ABSTRACT
The object of the current study was to evaluate the efficacy of thermography and ultrasonography in the diagnosis of thoracolumbar lesions in Quarter Horse athletes and associate the different types of lesions found with the athletic modality practiced. Twenty-four horses were admitted to the Surgery Service for Large Animals of the Veterinary and Animal Science Faculty, UNESP, Botucatu, Brazil, with complaints of back problems. All the horses were submitted for physical examinations to confirm the existence of thoracolumbar alterations and then for thermography and ultrasonography. Thermography was used to map the lesioned areas of this region and ultrasonography for lesion characterization. The lesions found were supraspinous desmitis, interspinous desmitis, dorsal intervertebral osteoarthritis, and impingement of the spinous processes or kissing spines. The existence of a relation between the type of event practiced by the horse and the type of lesion found was determined. In horses that competed in the barrel race, a predominance of lesions in the thoracic caudal, thoracolumbar, and cranial lumbar regions occurred, with intervertebral osteoarthritis and interspinous desmitis being the most common. In cutting horses, most of the lesions were observed in the caudal lumbar region, whereas horses competing in reining showed a preferential location for lesions in the middle lumbar, with a predominance of supraspinous desmitis and myositis. Thermography associated with ultrasonography was shown to be efficient in the diagnosis of the thoracolumbar lesions of these horses.

Keywords: back pain; lameness; loss of performance; vertebral column

INTRODUCTION
The elevated incidence of back problems, difficulty of diagnosis, and importance of this anatomic region in locomotion of the equine species justify investigations in this area, principally those directed at improved quality in diagnosis and consequent therapeutic innovation.

Currently, a growing number of horses are purchased and trained for participation in equestrian sports in Brazil, especially the western sports engaged in by the Quarter Horse. These horses compete in reining, cutting, team roping, and barrel racing events, in which demands for exercises at high speeds and abrupt stops or changes in direction are observed and considered unique in the equestrian athletic world. These demands generate a constant challenge to the musculoskeletal system, often passing the physiologic limits of these horses, with consequent compromise to the health of the locomotor system, in such a manner that the incidence of certain lesions for specific sports is clear, although back pain is observed in all western modalities.1 Diagnosis of the source of equine lameness is often difficult, principally in cases in which the pain is located in the proximal hind limbs and is not related to synovial structures.2,3 Back pain is included in this category of lesions. Lumbar pain, whether of primary or secondary origin, is an important cause of the loss of performance in equine athletes.4,5 Therefore, diagnosis of both the location of lesions and their magnitude, in terms of pain, is difficult, because frequently the most evident clinical sign is not the pain itself, but the loss of performance.6,7

We believe that scientific and technological advances in the diagnosis of back problems are essential to enable horses to express their maximum athletic potential, whether in western sports or in many other equestrian sporting modalities. Increased development in thermography and ultrasonography as complementary diagnosis methods has been observed worldwide by means of the numerous papers published in the last few years.8,9 In Brazil, notable interest in the use of thermogram and ultrasonogram in the diagnosis of lameness has been observed, though controlled studies relating thermographic
and ultrasonographic images to clinical findings in cases of lumbar pain do not exist.

Thus, the objectives of the current study were to evaluate the efficacy of thermogram and ultrasonogram in the diagnosis of thoracolumbar lesions in Quarter Horse athletes and to associate the different types of lesions found with the athletic modalities practiced: cutting, reining, and barrel racing.

MATERIALS AND METHODS
Twenty-four Quarter Horses were used, aged between 4 and 8 years, of both sexes (11 male and 13 female) and all active athletes. The horses were admitted to the Surgery Service for Large Animals of the Veterinary and Animal Science Faculty of the São Paulo State University (UNESP), Botucatu Campus in Brazil, with complaints of back pain, during the period April 2004 to May 2005. These horses competed in three sporting modalities within western categories: reining (4 animals), cutting (9 animals), and barrel racing (11 animals).

A physical examination of the locomotor apparatus of each horse was performed with the horse static. The examination evaluated alterations in posture, conformation, and movement to characterize the type and degree of lameness and to perform flexion tests, with the objective of excluding horses that presented lameness unrelated to the thoracolumbar region. The physical examination of the thoracolumbar region comprised inspection, palpation, and mobility tests in accordance with known protocols.

A thermography examination (DTIS 500, Emerge Vision) was performed after the physical examination, with a period of 1 hour between examinations, so that body temperature of the horse returned to normal. Thermographic images were obtained from the following positions: side view of the body and neck from both sides, including the side of the hind limb, and dorsal view of the extension of the vertebral column divided into thoracolumbar view and lumbosacral view.

The examinations were performed in the Equine Sports Medicine Center (Centro de Medicina Esportiva Equína) of the FMVZ, UNESP, Botucatu Campus, Brazil, while maintaining the environment as stable as possible in relation to the natural temperature and humidity. Direct marking and visualization of the exact locations of alterations in the thermal pattern was realized through the use of adhesive tape (Fig. 1). The parameters of normal thermal profile at rest were based on preestablished norms. A temperature difference between antimeres within a range of 0.5°C to 1°C was considered normal. After mapping the thoracolumbar region using the thermography examination, ultrasonography (SSD-900, Aloka, Japan) of this area was performed using a 7.5-MHz linear transducer.

For the ultrasonographic examination, the area under evaluation was prepared by moistening the hairs with warm water and applying hydrosoluble contact gel (Ultra-gel, Ind. e Comércio de Produtos Gelatinosos Ltda, São Paulo, Brazil) for the best contact with the transducer. Median, paramedian, and transverse approaches were combined for complete access to axial structures.

Supraspinous ligament lesions were characterized according to their echogenicity and parallelism of the fibers; lesions of the interspinous space were classified according to increased echogenicity, presence of hyperechoic points in the space, and the reduction or loss of the space. Spinous processes were characterized regarding the regularity of the dorsal surface. Kissing spines were considered present when a continuity of the bone line between two or more spine processes, with loss of interspinous space, was observed. This may or may not have been associated with supraspinous desmitis.

Articular processes were classified with regard to the regularity of the articular surface and the reduction or loss of articular space. The muscles were characterized by the echogenicity of the fibers (hypoechoic zones) and perimysium (hyperechoic lines separating the fibers). Presence of a hypoechoic or anechoic gap within the muscle fibers was considered a criteria for the myositis diagnosis. In chronic cases, a fibrosis area can appear as a hyperechoic circumscribed lesion.

All examined and diagnosed animals were treated. Treatments used were: supraspinous and interspinous desmitis: paravertebral infiltrations with steroids (methylprednisolone acetate, depo-medrol, Pfizer; 40 mg/point of injection) and neurolytics (Sarapin, High Chemical Company; 2 ml/point of injection) in the lesion area; myositis: muscle relaxants (Tiocolchicosido, Coltrax, Aventis Pharma; 20 mg/animal intramuscularly) and nonsteroidal anti-inflammatories (Phenylbutazone Butazoldina, Novartis; 2.2 mg/kg intramuscularly); dorsal intervertebral osteoarthritis: local infiltration in the multifidus muscle with steroids; kissing spines: shock wave therapy.

RESULTS
In all horses, presence of thoracolumbar pain was confirmed by means of the physical examination performed. The degree and type of pain response and mobility alterations varied between horses, whereas more than one response could be found in a single horse.

Only three horses presented lameness, and in all cases the diagnosis of back pain preceded that of lameness. Alterations were observed in movement, principally in the circle gallop examination, where diminished dorsoventral mobility and shortness of gait were the most commonly observed.

In the thermogram, a high number of hot spots in the thoracic region were observed (65.4%), most in the midline (46.1%), corresponding to the trajectory of spinous...
and supraspinous ligament processes (Fig. 2). In four horses, hot spots were observed in the lumbar region, which suggests *Longissimus dorsi* myositis in the area corresponding to the increased temperature (Fig. 3), whereas the predominant finding in the lumbar region was cold spots (Fig. 4).

In the images obtained on ultrasound examination, both soft tissue and bone tissue lesions were identified. The lesion with the highest incidence was supraspinous desmitis, followed by dorsal intervertebral osteoarthritis, interspinous desmitis, spinous processes syndrome, and *Longissimus dorsi* lesions, suggesting myositis (Fig.)
5), although more than one lesion type could be found on the same horse.

The ultrasound examination showed that supraspinous and interspinous ligament lesions and spinous processes were best observed in the longitudinal scans; in the case of supraspinous ligament, by the reduced diameter and by the fact that most of the lesions observed were located at the insertion of this ligament in spinous processes, best seen in the longitudinal view. For dorsal intervertebral articulations and epaxial muscle, the transverse images were more elucidative (Figs. 6, 7, 8, and 9).

Dorsal intervertebral osteoarthritis was observed in the caudal thoracic and lumbar region of the horses examined (Fig. 5) and occurred either unilaterally (15 vertebrae) or bilaterally (17 vertebrae) in any particular vertebra. In three horses, only one lesioned articulation was found, whereas in the remaining horses (n = 9), at least two articulations were affected.

After performance of both examinations, it was possible to ascertain a relationship between the images obtained by thermography and those obtained by ultrasonography. In the case of hot spots, in all locations indicated by the thermography, a corresponding lesion was found; however, in some horses, not all of the lesions that were potential causes of local temperature increase observed using ultrasonography were detected by thermography (Fig. 10, Table 1).

In contrast, in the images of cold spots, a relation between the thermographic and ultrasonographic images was seen in all horses. In the case of cold spots, their extension, rather than their number, was computed.

Separating the horses submitted to the thermography and ultrasonography examinations according to the athletic modality practiced (cutting, reining, and barrel racing), a relationship between these events and the types of lesions found was observed.

According to sporting modality, horses competing in cutting events showed a predominance for supraspinous desmitis (89%), followed by dorsal intervertebral osteoarthritis (44.4%); in barrel racing horses, osteoarthritis was the lesion of highest incidence (63.6%), followed by interspinous desmitis (45.5%), whereas in horses practicing reining, supraspinous desmitis was the lesion found most frequently (100%), followed by Longissimus dorsi lesions (50%).

Among barrel race horses with osteoarthritis, 87.5% of the lesions observed were unilateral, and of these, 62.5% occurred on the right side, a fact probably due to the horse turning twice at the barrel on the right side and only once at the barrel on the left.

Among the cutting horses with dorsal intervertebral osteoarthritis, 62% presented this lesion in the caudal lumbar region, located in the articulation between L3 and L4 up to articulation L5 and L6; whereas in barrel-racing horses, 65% of the affected articulations were found in the cranial lumbar region, from the thoracolumbar articulation up to the articulation between L2 and L3. The only affected reining horse presented lesions between L2 and L3, bilaterally.

After treatment, only one animal did not present improvement in the clinic board after treatment, failing to return to athletic performance. This animal was diagnosed with dorsal intervertebral osteoarthritis. All other

**Figure 4.** Thermogram with cold spots (arrows) in the lumbar region of a horse, suggesting dorsal intervertebral osteoarthritis.

**Figure 5.** Alterations found in the ultrasonography examination of the horses examined: (DIOA) dorsal intervertebral osteoarthritis; (SSD) supraspinous desmitis; (ISD) interspinous desmitis; (KS) kissing spines; (MS) myositis.
horses returned to athletic performance, without presenting clinical signs of back pain.

**DISCUSSION**

Determining the exact location of the lesion and the cause of pain using physical examination only was not possible, although the pain could be determined as originating from the thoracic or lumbar region, using as a base the horse’s response to epaxial structure palpation, the mobilization examinations, and inspection at work.

The best gait for examining the movement of the vertebral column was the gallop, where the horse’s neck assumes different positions. Among these antalgic gaits, the cervical position during movement of the horses stood out, because the neck has a direct influence on the biomechanics of the vertebral spine, especially by means of the nuchal connection that continues into the thoracolumbar spine as a supraspinous connection. When the animal bends its neck, that is, puts it down, a flexion of the entire thoracic spine occurs, by the augmentation of the tension of the nuchal connection, increasing the amount of movement, especially between T6 and T10. Horses with thoracic pain have a tendency to lower the neck during work. In the lumbar region, cervical flexion reduces the amount of lateral bending and rotation allowed, especially between T18 and L5. Because of this, horses with lumbar pain tend to raise the neck to increase mobility and reduce stress in this region.

Regarding thermography in the examined horses in this study, the predominant findings were hot spots; the cases of supraspinous and interspinous desmitis and muscular lesion depicted inflammatory lesions that led to increased local surface temperatures. The thermographic finding associated with possibility of myositis is an increase of temperature in the region of the *Longissimus dorsi*. Increase in temperature in this region can be from the muscle or from the skin and subcutaneous tissue. Animals were examined for dermatological health before

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**Figure 6.** Ultrasonographic image of supraspinous desmitis, showing the irregularity of the associated spinous process, with an anechoic focus in the ligament. Longitudinal view. CR—cranial; CA—caudal.
the thermographic examination, so that only animals without cutis lesions in the thoracic and lumbar regions were submitted to this examination. Therefore, the only possible structure capable of creating heat in an abnormal manner at the time of examination was the thoracolumbar muscle.

Cold spots occurred in cases of dorsal intervertebral osteoarthritis, which causes local pain without causing an inflammatory reaction at the lesion location.9 Some authors9,18 contradict this statement, classifying only hot spots as active, that is, as causes of pain. In view of the fact that lesions of these articulations were only found in the lumbar region, clearly a predominance of cold spots occurs in this location.

For the exact location of hot and cold spots, adhesive tape was used. No reports of similar lesion marking methods were found in the literature, with no description of any such technique. Thus, thermography presented a great potential as an auxiliary in back pain diagnosis, because it quickly reveals the presence or absence of alterations in this region, whether inflammatory or degenerative.

Desmitis of the supraspinous ligament was visualized as areas of diminished echogenicity and loss of fiber parallelism in this ligament.12 Another finding related to supraspinous desmitis in some cases was the presence of points of increased echogenicity in the ligament, indicating the presence of tissue fibrosis in certain areas; as presented in the suspensory ligament of the fetlock joint,18 an occurrence that was not described by some authors.8,12

In the case of the interspinous ligament, images were obtained in longitudinal scans. The lesions found in this ligament were especially characterized by increased echogenicity and the presence of hyperechoic points. In some cases, visualizing diminished interspinous space and even the loss of this space was possible.12

In the case of articular processes, use of a sectorial transducer of 3.5 MHz or 5.0 MHz to obtain images of

Figure 7. Ultrasonographic image of interspinous desmitis, showing increased dorsal echogenicity and hyperechoic foci in the ligament. Arrows indicate the lesion location. Longitudinal view. CR—cranial; CA—caudal.
This finding reaffirms the fact that kissing spines is often a subclinical condition found in asymptomatic horses. Considering the cold spots, a correlation between the thermographic and ultrasonographic findings occurred. All horses that exhibited diminished surface temperature have associated lesions found by ultrasonography. Dorsal intervertebral osteoarthritis was the lesion found and considered as the cause of this type of alteration in the thermal pattern, which led indirectly to diminished surface temperature by action on the vasomotor tonus, causing a local vasoconstriction. Haussler et al, Leclaire et al, and Denoix stated that intervertebral osteoarthritis is the greatest cause of back pain in horses. Taken as stated, this declaration suggests that the greater part of the lesions found in this articulation were active, thus causing pain to the horse. In contrast, in the current study, all horses that showed ultrasonographic alterations in this articulation also presented cold spots in this structure is recommended by authors. However, performing a complete examination of this articulation with a 7.5-MHz linear transducer was possible.

The findings obtained by thermography could be correlated to those obtained by ultrasonography, as previously described for cases of tendonitis. In the case of hot spots, all of them possessed an associated lesion identified with ultrasonography, but not all the lesions that could lead to diagnosable increased surface temperature, such as supraspinous and interspinous desmitis, were detected with thermography. This was probably because the non-indicated lesions showed images compatible with chronic inactive processes, as also described in studies with Thoroughbred racing horses.

Another case in which thermography did not reveal the presence of a lesion was in the kissing spines, found in four horses examined here. In these cases, the lesioned area presented no thermographic alteration whatsoever. Figure 8. Ultrasonographic image of kissing spines, where the continuity between the bone line of two adjacent spinous processes can be observed, indicated by the arrow. Longitudinal view. CR—cranial; CA—caudal.
Figure 9. Ultrasonographic image of dorsal intervertebral osteoarthritis, showing the irregularity of the cranial and caudal articular process, with loss of articular space. (R) right; (L) left; (white arrow) articular space; (red arrow) lesion. Transverse view.

Figure 10. Relationship between the number of hot spots found in the thermography examination and the number of lesions found in the ultrasonography examination.
their thermal maps, demonstrating that all the lesions were active.12

Regarding athletic activity, in the current study a relationship could be established between the sporting modality practiced by the horse and the lesions found. In horses that competed in cutting, the lesion showing highest incidence was supraspinous desmitis, followed by dorsal intervertebral osteoarthritis. The prevalence of these lesions can be explained by the type of movement performed by the horse and in the way this movement altered the vertebral column biomechanics in these horses.21 In this sport, the horse adopts a position of forced ventriflexion throughout almost the entire period of competition. This position increases tension in the supraspinous ligament and on the dorsal intervertebral articulations of the lumbar region, principally from L4 onward. This would explain the findings from this study showing a majority of the osteoarthritis lesions in articulations of the caudal lumbar region.

In horses competing in three-barrel racing, the infirmities of greatest incidence were dorsal intervertebral osteoarthritis and interspinous desmitis. In this modality, lateroflexion and rotation movements are more frequently realized by the horse. These movements act directly on the dorsal intervertebral articulations, principally in the lumbar region because of its characteristic configuration in this region, and on the interspinous ligaments, which, during the axial rotation movement, suffer increased tension force.15 The articulations affected by osteoarthritis are predominantly located in the lumbar region between L1 and L3, because rotation and lateroflexion movements act principally on the cranial lumbar vertebrae, whereas from L4 or L5 the vertebrae are stabilized by intertransverse articulations.15

For horses competing in reining, it was difficult to draw a concise relationship between the alterations in the biomechanics of the horse caused by the movement during competition and the lesions found, because only four horses were examined, but these animals show a tendency to present supraspinous desmitis and Longissimus dorsi muscle lesions. This prevalence can be associated with movements made during competition, where the horses repeatedly perform dorsoventriflexion (slide) and lateroflexion (spin). These movements increase tension on

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(-) normal; (+) mild; (++) moderate; (+++) severe.
the supraspinous ligament and dorsal intervertebral articulations, respectively, based on thoracolumbar biomechanics,15,22 which could explain the incidence of these two lesions in these horses. Occurrence of muscular lesions can be associated with the fact that the competing time for reining is relatively long with repeated movements, as previously noted, which leads to an overloading of the thoracolumbar musculature, principally the epaxial muscles, which provide stability to the vertebral column during ventriflexion movement.1,15

In conclusion, when analyzing the results obtained under the conditions of this study, thermography and ultrasonography associated with a physical examination proved to be a rapid and efficient method for diagnosis of existing lesions in the thoracolumbar region. In addition, it was found that the sporting event practiced by a horse and the type of lesion present in the thoracolumbar region are related.

REFERENCES