Dr Hans Wilderjans,
Dipl ECVS

Dierenkliniek De Bosdreef
Spelonckvaart 46
9180 Moerbeke-Waas
Belgium
www.bosdreef.be

info@bosdreef.be

APPROACHES TO THE DISTENDED DIGITAL FLEXOR TENDON SHEATH

During this lecture the most common findings during tenoscopy of the digital flexor tendon will be discussed. In warmblood horses the most common lesion is a longitudinal tear in the lateral border of the deep digital flexor tendon (DDFT). We will discuss the treatment, the outcome and problems we are facing in the healing of those lesions.
The prognosis for full athletic recovery long term is still poor (< 50 %) despite more than 10 years experience in diagnosing and treating them. We will discuss where we are now in the treatment and where we want to go in the future.

Non-infected tenosynovitis of the digital flexor tendon sheath (DFTS) is a common finding in warmblood horses especially in show jumpers. Chronic inflammation of the DFTS can lead to constriction of the annular ligament. In our hospital case-load, almost 80% of horses suffering from a unilateral chronic distension of the DFTS in a front limb, a longitudinal tear or marginal cleft in the border of the deep digital flexor tendon is the primary source of inflammation and subsequent distension.

DDFT lesions within the digital flexor tendon sheath (DFTS) are almost always associated with chronic (non-infected) tenosynovitis. The most common presentation of DDFT lesions within the DFTS, are longitudinal tears in the lateral border of the DDFT (Wright and McMahon EVJ, 1999, Wilderjans et al. EVJ, 2003, Smith and Wright EVJ 2006, Arensburg and Wilderjans 2011 EVJ *Equine vet. J.* (2011) **43** (6) 660-668).
Central core lesions, dorsal or palmar/plantar lesion in the DDFT are also diagnosed but are less common.

Other less common lesions that can cause tenosynovitis of the digital flexor tendon sheath are:
Manica flexoria (MF) tears, longitudinal and branch tears of the SDFT, desmitis of the palmar annular ligament (PAL) and tears in the DFTS.

Anatomy of the digital flexor tendon sheath:
The DFTS surrounds the SDFT and DDFT palmar or plantar to the fetlock joint. The DFTS starts 4 to 7 cm proximal to the proximal sesamoid bones and extends distally to the middle third of the middle phalanx. At this level a thin wall separates the DFTS from the proximal recess of the podotrochlear bursa and the proximopalmar recess of the distal interphalangeal joint (Denoix JM 1994).
The DFTS is surrounded by the PAL.
The **PAL** attaches on the palmar/plantar aspect of the sesamoid bones and creates an inelastic canal between the sesamoid bones, intersesamoidean ligament and the PAL.

The **digital manica flexoria** is a thinner sheet located in the pastern, dorsal to the DDFT and palmar/plantar to the straight sesamoidean ligament. There is a membranous and a tendinous type. Pathology is uncommon but a few cases are described and clinicians should be aware of the variations in order to perform a correct interpretations during ultrasound and tenoscopy.

More proximal in the fetlock canal, the SDFT encircles the DDFT forming a ring called the **manica flexoria (MF)**. The distal aspect of the MF is located underneath the PAL.

Proximal in the DFTS and underneath the MF the DDFT is attached to the tendon sheath wall by a medial and lateral band. This band is called the **mesotendon of the DDFT** (lateral and medial mesotendon). It can easily be recognised on a transverse ultrasound image especially if the tendon sheath is distended.
On the palmar aspect of the fetlock, the SDFT is also attached sagittaly (palmar/plantar midline of SDFT) with a mesotendon to the DFTS (Dik et al, 1995; Nixon 1990). This band, the mesotendon of the SDFT, can clearly be visualised on an ultrasound image of a distended DFTS when there is no important constriction of the PAL. The **mesotendon of the SDFT**, both medial and lateral mesotendon of the DDFT and the MF can also clearly be visualised by tenoscopy of the DFTS (Wright and McMahon EVJ 1999, Wilderjans et al. EVJ 2003) and are important reference points/landmarks when performing a tenoscopic inspections of the DFTS.

In the **pastern** there is also a mid sagittal **mesotendon** present connecting the palmar aspect of the DDFT with the DFTS. This one is also best visible when the tendon sheath is distended.

General comments on distended digital flexor tendon sheaths in warmblood horses.
Non-infected tenosynovitis caused by LTs are common in the warmblood show jumper. Longitudinal tears affect the forelimb more frequently than the hind limb and the right forelimb is more affected than the other limbs. Further information can be found in the paper from Arensburg and Wilderjans *Equine vet. J.* (2011) **43** (6) 660-668.
Smith and Wright 2006 also identified more marginal tears of the DDFT in the forelimb compared to the hind limb. LTs are caused by increased stress and trauma on the border of the flexor tendons.
Longitudinal tears will mainly affect the lateral border of the DDFT. Distension of the DFTS is almost always present but can disappear temporarily in acute cases with some rest or after treatment of the sheath with steroids.
Lameness is often very subtle or not present but there is, at some point, often a loss of performance and the rider is getting concerned about the permanent distension of the tendon sheath that becomes bigger in time.

A positive flexion of the fetlock joint is often present on an orthopaedic examination.
Distension of the tendon sheath is often best noticed proximal from the palmar annular ligament and in a lesser extend in the pastern between the proximal and distal digital annular ligament.
In acute cases the distension proximal to the palmar annular ligament is soft and fluctuating. In chronic cases the distension is firm, hard and painful on deep pressure of the DDFT just proximal to the annular ligament.

Ultrasound examination is the best non-invasive diagnostic tool to identify longitudinal tears in the border of the DDFT.
With growing experience and based on case history, clinical and ultrasound examination, an experienced examiner is able to diagnose LT's as the underlying cause of tenosynovitis in min. 80% of the cases.

In doubtful cases an MRI can be performed but this is often not needed and this money is often better spend on a diagnostic tenoscopy of the DFTS. The latter will enable us to make a diagnosis and meanwhile start a treatment.

Typical but non-specific changes on ultrasonographic examination of chronic distended DFTS's are:
- thickening of the tendon sheath wall
- increased synovial fluid
- thickening of the PAL
- thickening of the mesotendons of the DDFT
- thickening the soft tissue palmar/plantar to the SDFT (synovium, DFTS wall, PAL, subcutaneous tissue).

In acute cases only increased presence of synovial fluid is found without the thickening of the previous described structures.

Irregular outlining, hypoechoic lesions/lines and echogenic masses at the margin of the DDFT are strongly indicative for longitudinal marginal tears ($P < 0.001$)
These changes are often best visible on ultrasound, just proximal to the proximal border of the PAL and just distal to the mesotendon of the DDFT. At this level the DDFT is still surrounded by the MF. Slightly oblique views with the US probe, can help identifying the LT's.

Constriction of the PAL can be present in more chronic cases and is often a secondary problem in chronic long-standing tenosynovitis of the DFTS with LT's in the DDFT being the primary problem.
If on US, synovial fluid is present between the SDFT and the PAL, we consider the PAL not to cause constriction of the "fetlock canal". Only low pressure should be applied on the ultrasound probe to avoid pushing the PAL against the SDFT and to allow visualisation of this fluid.
Primary desmitis and constriction of the PAL is possible but a rather infrequent finding in our warmblood sporthorses.

Torn tendon fibrils protruding from the edge of the flexor tendons, as seen during tenoscopic inspection of a DFTS, always indicates the presence of a LT. However the tenoscopic appearance can vary from subtle fraying of the margin of the tendon to large pieces of torn tendon bundles floating in the irrigation fluid. In some cases a deep V shaped cleft can be found in the border of the DDFT.
Palpation of the tendon border and placing the arthroscope in the tear is necessary to appreciate the depth of the tear.

In some cases a large mass of tissue, called granulomata, is sitting in the distal end of the tear representing retracted and curled up tendon bundles often adhered to the surrounding synovial membrane. Those can be removed with a punch, rongeur and shaver.

Disrupted collagen fibrils protruding from the tendon are very likely to be an important cause of the chronic irritation of the DFTS, creating distension of the sheath and secondary changes like thickening of the sheath wall, synovial hypertrophy and annular ligament constriction syndrome (ALCS) in chronic cases.
Within a tendon sheath there are no mechanisms available that can remove disrupted collagen fibres (Wright and McMahon 1999). Removing those fibres are, for this reason, an important part of the treatment but the tendon is left to heal by second intention.
Suturing the tear is theoretically always a better option but no custom made instrument are available at this moment that allow suturing of the tendon through a scope portal.
An open approach and suturing the tear is an option but is more invasive with potential more scarring/fibrosis and loss of normal motion range. However this is a viable options and should be considered in good horses that do not respond to a tenoscopic approach.

PAL desmotomy can be performed when there is indication of constriction. PAL desmotomy is not free of complication and should be restricted to those cases showing clear signs of annular ligament constriction syndrome (ALCS).
We noted extensive adhesions between the sectioned PAL edge and the SDFT during tenoscopy of 2 cases that had PAL desmotomy before referral. We do not know if this is a common finding after PAL desmotomy and/or if it has any clinical importance.

Cutting the PAL is however important in chronic cases to decompress the fetlock canal and to reduce the pain.

Tenoscopy of the DFTS is the only way to confirm and accurately describe the morphology of the longitudinal tears. The length of the LT and the reduction of distension of the DFTS after the tenoscopic surgery will affect the outcome.

Horses suffering from long tears have a poor long term prognosis to return to previous level of work, ± 40% return to previous level of work regardless of what treatment has been performed (corticosteroid injections, surgery, stem cells, other biological treatments).

We found the following outcome in a long term follow up of 130 cases suffering from longitudinal tears in the DFTS:

38% return to an equal or higher level of work
27% return to a lower level of work
35% remains lame.

Our results are in accordance with the findings of Smith and Wright (2006) who reported 14 of 33 horses (42%) with marginal tears of the DDFT returning to previous level of work. Longer tears and horses operated after 15 weeks seemed to carry a worse prognosis. Early diagnosis and treatment seems to improve the final outcome.

Persistence of post-operative distension of the DFTS is normal but marked distension after surgery always indicates incomplete healing and increased chance of permanent lameness.

A long and controlled postoperative rehabilitation program is considered to be important in the final outcome of the cases. Controlled exercise is started 10 days after the surgery but return to normal work is often postponed until 8 months after surgery. In most cases clinical symptoms improved quickly after surgery but a final evaluation is only possible after resuming the intended work level.

Cooling the tendon sheath after each training and competition is strongly advised.

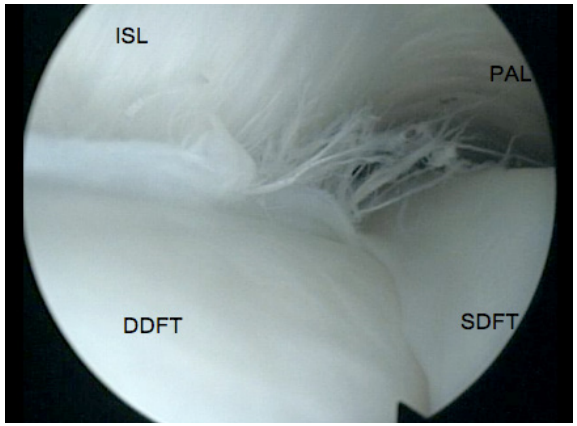
Intra-synovial treatment with PRP and/or stem cell do not seem to change the long term outcome.

It is important to note that even after a successful surgery the cosmetic result is seldom completely perfect. In most cases a firm non-painful distension will remain visible and palpable. The typical non-specific ultrasonographic changes will improve but never disappear completely.

Take home message:

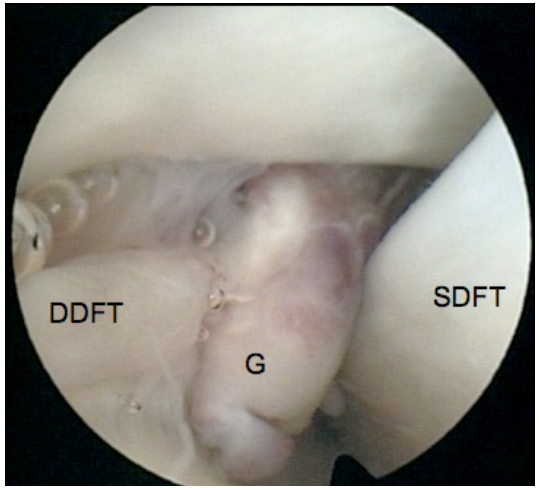
- Warmblood horses presenting with a unilateral distension of the digital flexor tendon sheath are often suffering from a longitudinal tear in the lateral border of the deep digital flexor tendon. Those horses are not necessarily lame in the acute phase.
- A concurrent constriction of the palmar annular ligament is a secondary lesion caused by the chronic synovitis in the digital flexor tendon sheath.
- The diagnosis is made by using ultrasonogrpahy and/or tenoscopy.
- Tenoscopic surgery is at this moment still the treatment of choice.
- In non-healing tears an open approach and suturing of the tendon can be performed to achieve primary healing of the tendon lesion.
- The prognosis for full recovery to previous level of work remains low (38% of the operated cases return to previous level of work).
- Intra synovial treatments with biological (PRP, stem cells, IRAP) do not improve the long-term outcome
- New treatment options need to be explored. A tenoscopic suturing of the LT in the DDFT would be the logic next step forward and will probably increase the chance of healing and improve the chance of returning to a sportive career.

Ultrasound picture of a LT in the lateral border of the DDFT at the level of the mesotendon of the DDFT. Note the typical ultrasonographic changes indicative of a LT: irregular lateral border of the DDFT (arrow), hypoechoic foci and/or echogenic mass (x) continuous with DDFT border.

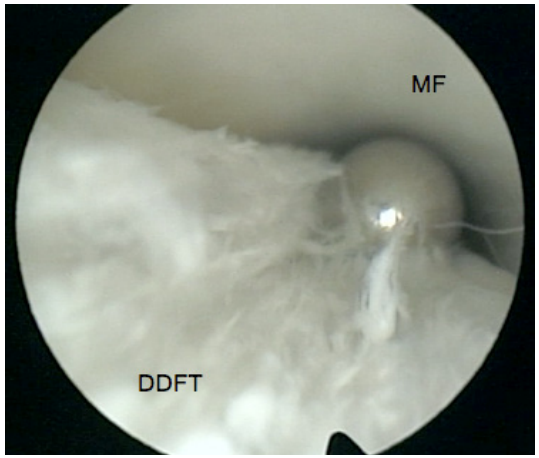


Typical view of a LT of the lateral border of the DDFT where it emerges from underneath the manica flexoria. Note the torn tendon fibres along the lateral edge of the DDFT.

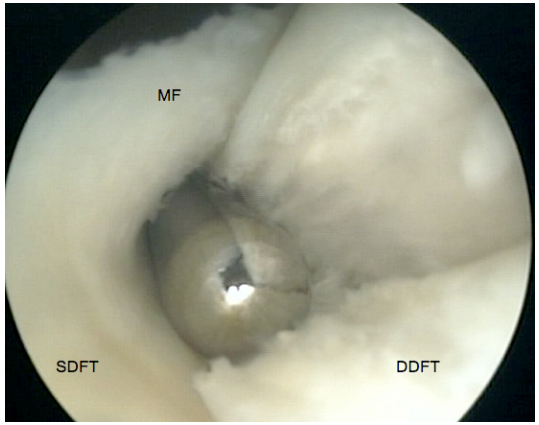
ORTHOPAEDICS



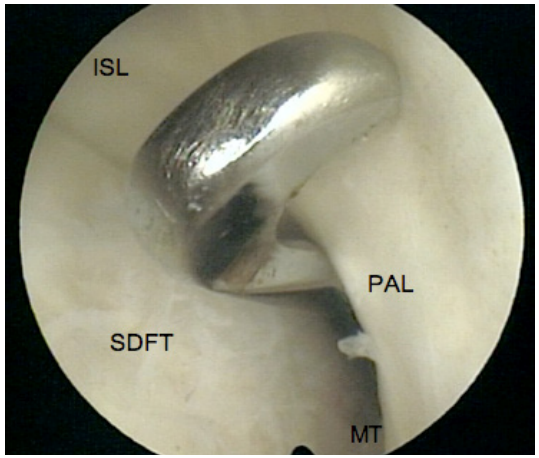
Torn tendon bundles curled up in the distal part of the tear forming granulomata (G) often adhered to the surrounding structures.



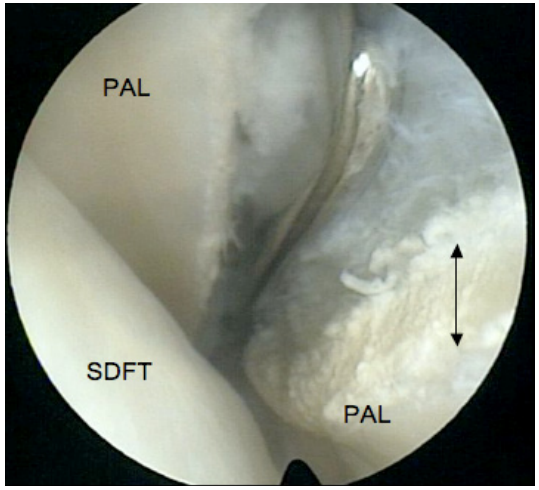
Tenoscopic view with the arthroscope positioned in the LT of the lateral edge of the DDFT. The bulk of torn tendon tissue is removed with a motorised synovial resector. MF : manica flexoria.



Shaver positioned in a deep V shaped tear (> 5 mm) in the lateral border of the DDFT. Note how the LT continues to more proximal underneath the MF.



Desmotomy of the palmar annular ligament (PAL) performed with a slightly curved custom made hook knife. The hook knife is positioned half way between the intersesmoidean ligament (ISL) and mesotendon (MT) of the SDFT. The curved angle of the shaft of the hook knife facilitates a good grip of the hook within the palmar annular ligament (PAL).



Desmotomy of the palmar annular ligament (PAL) in a distal to proximal direction. Note the thickening of the PAL (arrow) and how the edges of the cut PAL separate after cutting the PAL.

References

- **Denoix**, J.M. (1994) Functional anatomy of tendons and ligaments in the distal limbs (manus and pes). Vet. Clin.N.Am.: Equine Pract. 10, 273-322
- Dik, K.J., Dyson, S.J. and Vail, T.B. (1995) Aseptic tenosynovitis of the digital flexor tendon sheath, fetlock and pastern annular ligament constriction. Vet.Clin.N.Am.: Equine Pract. 11,151-162
- **Dyson SJ, Murray R, Schramme MC**. (2005) Lameness associated with foot pain: results of magnetic resonance imaging in 199 horses (January 2001--December 2003) and response to treatment. Equine Vet J. Mar;37(2):113-21.
- **Nixon**, A.J. (1990) Endoscopy of the digital flexor tendon sheath in horses. Vet. Surg. 19, 266-271.
- **Nixon**, A.J., Sacus, A.E. and Ducharme, N.G.(1993) Endoscopically assisted annular ligament release in horses. Vet. Surg. 22, 501-507.
- **Wright**, I.M. and McMahon, P.J. (1999) Tenosynovitis associated with longitudinal tears of the digital flexor tendons in horses: A report of 20 cases. Equine vet.J. 31, 12-18
- Smith, M.R.W. and **Wright**, I.M. (2006) Non-infected tenosynovitis of the digital flexor tendon sheath: a retrospective analysis of 76 cases. Equine vet.J. 38, 134-141
- **Wilderjans**, H., Boussauw, B., Madder, K. and Simon, O. (2003) Tenosynovitis of the digital flexor tendon sheath and annular constriction syndrome caused by longitudinal tears in the deep digital flexor tendon: a clinical and surgical report of 17 cases in Warmblood horses. Equine vet.J. 35, 270-275
- Arensburg Liat, **Wilderjans** Hans, Simon Olivier, De Wulf J, Boussauw B. (2010) Non-septic tenosynovitis of the digital flexor tendon sheath caused by longitudinal tears in the digital flexor tendons: A retrospective study of 135 tenoscopies, *Equine vet. J.* (2011) 43 **(6) 660-668**