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Ultrasonographic examination of the foot and fetlock in horses
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Introduction
Ultrasonography is now systematically associated to radiography in the routine evaluation of every horse presenting foot or fetlock lamenesses.

Ultrasonographic examination of the foot
Deep digital flexor tendon (DDFT) lesions and collateral ligament (CL-DIPJ) injuries of the distal interphalangeal joint are often considered in the differential diagnosis of foot problems without or with radiographic findings. The diagnosis of collateral sesamoidean ligaments (CSL) and distal sesamoidean ligament (DSL) can be achieved and documented with ultrasonography.

Ultrasonographic technique
Examination of the podotrochlear apparatus (PTA: distal sesamoid bone-DSB and associated ligaments, DDFT and podotrochlear bursa) is performed with two approaches. The proximalpalmar aspect of this apparatus is examined on sagittal and parasagittal sections as well as transverse oblique sections using a 7.5 MHz microconvex probe placed at the most distal part of the pastern. Examination of the distopalmar aspect of the PTA is performed with a 5 to 7.5 MHz convex probe through the frog to image the DSB, distal sesamoidean ligament-DSL, DDFT and distal surface of the distal phalanx (P3). The CL-DIPJ are imaged at the dorsolateral and dorsomedial aspects of the coronet in transverse and longitudinal sections using a 7.5 MHz linear probe.

Deep digital flexor tendinopathies
a- Suprasesamoidean lesions
Suprasesamoidean DDF tendinopathy can be diagnosed using a palmar approach of the foot, proximal to the heels. Abnormal ultrasonographic findings include: thickening of the tendon (compare the 2 symmetrical limbs), asymmetrical size and shape of the 2 lobes of the DDFT, irregular dorsal border of the tendon, changes in echogenicity (hypoechogenic images are found in recent lesion or are indicative of granulation tissue; hyperechogenic images are induced by scar tissue, dystrophic mineralisation, calcification or even bone metaplasia), alteration of the fiber pattern as demonstrated on parasagittal images.

Synovial fluid distension or chronic proliferative synovitis of the podotrochlear bursa is frequently (but not always) associated to DDFT injuries.

b- Infrasesamoidean lesions
Infrasesamoidean DDF tendinopathy can be diagnosed using a transcuneal approach through the frog. Abnormal findings include: thickening of the tendon (compared to the opposite limb), changes in echogenicity, alteration of the fiber pattern, bone remodeling (osteolysis, enthesophyte production) of the flexor surface of P3 if a distal enthesopathy is also present.

Collateral sesamoidean desmopathies
Abnormal findings indicative of CSL desmopathy are: thickening of the ligament (compared to the contralateral limb), asymmetrical size and shape of the 2 (lateral and medial) parts of the ligament, changes in echogenicity: hypoechogenic images are found in recent and chronic lesions; hyperechogenic images casting acoustic shadow are induced by

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dystrophic mineralization, bone metaplasia or old avulsion fractures. Synovial fluid distension or chronic proliferative synovitis of the distal interphalangeal joint and/or podotrochlear bursa are sometimes seen with CSL injuries.

**Distal sesamoidean desmopathies**

The DSL can be imaged using a transcuneal approach through the frog. Abnormal findings indicative of DSL lesions are: thickening of the ligament (compared to the opposite limb), hypoechogenicity and alteration of the fiber pattern, bone remodeling (osteolysis, enthesophyte production) of the flexor surface of P3 (distal enthesopathy) and/or of the distal border of the DSB (proximal enthesopathy).

**Collateral desmopathies**

Ultrasound examination of the CL-DIPJ is performed using dorsomedial and dorsolateral approaches of the coronet using longitudinal and transverse sections made with 7.5 or 10 MHz linear probes.

Abnormal ultrasonographic findings indicative of the CL-DIPJ desmopathy include, thickening of the injured ligament inducing alteration of the skin profile, alteration of echogenicity compared to the opposite sound one of the same limb or the homologous one of the normal limb (hypoechogenic images can be seen in acute and chronic desmopathies, hyperechogenic images casting acoustic shadows are indicative of avulsion fractures), alteration of the fiber pattern (the fiber pattern of the ligament is lost in acute lesion and altered in chronic or old desmopathies), bone changes at the insertion sites including enthesophyte production, osteolysis and avulsion fractures. All these abnormal findings are more easily detectable on transverse than on longitudinal sections. Synovial fluid distension of the DIPJ dorsal recess is also present in most cases.

**Ultrasonographic examination of the fetlock**

**Introduction**

Soft tissue and articular surface injuries of the equine fetlock are common in sport and race horses. With ultrasonography a specific diagnosis of the involved structures can be made.

**Dorsal lesions**

Several lesions can induce deformation/ enlargement of the dorsal aspect of the fetlock. The most superficial include skin injuries, subcutaneous connective tissue lesions (cellulitis, hygroma, abscess), subcutaneous fibrosis and dorsal metacarpophalangeal fascia lesions. Traumatic tendinopathy of the dorsal (or long) digital extensor tendons and/or subtendinous bursitis also induce dorsal fetlock deformation.

Deeper, articular soft tissues injuries such as capsulopathy, synovial fluid distension with or without synovial membrane proliferation and chronic proliferative synovitis can be diagnosed on fetlocks with dorsal enlargement.

Ultrasonography is also very sensitive to any articular margins and surfaces alterations. Osteophytes and periarticular bony fragments (ostechondral fragments or chip fractures) are easily detectable at the proximal articular margin of the proximal phalanx. The metacarpal (metatarsal) condyle is examined on the weight-bearing limb and on the flexed joint. Subchondral bone defects of the sagittal ridge and collateral parts of the condyle (fragmentation, subchondral bone cyst, erosion or flattening) and articular cartilage degenerative changes can be diagnosed.

**Collateral aspects of the fetlock**

Recent desmopathies of the superficial and/or deep layers of the collateral ligament of the fetlock induce regional enlargement. Ultrasonographic findings include: thickening, loss of echogenicity and alteration of the fiber pattern on longitudinal sections. Old or chronic desmopathies can be found with little deformation. The echogenicity is mildly altered and
the architecture pattern is coarse. Collateral enthesopathy with or without bony avulsion can be seen at the metacarpal (metatarsal) or phalangeal insertions. When a collateral ligament is completely ruptured with fetlock luxation, hemorrhage and edema diffuse in adjacent connective tissue.

As mentioned previously, ultrasonography is very sensitive for the detection of periarticular osteophytes and osteochondral fragments over the metacarpal (metatarsal) and phalangeal articular margins. Osteolysis (collateral enthesopathy) and collapse of the metacarpal (metatarsal) condyle are also easily documented.

**Collateropalmar (plantar) aspect of the fetlock**
Several findings of the proximopalmar (plantar) recess of the fetlock joint can be seen between the metacarpal (metatarsal) metaphysis and the distal branch of the third interosseus muscle; they include: synovial fluid distension with or without echogenic material (debris, septic arthritis, hemorrhosis) and synovial membrane proliferation or hyperemia.

Third interosseus distal (distal branch) enthesopathy is a common condition in front and hind limbs. Five ultrasonographic changes are present: thickening, alteration of echogenicity, disrupted architecture pattern, bone surface alteration (enthesophytes, avulsion fracture, osteolysis…) and peritendinous fibrosis.

**Palmar (plantar) aspect of the fetlock**
Tenosynovitis of the digital sheath with synovial fluid effusion and chronic thickening of the synovial membrane and plica is the most common condition of the palmar (plantar) aspect of the fetlock. The palmar/plantar annular ligament is distended by the excess of synovial fluid. The objective of the ultrasonographic examination is to identify the cause of these changes (tendinopathy of the deep digital flexor tendon, of the manica flexoria, desmopathy of the sesamoidean ligaments…).

Palmar/plantar (intersesamoidean) desmopathy, enthesopathy or rupture are significant condition of the fetlock inducing lameness.

**Discussion**
With ultrasonography several different lesions responsible for foot pain in horses can be diagnosed allowing a specific management. The severity and evolution stage of the lesion can be assessed improving the monitoring of each condition. An essential part of the treatment is based on corrective shoeing combined with the use of adequate footing and exercise programme.

A precise evaluation of the soft tissues, articular margins and surfaces of the equine fetlock can be performed with this imaging modality. The differential diagnosis of distension of the dorsal aspect of the fetlock, and of tendinous, ligamentous, capsular and synovial lesions of the metacarpo/metatarsophalangeal joint can be achieved.