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The Value of Thoracolumbar Radiography for the Judgment of Horse Soundness and the Pre-purchase Requirement

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Abstract

Background: Back pain is a disorder with a high-frequency recurrence in horses. There are absolute indications to request radiography besides physical, dynamic, and lameness examinations, especially in animals with normal appearance and without lameness undergoing alteration of the thoracolumbar spines and the sudden onset of back pain.

Objective: To assess the value of radiography in identifying thoracolumbar conditions in normal equine that may affect the soundness of the animal and its significance as a pre-purchase basic exam. To determine how well radiography can find thoracolumbar conditions in horses that seem healthy but could affect the animal's health and how important it is as a basic pre-purchase exam.

Methods: Nine horses of both sexes, 2 of them were showing lameness, and 7 were apparently normal (lameness-free). A series of lateromedial and DM 20° VLO radiographs of the thoracolumbar column (T1-L6) were acquired with digital equipment. The images were analyzed, and radiographic findings were noted.

Results: Different osseous lesions were noted among the studied horses groups. Variable degrees of bone lysis, bone cyst-like lesions and bone remodelling were observed. Kissing spines, sclerosis, and APJ ankylosis were also detected. Though the animals suffer no lameness, radiography predicts their future unsoundness.

Conclusion: A radiographic examination of the thoracolumbar spine should be a basic annual exam and a fundamental pre-purchasing procedure to predict an animal's future back pain and lameness.

Keywords: Horse; Lameness; Radiography; Thoracolumbar; pre-purchasing

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1. Introduction

Egypt has approximately 1.7 million horses and donkeys (FAO, 2016). In a recent study, by the Ministry of Agriculture and Land Reclamation's General Organization for Veterinary Services, Egypt, the total population of equids in Egypt is approximately 659,631. They are exclusively employed for riding and working in huge agricultural expanses in rural and tourist areas (641.508), and the others (18123) are used for racing, jumping, and show horses (Ali, 2021).

Back pain (BP) is a medical disease that can have a variety of etiologies that causes performance failure in working horses. Among the causes of BP are thoracolumbar (TL) conditions (García-López, 2018; Mayaki, 2020). Equine back issues can either be the primary or secondary cause of limb issues. (García-López, 2018). About 9 % of horses with back pain may show no degree of lameness and appear sound (Landman et al., 2004). The subclinical lameness, caused, for instance, by imbalanced shoeing, has also been reported to lead to back problems and remains unnoticed. (Ridgway & Harman, 999).

Congenital abnormalities, soft tissue diseases, and spinal problems are the three groups of disorders that affect a horse's back (Jeffcott, 2005). Due to the possibility of the pain's presentation being ongoing, intermittent, or nonexistent, it always happens in horses with low or normal athletic performance and poorly defined clinical indicators. (Henson & Kidd, 2009).

According to Dyson (2003), bone is a dynamic tissue that reacts to internal and external stimuli. In the early phases of a disease process, radiographic pictures are anatomically precise but relatively insensitive. Bone has a finite range of responses to stimuli. In addition to callus formation, cortical thickening, increased trabecular thickness, osteophyte and enthesophyte creation, and the palisading periosteal new bone characteristic of hypertrophic osteopathy, bone can also manufacture new bone. Increased opacity of the bone, often known as sclerosis in radiology, is frequently the consequence of the formation of new bone. Bone resorption, or Osteolysis, causes radiolucency. Bone destruction and resorption are usually seen more easily in cortical bone rather than cancellous bone because of the greater contrast (Dyson, 2003).

Overriding dorsal spinous processes (ORDSP), often referred to as "kissing spines" identified as being the most frequent cause of pain in the back in horses. Impingement of the DSPs is primarily found at the level of T13-T18, but it also can affect the lumbar DSPs (García-López, 2018).

Because radiography alone cannot tell a clinician how much current inflammation is present, detecting active ORDSP can be tricky at times. Additionally, the presence of bony remodelling, impingement, and/or overriding does not necessarily indicate that a horse has this condition because radiographic signs of ORDSP have been reported in clinically normal horses (García-López, 2018).

In addition to physical, dynamic, and lameness testing, radiographic assessment of the equine thoracolumbar column enables improved diagnosis utilizing a grading system that is required to establish Surgical or medical therapies (Butler et al., 2008).

The use of digital radiography technologies has made it easier to find lesions in the thoracolumbar spine of horses by improving certain picture quality (Johns et al., 2008).

Due to the uneven distribution of horses representing different disciplines, it is difficult to determine whether certain physical activities impact the prevalence of back problems. (Mayaki et al., 2019).

This study was set out to describe the radiological findings of the thoracolumbar vertebral segment corresponding to horses in Egypt. For this purpose, we described diseases and conditions, their distribution at the thoracic and lumbar segments, and the correlation between these conditions and the degree of animal soundness.

Table 1: Criteria of the thoracolumbar segment radiographic assessment (Looijen et al., 2021).

Interspinous space width (ISW)	0 =>4mm I = 1–4 mm (narrowing) II = 0 mm (impinging) III =< 0 mm (overlapping)	**Isolated linear radiopacity dorsal margin (IsolDo)**	0 = no I = focal (<25% of the width) II = moderate (25%–50% of the width) III = marked (>50% of the width)
Modeling dorsal margin (DoMod)	0 = normal I = mild regular modeling II = moderate regular or mild irregular modeling III = marked regular or moderate irregular modeling IV= marked irregular modeling	**Modelling craniodorsal margin/beak-shaped formation (DoNose)**	0 = normal I = mild elongation II = moderate elongation III = marked elongation and/or fragment
Intensity of increased opacity cranial (InOpCr)/caudal margin (InOpCa)	0 = normal, no increased opacity I = mild increased opacity II = moderate increased opacity III = marked increased opacity Separately recorded but similarly graded	**Width of increased opacity cranial (WidthOpCr)/caudal margin (WidthOpCa)**	0 =0mm I = less than 2 mm II = in between 2–4 mm III = more than 4 mm Separately recorded but similarly graded
Radiolucency cranially (Lucency Cr or OCCLCr) / caudally (LucencyCa or OCCLCa)	0 = no radiolucency I = radiolucency <5mmindiameter II = radiolucency5–10mmindiameter III = radiolucency >10 mm in diameter The largest abnormality is recorded. Separately recorded and graded. OCCL is radiolucency with the presence of a circumferential rim of radiopacity.	**Modeling craniodorsal third (CrDMod)/cranioventral two-thirds (CrVMod)/caudodorsal third (CaDMod)/caudoventral two-thirds (CaVMod)**	0 = normal I = mild regular modelling II = moderate regular or mild irregular modelling III = marked regular (mishappening) or moderate irregular modelling IV= marked irregular modelling (mishappening) V= fused spinous processes or congenital deformities/bony bridges Separately recorded but similarly graded

2. Materials and Methods

2.1. Case selection

The current study was conducted on nine horses found in Egypt presented to the university veterinary hospital (Animal Panorama Center of Excellence), Damanhour and the Police Heights Equine Hospital inside Police Heights Equistarian, Cairo.

Clinical information including breed, gender, work discipline, body weight using height weight tape, height at withers, clinical, physical examination, and lameness score, was recorded for all horses.

2.2. Radiological Examination

After being sedated with xylazine hydrochloride, the horses were inspected. To avoid lateroflexion or rotation of the spine and maintain a neutral head-neck position, horses were standing squarely on all four limbs. Four to five skin markers were applied to each horse's skin in the median plane above the spinous processes.

To protect themselves from radiation risks, radiologists are required to wear lead-based protective gear, including lead suits, gloves, and thyroid pieces. A film-focus distance (FFD) of 100 cm was maintained, and the detector plate was placed such that it touched the horse.

For the section T18-L6 two radiographic views (lateromedial and DM20°VLO), were acquired for each animal. Lateromedial views from the withers to the lumbar area should be taken in three images minimum per thoracolumbar spine, with at least one DSP overlapping between subsequent images.

Radiographic images were classified according to different disease conditions considering degrees, increased opacity, radiolucency, and remodeling of the examined segments.

2.3. Radiographic grading and Interpretation

Radiographic interpretation and assessment were performed by a single surgeon for each horse apart. Findings were tabulated for further analysis.

Table 2. Shows the criteria of examined horses' data

No	Gender	Age (Y)	Work type	Weight (Kg)	Lameness grade
1	M	8	D and B	400	0
2	M	5	D	450	0
3	M	7	D and B	500	0
4	F	20	B	361	2
5	G	7	J	373	0
6	M	6	D	331	0
7	M	1.5	D	254	0
8	F	7	Der	290	5
9	M	1	No work	246	0

D: draft, B: breeding, J: jumper, Der: dressage, G: gelding

Table 3. Lameness grading system according to AAEP (Stashak, 2002)

Grades	Description
0	Lameness is not perceptible under any circumstances
1	Lameness is difficult to observe; not consistently apparent regardless of circumstances such as weight carrying, circling, inclines, or solid surface
2	Lameness is difficult to observe at a walk or trot in a straight line; consistently apparent under some circumstances such as weight carrying, circling, inclines, or solid surface
3	Lameness is consistently observable at a trot under all circumstances
4	Lameness obvious; marked nodding, hitching, and/or shortened stride
5	Lameness obvious; minimal weight bearing in motion or rest; inability to move

3. Results

Despite several obstacles, the DR system enables high-quality diagnostic pictures of the thoracolumbar spine in a clinical situation. This enables us to precisely match the clinical relevance of back diseases in horse patients to radiography data. Upon lameness and radiographic examination, 22.2 % of the cases exhibited back pain with different lameness degrees (scored 2 and 5 grades) with many radiographic lesions (beak shape, bone lysis, KS, bone remodelling, and anakylosis of APJ). Also, 55.55% of examined animals showed multiple radiographic abnormalities (beak shape, bone lysis and KS) which were apparently normal. Finally, 22.22 % of examined animals are outwardly normal without any radiographic lesions.

The radiographic examination revealed different thoracolumbar conditions. Bone remodeling of the dorsal spinous process (DSP) was detected in five cases (55.55%). On radiographs, bone remodeling of the dorsal spinous process appeared as irregular thickening of the bone with an uneven density. The affected processes may also have a rough or spiky appearance, and in some cases, they may fuse together. These changes can be seen in both lateral and dorsal radiographs of the thoracic and lumbar spine (**Figure 1**).

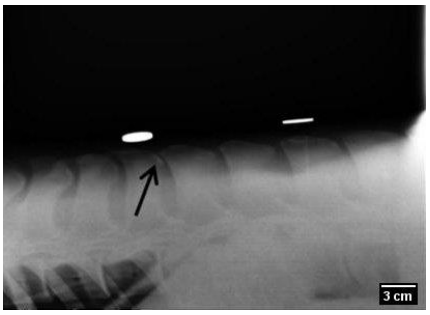

Figure 1. A lateromedial radiograph of the DSPs was obtained in the caudal thoracic region shows the evidence of bone remodelling of the adjacent bony surface, indicated by sclerosis of the bone in 6 years male horse.

Small bone cyst-like lesions (Radiolucencies) in DSP were detected in two cases (22.2 %). On radiographs, bone cysts appeared as well-defined, radiolucent (dark) areas within the bone. They typically have a round or oval shape and can vary in size from small to large (**Figure 2**).

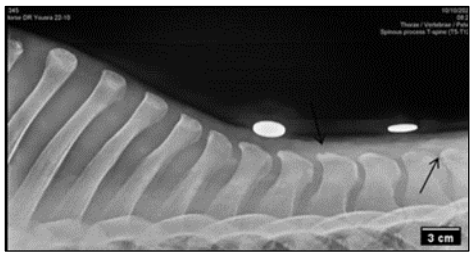

Figure 2. A lateromedial radiograph of the dorsal spinous processes (DSPs) was taken in the mid and caudal thoracic region to show the radiographic appearance of bone cyst in 20-year-old mare

DSP bone lysis of the thoracolumbar spinous processes was detected in two cases (22.2 %), and DSP beak shape in different degrees in six cases (66.7 %). Bone lysis appears as areas of decreased density or radiolucency within the bone.

Kissing spine with variable degrees in five cases (55.6 %) and osteoarthritis of the articular facets in 2 cases (22.2%). On radiographs, the kissing spine appeared as a narrowing of the interspinous space, with the tips of the adjacent dorsal spinous processes coming into contact or overlapping. The affected spinous processes may appear flattened or have irregular margins on radiographs. In severe cases, the affected spinous processes may show signs of remodelling or resorption (**Figure 4**). No DSP fracture (wither area) is detected, and no lesion is present in two cases (22.2 %).

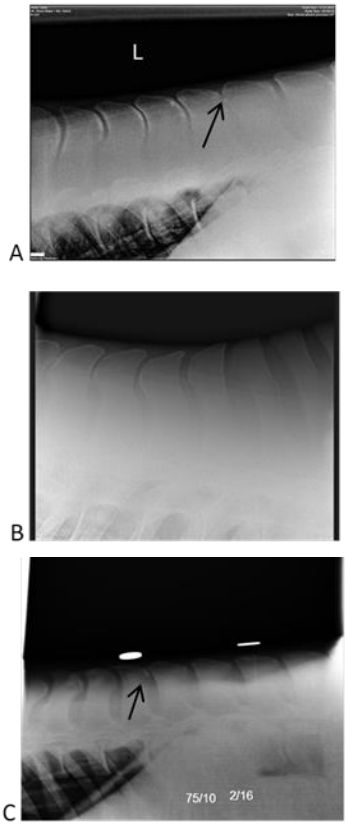

Figure 3. Lateromedial radiographs of the dorsal spinous processes (DSPs) were taken in the caudal thoracic and lumber regions to show the radiographic appearance of different degrees of KS in horses.

Osteoarthritis (OA) of the articular facets of the vertebrae is accompanied by space narrowing as the cartilage in the joint wears down, and osteophytes, also known as bone spurs, develop on the edges of the joint. These are seen as small, bony growths on the radiograph, and subchondral cysts, which are seen on the radiograph as small dark areas; sclerosis which is seen as a white area on the radiograph, and facet joint hypertrophy, where the facet joints become larger and thicker, and are seen on the radiograph as thickened or enlarged areas.

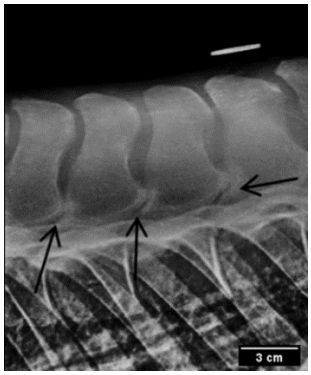

Figure 4. A DM20°VLO radiograph of the vertebral bodies was obtained in the midthoracic region to show the radiographic appearance of osteoarthritis of the articular facets of the vertebrae in 7-year dressage mare.

4. Discussion

Back pain (BP) is a common problem among working horses and a major reason for performance loss. The nature of the damage and the affected back structure determine the prevalence of back issues (Cauin, 1997). According to the results of the present study, active KS may be a major cause of BP, especially in older ages (7:20 years). Even though the same osseous pathogenic lesion can be found in the back of the young ones, this is perfectly normal. There is no reported association between age and predisposition in back disorders (BDs), especially KS syndrome. Due to the uneven distribution of horses across disciplines in Egypt, making any conclusive judgments is challenging. from our research about the relationship between the frequency of back issues and particular physical activities. The owners reported that cases could last for a few weeks to several months or even years before being presented.

In horses, thoracolumbar pain caused by kissing spines is the most prevalent osseous lesion thought to contribute to poor performance. Similar to previous reports, clinical signs and radiographic evidence of kissing spines in horses with back discomfort were most prevalent in the thoracolumbar vertebrae. (Clayton & Stubbs, 2016). The caudal, thoracic, and lumbar areas are particularly vulnerable to the development of KS. When a pathological osseous lesion and other soft tissue illnesses occur together, they exacerbate BP symptoms. Kissing spine, involving more than three vertebrae was also noted in back pain associated with poor performance, corroborated by a prior study (GIRODROUX, DYSON, & MURRAY, 2009). Consistent with prior research (Butler et al., 2008) and (Zimmerman, Dyson, & Murray, 2012), radiographic assessment of the equine thoracolumbar column, in addition to physical, dynamic, and lameness examination, allows for better diagnosis using a grading system necessary to determine clinical and/or surgical treatments. Some grades of KS are associated with a high risk of clinical signs of BDs, consistent with a prior study (De Graaf, Enzerink, Van Oijen, Smeenk, & Dik, 2015). (Dyson, 2003). Bone is a dynamic tissue that always responds to internal and external stimuli. Since a response takes time to develop and changes in bone density must increase by 40% before they are visible radiologically (radiographic latent period), we should radiographically follow up on cases of KS once a year, regardless of grade. Put this data (radiographs) in a special record and make it a point of interest during the pre-purchasing exam. Other vertebral problems associated with BDs include spinal compression, degeneration and lysis, cyst formation and fractures. These conditions are similar to those observed in humans and other species.

5. Conclusion

Vertebral pathologies of the back can manifest in various ways in horses, both lame and not. We suggest a digital radiographic examination as the primary pre-purchase exam, particularly for high-value horses, because of its usefulness in predicting back vertebral pathologic changes.

Conflict of interests: There are no conflicts of interest stated by the authors.

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