Proceedings of the
10th International Congress of World
Equine Veterinary Association

Jan. 28 – Feb. 1, 2008 - Moscow, Russia

Next Congress:
WEVA 2009 Congress
Guanujá-SP, Brazil. September 24-27, 2009

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DIAGNOSIS OF FEMOROTIBIAL INJURIES IN HORSES

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Summary:
The stifle joint presents a lot of soft tissues that cannot be imaged with radiography. Therefore, the use of ultrasonography to examine this joint may provide useful complementary information that can be essential for the diagnosis and management of many stifle conditions.

The purpose of this paper is to present the ultrasonographic technique to image the ligaments and tendons of the femorotibial joint, to show the reference ultrasonographic images and to present the main clinical conditions that can be diagnosed with this technique. The use of ultrasonography has considerably improved the diagnosis and knowledge of ligament and tendon injuries in the stifle.

Introduction
Injuries of the equine stifle are frequent causes of hind limb lameness. The femorotibial (FT) joint is an underestimated site of lesions causing lameness. Examination with radiography has tremendous limitations because of the number of soft tissues that cannot be seen with this procedure. The interest of ultrasonography in the diagnosis and management of stifle injuries has been demonstrated (Denoix et al 1993, Dik 1995, Denoix 1996). This easy and non invasive procedure can be easily performed in the field with portable machines (Denoix and Audigié 2003, Hoegaerts et al 2005).

The specific purposes of this paper are to present the technique and reference ultrasonographic images of the FT joint, and to show the main clinical conditions that can be diagnosed with this modality.

Indications
Indications for performing imaging evaluation of the stifle in clinical cases are based on the results of physical, dynamic examination, diagnostic analgesia and/or scintigraphic examination. In this process, ultrasonography is now systematically associated to radiography. Therefore, this procedure is used in a lot of cases presented with:
- synovial fluid distension, local deformation,
- pain to mobilisation during flexion or retraction of the hind limb,
- positive intraarticular analgesia with or without radiographic findings,
- radiographic findings such as subchondral bone cyst, femorotibial collapse or instability,
  to check for associated soft tissues injuries,
- positive findings on scintigraphic images.

Technique
The basic equipment is composed of a 7.5 MHz linear probe to image the superficial elements, a thin acoustic pad and a printer. Three to 5 MHz convex or sector probes are required to examine the caudal aspect of the joint. Preparation of the area includes clipping of the hair, washing the skin with hot water and application of acoustic gel.

Routine examination of the FT joint is made on the limb bearing weight as well as on the flexed joint. Operator comfort is improved if a rolling seat is used for examination of the cranial, medial and lateral aspects of the joint. The operator is placed behind the limb to examine the caudal aspect of the stifle; therefore, the horse’s behaviour should be carefully evaluated before performing this approach.
Reference images

The body (intermediate part) of the medial meniscus (MM) is homogeneously echogenic when the probe is perpendicular to its medial surface; it is in direct contact with the medial collateral ligament (MCL) (Fig 1). As it is deeper, the lateral meniscus (LM) is less echogenic; it is separated from the lateral collateral ligament (LCL) by the proximal tendon of the popliteus muscle (Denoix 2003a). The two collateral ligaments can be imaged on longitudinal and transverse sections from their proximal attachments on the femoral condyles to their distal attachments (Coudry and Denoix 2005). As its fibers are parallel, the MCL is more homogenous than the LCL. The normal articular margins of the femoral condyles and tibial plateau are smooth and regular (Denoix 1996). The medial recess of the MFT joint is located proximally to the MM (Fig 2a), between the MCL and the medial patellar ligament (MPL). On normal horses there is no synovial fluid in the subextensorius recess of the LFT joint. The proximal common tendon of the peroneus tertius and long digital extensor muscles begins in the extensor fossa of the femur and slides inside the extensor sulcus of the tibia (Barone 1989). In its proximal part, it presents a round and ovale shape on transverse section. At the caudal aspect of the stifle, the proximal part of the superficial digital flexor muscle can be imaged as an heterogenous linear structure inserted in the supracondylar fossa of the femur and covered by the gastrocnemius muscle.

Abnormal findings and lesions

1- Medial femorotibial joint

- Medial recess of the femorotibial joint

The medial recess of the MFT joint can be considered as the mirror of the femorotibial joint as its size and content are influenced by every lesions of this joint. A wide variety of abnormal findings of this recess can be observed (Denoix 2003), in relation with different types of FT lesions, such as:
- synovial fluid effusion,
- chronic proliferative synovitis (Fig 2b),
- echogenic spots compatible with fibrine, cartilaginous or meniscal debris,
- hemorrhaxis,
- osteochondral fragments and calcinosis circumscripta.

The caudal recess of the MFT joint can be examined with 3 to 5 MHz sector or convex probes. Distension of this recess is always indicative of severe femorotibial arthropathy.

- Medial collateral ligament

Medial collateral desmopathy is not a rare condition in horses (Coudry and Denoix 2005). As this ligament is subcutaneous and presents parallel fibers, this diagnosis is easy with ultrasonography and is much more reliable than with mobilisation tests. Lesions of this structure can be found alone but are also frequently associated with other injuries. They include:
- acute rupture (with hemorrhaxis and/or avulsion fracture) with instability of the FT joint (Dik 1995);
- subacute lesion with or without avulsion fracture of other ligaments such as the caudal cruciate ligament;
- chronic lesion with secondary degenerative joint disease of the FT joint.

- Medial meniscus

Meniscal injuries can be observed alone or in association with other ligaments or condylar injuries (Denoix 2003b). In our patients, more than 80% of these lesions are found in the MM and less than 20% in the LM (Denoix and Lacombe 1996). Relatively more lesions of the LM are found in young horses.

A wide range of variety and severity of MM injuries can be observed in horses:
- acute lesions found in the intermediate part of the meniscus (body) following trauma to the stifle or fall;
- progressive degenerative lesions with hypoechogenic fiber disruption (Fig 2b) and increased cellularity as well as medial prolapsus found in horses with slowly progressive degenerative joint disease of the FT joint;
- hyperechogenic material casting acoustic shadow found in the body as well as horns of the...
MM, is indicative of focal mineralisation and has been observed in young as well as adult horses;
- collapsus (Dik 1995) and prolapsus of the MM are usually indicative of severe degenerative changes of the FT joint.

When the stifle is examined in flexion the cranial attachment of the MM in the cranial intercondylar area of the tibia can be imaged (Coudry and Denoix 2004). Cranial enthesopathy of the MM can be suspected when alteration of the bone surface profile, heterogenous appearance of this cranial ligament and local synovial fluid distension are present.

- **Articular margins**
  A complete examination of the articular margin of the medial femoral condyle is possible when moving the probe vertically in a caudocranial direction (Denoix 1996). This procedure is more sensitive than radiography to detect periarticular osteophytes in this particular location. When marginal modeling is severe it can produce secondary trauma on the MM and mechanical interference with it (Fig 2b).

- **Articular surfaces**
  The cartilage and subchondral bone surface of the femoral condyles can be imaged when the stifle is held in flexion (Jacquet *et al* 2004). Alteration of the subchondral bone surface profile and echogenicity can be diagnosed (Fig 3). The diagnosis of subchondral bone cysts can be made with ultrasonography and this technique is more sensitive than radiography to small alterations of the subchondral surface (Jacquet and Denoix 2007).

### 2- Lateral femorotibial joint

- **Lateral collateral ligament**
  Lateral collateral desmopathy is a quite rare condition in our clinical cases (Coudry and Denoix 2005).

- **Lateral meniscus**
  Lateral meniscal injuries can be observed alone or in association with other ligaments or condylar injuries (Denoix and Audigié 2003). They are usually found in the cranial horn and consist in cleavage, fissuring or laceration (tear). Traumatic injuries of the body of the LM were found in association with MCL rupture (Denoix and Lacombe 1996). Progressive degenerative injuries were found alone or associated with subchondral bone lesion of the lateral tibial or femoral condyles.

- **Recesses of the lateral femorotibial joint**
  Synovial fluid distension of the subextensorius recess of the lateral femorotibial joint can be observed in either lateral femorotibial arthropathy or femoropatellar lesions. Synovial fluid effusion of the cranial recess of the lateral FT joint can be found in the infrapatellar fat pad close to the intermediate patellar ligament.

### 3- Cruciate ligaments injuries

Diagnostic imaging of cruciate ligaments injuries is still difficult and ideally requires combination of radiography, ultrasonography and nuclear scintigraphy.

- **Crannial cruciate ligament (CrCL)**
  Ultrasonographic imaging of the CrCL is a technical challenge and can be done with a 5MHz convex probe. The tibial part can be seen when the stifle is in flexion and the probe located cranial to the lateral femoral condyle (Fig 4). The femoral attachment can be imaged with a caudal approach, the probe being placed at the caudomedial aspect of the thigh.

- **Caudal cruciate ligament (CdCL)**
  Ultrasonographic imaging of the CdCL is also difficult and can be done with a 5MHz convex probe. The femoral part can be seen when the stifle is in flexion and the probe located at the lateral aspect of the FT joint. The tibial (caudal) part can be investigated with a caudal approach, the probe being placed at the caudal aspect of the thigh.

### 4- Tendon injuries

- **Proximal common tendon of the peroneus tertius and long digital extensor muscles**
  Proximal enthesopathy of this tendon has been diagnosed in young and adult horses. Various abnormal findings have been seen, including: distension of the subextensorius recess of
the LFT joint, thickening of the tendon, hypoechoic images with architectural changes, bone remodeling of the extensor fossa of the femur and avulsion fractures. Enlargement of this tendon may predispose to luxation out of the sulcus extensorius of the tibia when the stifle is flexed and this can be documented ultrasonographically.

- **Proximal tendon of the superficial digital flexor muscle**
  A proximal enthesopathy of the superficial digital flexor muscle has been identified in a polo horse. Bone remodeling of the supracondylar fossa of the femur, thickening of the tendon and hypoechoic images with architectural changes were present.

5- Limitations
Ultrasoundography is a very informative technique in the diagnosis of stifle injuries (Denoix et al 1993, Dik 1995) and is now routinely used in combination of radiography. Though most of the soft tissues of the FT joint can be imaged with ultrasonography, the intermediate part of the cruciate ligaments cannot be imaged adequately because of their orientation and their location in the intercondylar fossa of the femur. Besides, the caudal attachments of the menisci and meniscofemoral ligament are difficult to image completely because of their orientation and location deep to the caudal femoral muscles.

Discussion and conclusions
When a problem is identified in the stifle during the clinical examination or scintigraphic examination, radiography remains essential for the diagnosis of osteoarticular lesions. Ultrasonography is a valuable adjunct to clinical and radiographic examination (Denoix and Audigié 2003) especially in horses presenting a diffuse swelling or a localised enlargement. When radiographic findings are present, a complementary evaluation with ultrasonography permits to demonstrate associated soft tissue injuries and to precise the location and nature of bony lesions (Denoix 1996, Denoix 2003). In a lot of clinical cases with normal radiographs, soft tissue injuries and/or superficial bone lesions can be identified ultrasonographically.

References


Figures

Fig. 1: Cranial aspect of the left femorotibial joint showing the menisci and ligaments.
1- Medial femoral condyle; 2- Lateral femoral condyle; 3- Tibial tuberosity; 4- Medial meniscus; 5- Medial collateral ligament; 6- Lateral meniscus; 7- Lateral collateral ligament; 8- Cranial cruciate ligament; 9- Caudal cruciate ligament

Fig. 2a: Frontal anatomical section of the medial femorotibial joint (medial part).
1- Medial femoral condyle; 2- Medial tibial condyle; 3- Medial meniscus; 4- Medial recess of the medial femorotibial joint.

Fig. 2b: Frontal ultrasonographic section of the medial femorotibial joint using a craniomedial approach and showing 3 abnormal findings: a chronic synovitis with thickening of the synovial membrane, a degenerative medial meniscus, a high osteophyte at the medial border of the medial femoral condyle (arrow-head).
1- Medial femoral condyle; 2- Medial tibial condyle; 3- Medial meniscus; 4- Medial recess of the medial femorotibial joint.

Fig. 3: Imaging of the stifle of a 20-month-old Thoroughbred. (Photo is not submitted)
Fig. 3a: Caudocranial radiographic view of the stifle showing a wide subchondral bone cyst (arrow-heads) in the medial femoral condyle.

Fig. 3b: Parasagittal ultrasound section of the medial femoral condyle made on the flexed stifle. A wide subchondral bone defect (arrow-head) can be seen.
   1- Subchondral bone surface; 2- Articular cartilage; 3- Infrapatellar fat pad
Fig. 4: Imaging of the stifle of a 2-year-old Thoroughbred. (Photo is not submitted)

Fig. 4a: Caudolateral radiographic projection of the stifle showing a bone fragment (arrow-head) in the intercondylar fossa of the femur.

Fig. 4b: Frontal ultrasound image of the femorotibial joint made on the flexed stifle. The hyperechogenic bone fragment (arrow-head) can be seen within the cranial cruciate ligament.

1- Medial femoral condyle; 2- Lateral femoral condyle; 3- Lateral meniscus; 4- Cranial cruciate ligament; 5- Fluid distension of the lateral femorotibial joint.