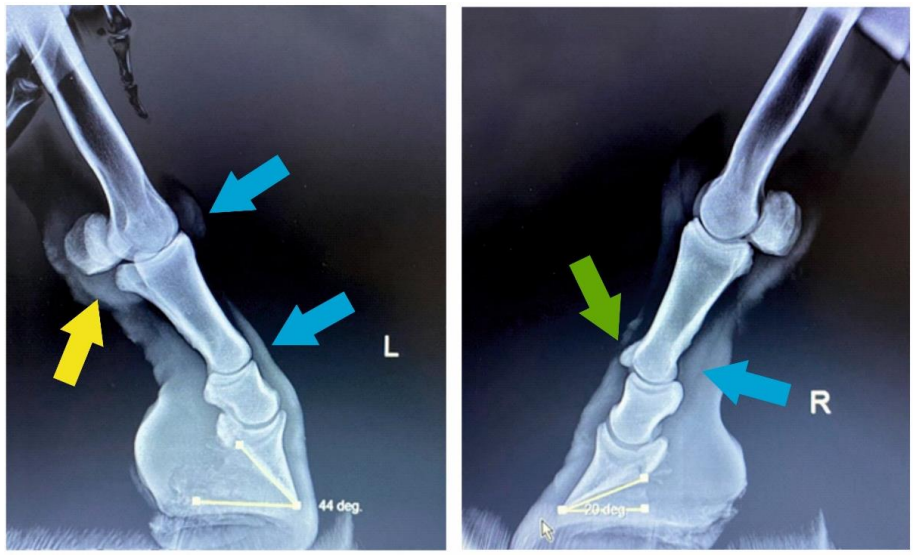

Figure 4: Radiographs in lateral projection of the left and right forelimbs. The palmar angle is 44° in the left forelimb and 20° in the right forelimb. There is a subluxation between the proximal phalanx and the proximal sesamoid bones of both forelimb. The flexor surface of these sesamoid bones has an uneven contour. There is higher opacity shadow in the soft tissues on the palmar region of the metacarpophalangeal joint (yellow arrow). In the right forelimb, there is an exostosis of the distal epiphysis of the proximal phalanx (green arrow). Joint space narrowing is present in both limbs' left metacarpophalangeal and proximal interphalangeal joints (blue arrows). Uneven contour of the trochlea of the metacarpal bone is also present.

Discussion

The infrared thermography showed significant differences and unevenly distributed temperatures in the distal regions of both forelimbs. Bilateral limb symmetry is present in healthy horses regardless of ambient temperature, and normally, the joints of the distal limb from the dorsal aspect are cooler than the surrounding structures because they have poor blood circulation (Turner *et al.*, 1996; Soroko-Dubrovina and Morel, 2023). In the present case, some small, localized areas of the distal forelimbs with higher surface temperatures were visible.

The localization of similar „hot spots" observed on the dorsolateral surface of the right limb matches the X-ray result, which shows an exostosis. It is probably a result of the permanent traumatic stress on the extensor tendons. In contrast, the palmar region of the fetlock joint of the left forelimb has a significantly lower temperature, which could result from vasoconstriction and is thus detected as a "cold spot" (Redaelli *et al.*, 2014). This low temperature is probably due to limb dysfunction and chronic subluxation in the proximal phalanx and sesamoid region following the X-ray image.

In the x-ray images provided, the palmar angle is measured as 44° for the left and 20° for the right forelimb. Normal palmar angle is considered 2-5° positive (heel higher than toe) or parallel to the ground according to some authors (Susan and Cristina, 2017). The findings on the x-ray exam of this horse are a certain sign of positive rotation of the coffin bone. This combined with the visible upright hoof conformation and the altered walk of the horse- stepping on her toe only and knuckling forward, indicate a "club hoof "conformation (Floyd, 2007).

The higher opacity shadow present in the soft tissue palmar region at the level of metacarpophalangeal joint combined with the lower localized body surface temperature measured (16,11°C) might indicate chronic tenosynovitis of the common synovial sheath.

There is a clear bilateral asymmetry between the coronary band temperatures on the left and right limbs, with the left being significantly higher than the right. This finding indicates a more progressive overload on the left leg due to its worst degree flexure and abnormal "club foot" hoof conformation (O'Grady, 2014). According to Ramsey *et al.* (2011), similar abnormal palmar angle measurements of the right and left forelimbs suggest increased load on the distal phalanx's suspensory apparatus.

Conclusion

In this study, infrared thermography complemented the results of X-rays but could not prognosis whether recovery of the affected limbs was possible. The horse's inability to remain in one place during the thermography sessions can be cited as a major disadvantage. In addition, we believe that infrared thermography would be useful in assessing similar cases after gaining more experience in scanning and apparatus settings.

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