**Tricks and tips in equine musculoskeletal ultrasound**

Ultrasound is well established in equine general practice since several decades as a clinical imaging modality in the diagnosis of musculoskeletal disease. B-mode ultrasound is routinely used for the diagnosis of tendon, joint and muscle damage. This presentation will aim to explain ultrasound developments and their use, as well as tips and tricks to improve the veterinarian’s ability to detect equine musculoskeletal injuries.

In the last years, ultrasound has continued to technically advance, extending into higher frequencies and taking advantages from tissues harmonic phenomena, the use of compound imaging and beam steering. Harmonic ultrasound leads to better contrast resolution and improved tissue interface discrimination and its now available on large range of ultrasound machines. Compound imaging and beam steering have been created to overcome anisotropy. Beam steering can be used in musculoskeletal ultrasound to better distinguish between hypoechoic patterns of pathological value and fibres bundles oriented in a different plane, but also to obtain an orientation of the ultrasound beam perpendicular to the bone for the assessment of enthesopathies io to better distinguish artefacts form meniscal damage. The use of beam steering is particularly interesting in assessing the origin of the suspensory ligament, in the stifle (for the menisci but also for the condylar surface in flexion) and in the foot (as perpendicularity of the ultrasound beam to the anatomical structures is difficult to achieve).

Doppler imaging is routinely used in musculoskeletal ultrasound in humans and intratendonous Doppler signal is considered correlated to painful tendinopathies. Doppler has tremendously increased its sensitivity with the technological evolution, and it is now able to detect low flow in small vessels (which is particularly useful in the assessment of tendon and synovium vascularity) in a large range of ultrasound machines. Although in horses the use of Doppler is relatively recent, the spread of portable ultrasound machines allowing a Doppler examination has increased its availability in equine practice. The Doppler examination should be realized on the non-weight-bearing limb as the anatomical structures under tension increase the stretching of the intratendonous vessels impairing their visualization. Normal tendons and ligaments do not show Doppler signal when they are normal at B-mode. However, tendons with sub-clinical B-more abnormalities can show minimal Doppler signal. Doppler signal will increase in presence of clinically significant tendon and ligament injury and will be higher in more severe and more recent damage. Power Doppler is more sensitive than Color Doppler and should be used for musculoskeletal structures. Doppler settings should be optimized for low flow with the lowest possible pulse repetition frequency and the lowest possible wall filter. The Color gain should be set just below the noise level. The focus should be placed where the highest sensitivity is required or just below the region of interest. The colour box should be placed on the entire section area of the anatomical structure to be examined.

Practical and technical tips and tricks make also use of non-weight bearing position, movement or anisotropic property of tendons and tissues to overcome the difficulties in the assessment of particular anatomical regions. Non weight-bearing position is used in several situations as for the assessment of the cranial aspect of the stifle or the proximal suspensory ligament. At the cranial aspect of the stifle, examination of the flexed joint is necessary to image the menisco-tibial ligament, the cranial horns of the menisci and the femoral condyles, otherwise inaccessible on the weight-bearing limb. In the examination of the suspensory ligament, because the width of its proximal portion is larger than the flexor tendons in fore and hindlimbs, its outer portions and margins can be easily missed if the exam is performed on the weight-bearing limb. In contrary, in the flexed limb, because the suspensory ligament can be approached slightly palmaro(plantaro-)medially or palmarolaterally (in the forelimb) and the flexor tendons displaced with the probe on the opposite side, the probe will be closer to the proximal suspensory ligament and the skin-probe contact will be on a larger surface resulting in a better visualization of the entire surface of the ligament on transverse sections.

To exploit anisotropy, the use of the so-called “angle contrast ultrasound technique” has also been proposed to allow the differentiation of regions of tendinous fibres from adipose tissue and muscle in the proximal suspensory ligament. This technique consists in imaging the anatomical structures using a nonperpendicular ultrasound beam to use the anisotropic properties of tissues. Because anisotropic properties of tendon and ligament fibres differ from that of adipose tissue and muscle, muscle and adipose tissue will not appear to have the same echogenicity than tendon fibres. Tendon echogenicity is in fact angle dependent and tendon fibres will become hypoechoic when the ultrasound beam is not perpendicular to them. In contrary muscle and adipose tissue echogenicity are respectively less and not modified depending on the beam angle. The result will be the ability to differentiate the hypoechoic tendinous part of the proximal suspensory ligament form the echogenic muscular/adipose bundles when the structure is imaged using a non-perpendicular beam angle. Using the angle contrast ultrasound technique, changes in echogenicity and architecture in the proximal portion of the suspensory ligament may be better identified by assessing the relative position of the hypoechoic fibrous portion of the ligament and the echogenic musculo-adipose bundles on the flexed limb. In fact, the increase in size of the affected fibrous area will produce a relative enlargement of the hypoechoic portion of the section surface and will induce compression and displacement of the adjacent echogenic bundle.

Finally, thanks to the real-time abilities of ultrasound, movement can be used to better explore mobility of structures and content of cavities, for example at the palmar/plantar aspect of the fetlock for the sliding of flexor tendons and for the detection of the ruptures of the manica flexoria.

**References**

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