

How to Obtain Digital Radiographs of the Thoracolumbar Spine in the Standing Horse

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Introduction

The accessibility of digital radiography (DR) provides a means for equine practitioners to obtain high-quality diagnostic images of the back in the standing horse. Use of conventional films has discouraged equine veterinarians in the past from performing comprehensive radiographic examinations of the back because their size and thickness has restricted image quality. DR systems have facilitated detection of lesions in the thoracolumbar spine in horses with clinical manifestations of back pain by enhancing specific viewing areas which allows for more effective diagnosis. It is important to evaluate the thoracolumbar vertebrae in their entirety, as several radiographic abnormalities can concurrently result in the existence of back pain. In a practice setting with digital radiography and high output x-ray equipment it is technically feasible to gather diagnostic quality views of the first thoracic vertebrae to approximately the fourth lumbar vertebrae including the dorsal spinous processes, articular processes, and vertebral bodies.¹ At our private practice, we have radiographed the thoracolumbar spines of 386 horses since 2004.

Radiographic findings in horses with back discomfort often include

1. Dorsal spinous process impingement
2. Osteoarthritis of the articular processes
3. Spondylosis
4. Supraspinous ligament trauma
5. Interspinous ligament trauma
6. Fractures
7. Congenital defects

Materials and Methods

Radiography of the thoracolumbar spine of the horse's back is best accomplished with the use of adequate sedation. We typically use a combination of butorphanol^a (0.004-0.007 mg/kg) and detomidine^b (0.02-0.04 mg/kg) to encourage the horse to stand squarely bearing weight evenly on all four limbs. This insures that true lateral views of the back are obtained. The horse's head is allowed to hang unsupported or rest on a flat cart so that the handler is a substantial distance from the x-ray beam. A high output x-ray machine capable of up to 150 kv(p) and 500 mA is advised. We use a vertically oriented mobile stand constructed of a square metal base and PVC piping with a direct capture digital x-ray sensor^c holder to help facilitate proper positioning and limit movement (Fig. 1). The sensor panel could also be secured to a fixed stand or a wall mount. The x-ray sensor panel should be oriented perpendicular to the ground, and the x-ray beam should be aligned horizontally with the center of the sensor panel. The sensor panel should be positioned as close to the horse's body as

possible (Fig. 3). We do not use a filtration system, but close collimation to the area of interest reduces radiation scatter and improves image quality. A lead marker may be placed on the midline of the horse's back to facilitate correct orientation along successive radiographs.

In our practice we have two sizes for the direct capture digital x-ray sensor panels, 9" X 11" and 14" x 17" (Fig. 2). We typically acquire 4 to 6 images of the thoracolumbar spine using the 9" x 11" sensor panel depending on the size and thickness of the patient. We begin by positioning the sensor panel just above the highest point of the withers and centering the x-ray beam. Next, we position the panel caudally focusing on the summits of the dorsal spinous processes of the mid-thoracic, caudal thoracic and first few lumbar vertebrae successively. For these images the x-ray beam is centered approximately 3 to 4 inches below the dorsal midline of an adult horse's back (Fig. 4). The next series of images focuses on the vertebral bodies and their articulations and the x-ray beam is centered 6 to 8 inches below the dorsal midline of the horse (Fig. 5). Our larger 14" x 17" sensor panel allows us to view the dorsal spinous processes, articular processes and vertebral bodies in three overlapping radiographs. Detail and contrast is preserved because our DR system enables us to adjust the contrast on the same view rather than performing multiple exposures to account for the considerable difference in tissue attenuation between the summits of the dorsal spinous processes, articular processes and the vertebral bodies.

On our DR unit we also utilize a software stitching program^d to align the adjacent radiographic images thus allowing us to assess the entire length of the dorsal spinous processes, articular processes and vertebral bodies in alignment. For best results, the exposure should be made during end expiration to limit motion. Our radiographic exposures vary depending on the size of the horse and the part of the thoracolumbar spine being imaged.



Fig. 1. Movable stand for direct digital capture sensor panel and high output radiographic generator^e.



Fig. 2. 14"x 17" and 9" x 11" sensor panels for obtaining digital radiographs.



Fig. 3. Close placement of the sensor panel to the trunk of the horse.



Fig. 4. Approximate placement of the x-ray beam to the sensor panel when obtaining lateral views of the dorsal spinous processes of the back.



Fig. 5. Positioning for the lateral projections of the dorsal articular processes and vertebral bodies of the back.

Results

The DR system facilitates high-quality diagnostic images of the thoracolumbar spine in a practice setting which allows us to accurately correlate radiographic findings and clinical significance of back discomfort in our equine patients. In 2007, our clinic imaged 81 patients with back pain following comprehensive clinical and moving evaluations. Of the 81 horses radiographed with signs of back discomfort, 28 horses had evidence of dorsal spinous process impingement, and 15 horses had evidence of articular process (facet joint) arthritis (Figs. 6 and 7). Sixteen horses had concurrent radiographic findings of dorsal spinous process impingement and facet joint arthritis. Seventeen horses had no abnormalities noted radiographically, and 3 horses had evidence of spondylosis (Fig. 8). One horse had numerous fractures of his dorsal spinous processes, and another horse had a fracture of an articular process of a thoracic vertebrae. These findings influenced the prognosis and therapeutic options for these patients.

In many of these cases, ultrasonography and/or nuclear scintigraphy were concurrently performed in order to assess the clinical significance of the radiographic findings. Radiographic changes that are scintigraphically active or have corresponding ultrasonographic lesions are likely to be clinically active in our equine patients. In our practice, we use digital radiography to view the thoracolumbar spine in its entirety in a short period of time. The ultrasound is of great benefit to identify such findings as enthesiopathies of the dorsal spinous processes and supraspinous ligament desmopathies. However, we have found a comprehensive ultrasonographic examination of this region to be more time consuming than radiographs, and primarily use it as an adjunct to specifically guide our interspinous injections of the dorsal articular processes. Some therapeutic options we routinely use to address back pain include: extra-corporeal shockwave therapy, ultrasound guided interspinous injections of the dorsal spinous processes and dorsal articular processes with corticosteroids, and mesotherapy of the thoracolumbar spine.

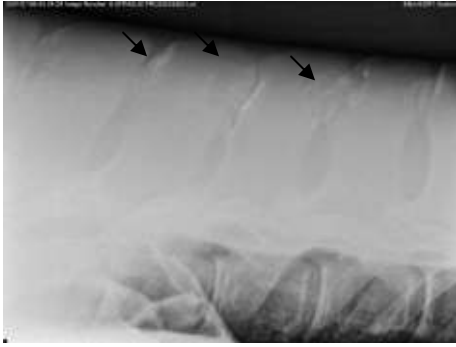


Fig. 6. Left lateral digital radiograph showing impingement of numerous mid-caudal thoracic dorsal spinous processes of the back. Significant sclerosis and osteolysis is evident at the affected spinous process summits (black arrows).

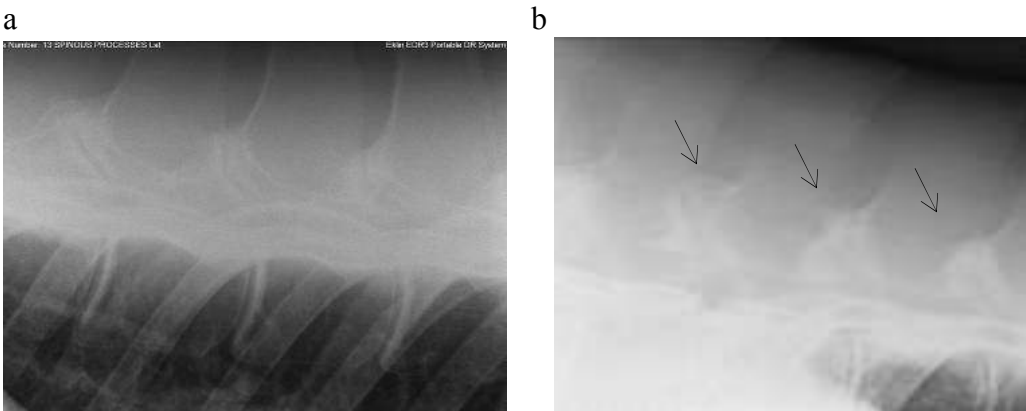


Fig. 7. Left lateral projection of the mid-caudal thoracic articular processes of a normal adult horse (a) and caudal thoracic articular processes of an abnormal adult horse (b). Bony modeling and sclerosis of the articulations is evident obscuring visualization of the joint spaces (black arrows).



Fig. 8. Left lateral digital radiograph of mid-caudal thoracic vertebral bodies showing bridging spondylosis (white arrows).

Discussion

With traditional radiography, often only the summits of the dorsal spinous processes of the back were considered diagnostic. However, with direct DR units and high output radiographic equipment we have been able to more accurately evaluate the thoracolumbar spine in its entirety. Although the DR system and special high output radiography equipment is a substantial financial investment, we have found at our practice the long term benefits both diagnostically and monetarily offset the initial expense. The ability to obtain more detailed images of broader regions of the back has more specifically guided our treatment to areas once difficult to obtain quality views. Therefore, once a clear diagnosis of back pain is established via digital radiography, more precise and immediate treatment techniques may be applied to help manage back discomfort.

References and Footnotes

1. Butler J, Colles C, Dyson S, et al: Clinical Radiography of the Horse. Oxford, Blackwell Science, 1993.

^a Torbugesic, Fort Dodge Animal Health, Fort Dodge, IA 50501.

^b Dormosedan, Pfizer Animal Health, Exton, PA 19341.

^c Eklin Medical Systems, Inc., Santa Clara, CA.

^d Eklin Medical Systems, Inc., Santa Clara, CA.

^e Tallent Images, LLC, (Sedecal Mobile X-ray Generator) Atlanta, GA 30329