Digital Sheath Synovial Ganglion Cysts in Horses

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Objectives: To report the clinical features of horses with fluid-filled masses associated with the digital flexor tendon sheath (DFTS) and outcome after surgery.
Study Design: Case series.
Animals: Horses (n = 10)
Methods: Medical records of horses with fluid-filled masses associated with the DFTS were reviewed and the clinical features, diagnostic methods, treatment, histopathology, and outcome reported.
Results: Masses were unilateral (7 hind limb, 3 front limb) and in 8 horses were associated with lameness. In 6 horses, lameness improved by $> 50\%$ with intrathecal DTFS anesthesia, whereas 2 were less positive but were further improved with perineural anesthesia just proximal to the cyst. Communication between the DFTS and mass was identified in all horses ultrasonographically. Resection of the mass resolved lameness in 7 horses. Histologically (5 specimens), the mass was characterized by a fibrous outer layer without a synovial lining, consistent with a ganglion cyst.
Conclusion: The histologic appearance of ganglion cysts suggests that they arise from trauma to the sheath wall and may subsequently be a cause of lameness.

The digital flexor tendon sheath (DFTS) is a thin-walled synovial cavity that extends from the level of the distal third of the metacarpal/metatarsal region to just proximal to the *Bb. podotrochleares manus* (navicular bursa) on the palmar/plantar aspect of the limb.[1] It contains the *Musculus flexor digitorum* (*digitalis*) *superficialis* (superficial digital flexor tendon [SDFT]) and *Musculus flexor digitorum* (*digitalis*) *profundus* (deep digital flexor tendon [DDFT]) and is composed of 2 layers, an outer fibrous layer and an inner synovial layer. The synovial layer produces constituents of the synovial fluid, which in turn provides a smooth, frictionless surface. The function of the DFTS is to allow smooth passage of the flexor tendons through the fetlock canal during metacarpo/metatarsophalangeal and interphalangeal joint flexion and extension.[1]

Fluid-filled cyst-like structures associated with the DFTS are uncommon in horses. Contradictions in terminology are apparent and synoviocoele, synovial ganglion, synovial cyst, adventitious burse, and synovial hernias have been used interchangeably to describe fluid-filled structures associated with synovial structures (joints, tendon sheaths, and bursae). In the human literature, reference to cysts associated with synovial structures is more common. A ganglion is a small cyst located near a joint capsule or tendon sheath and arises from cystic or myxoid degeneration of connective tissue and the hence the cyst wall does not contain a synovial lining.[2]This is in contrast to a synovial cyst or hernia where the synovial lining protrudes through a rent or defect in the capsule and can become hyperplastic (Fig 1).

There are a few reports of synovial hernias, cysts, and ganglia in horses.[3–5] Clinically, these structures may represent a blemish whereas in other instances they are associated with morbidity, including lameness. Successful surgical resection has been reported. Given the paucity of information, our purpose was to describe clinical and diagnostic features of fluid-filled structures associated with the DFTS in horses and to report outcome after surgical treatment in 8 horses.

MATERIALS AND METHODS

Inclusion Criteria

Medical records (May 1999 to January 2009) of 3 hospitals were reviewed for horses admitted with fluid-filled structures associated with the DFTS. Horses were included if they had an abnormal fluid-filled structure associated with the DFTS, had lameness localized to the region of the fluid-filled mass using diagnostic anesthesia including intrathecal and perineural anesthesia, had surgical treatment,

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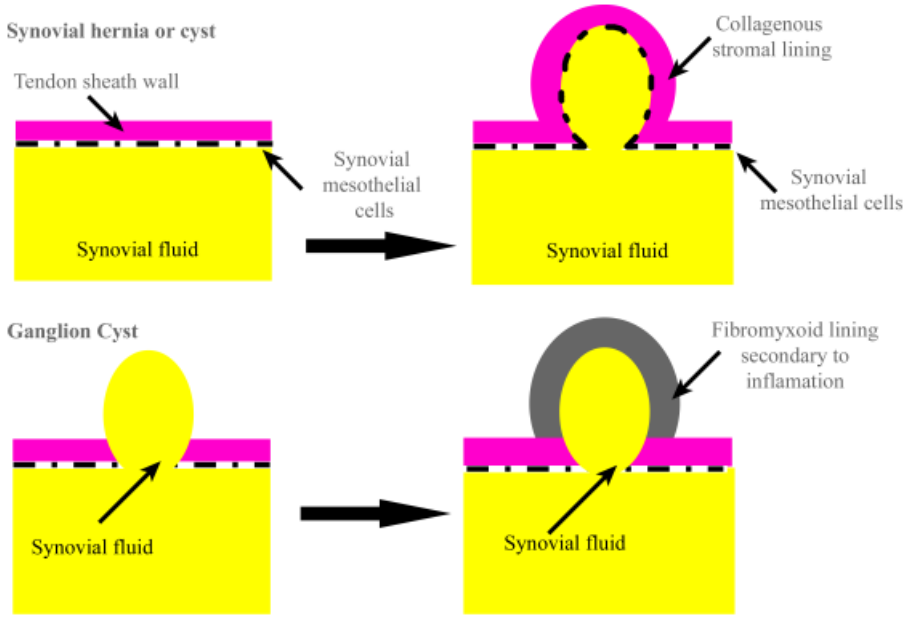

Figure 1 Schematic diagram representing the proposed cause of fluid-filled structures associated with joints or tendon sheaths.

and a minimum of 6-month follow-up. Retrieved data were signalment, clinical signs and duration, degree of lameness and response to flexion tests, results of perineural and/or intrathecal anesthesia, diagnostic imaging findings, surgical treatment, histopathology, and outcome.

Diagnostic Anesthesia

The extent of diagnostic anesthesia varied. When there was DFTS distension, this structure was anesthetized first by a palmar/plantar approach into the distal pouch of the sheath at the level of the pastern using 7–10 mL 2% mepivacaine hydrochloride. The level of lameness was reassessed at 10 and 40 minutes after injection. If the response was convincing, then treatment was recommended. If the response was less convincing (< 50% improvement) then perineural anesthesia was used to localize the site of the lameness. This was generally performed below and above the proximal aspect of the digital sheath (location of ganglion cyst) by infiltration of 1–3 mL mepivacaine per site and the lameness reassessed 15 minutes later. When there were no localizing signs to the tendon sheath, or the significance of the mass was questionable, perineural anesthesia was performed first. In 2 horses, anesthesia of the tarsometatarsal joint was performed before referral.

Radiography

Survey radiographs of the metacarpo/metatarsophalangeal region included lateromedial, dorsopalmar/plantar, dorsomedial–palmaro/plantarolateral oblique, and dorsolateral–palmaro/plantaromedial oblique projections. For contrast radiography, 7–10 mL contrast material (Omnipaque; GE Healthcare, Chalfont St. Giles, Buckinghamshire, UK) was injected into the distal pouch of the digital sheath on the palmar/plantar aspect of the pastern. This was performed in conjunction with the intrathecal anesthesia.

Ultrasonography

Transverse, longitudinal, and lesion-orientated views were obtained of the soft tissue structures on the palmar/plantar aspect of the limb extending from the mid-metacarpal/metatarsal region to the bulbs of the heel and included evaluation of the digital flexor tendons, the tendon sheath, and the associated perithecal ligaments. The nature and orientation of the fluid-filled structure was recorded. Any communication with the DFTS was established by identifying a defect in the wall of the digital sheath with a hypoechoic fluid line connecting the 2 structures. Images were also obtained of the contralateral limb for comparison.

Surgical Treatment

Surgery was performed under general anesthesia with horses positioned in dorsal recumbency (6 horses) or lateral recumbency with the affected side of the limb uppermost (2 horses).

Tenoscopy. Diagnostic tenoscopy was performed in 5 horses before surgical resection of the mass. A tenoscopic cannula was inserted into the DFTS through a portal created just distal to the palmar/plantar annular ligament, palmar/plantar to the neurovascular bundle on the lateral or medial aspect of the limb, and was replaced with a 4 mm 30° forward-angled arthroscope (Karl Storz Vet, Goleta, CA, or Richard Wolf Medical Instruments, Knittlingen, Germany).[6]

Instrument portals were located at the proximal aspect of the DFTS after needle placement and position verification. Any abnormalities within the DFTS were recorded and treated as appropriate.

Ganglion Cyst Resection. A curved incision was made on one aspect of the ganglion cyst, which was exposed by blunt dissection to the level of the stalk communicating with the DFTS. The ganglion cyst was resected by dissection of the mass and stalk from the surrounding tissues including attachment to the neurovascular bundle of the palmar nerve, artery, and vein in 4 horses. The mass and stalk were removed with a small cuff of contiguous joint capsule. After removal, the digital sheath was closed carefully to prevent synovial leakage and risk of cyst reformation. This was achieved by closing the defect in the synovial membrane and wall of the DFTS using 1 or 2 sutures of 0 or 2-0 USP polydioxanone (2 horses) or polyglycolic acid (6 horses). The subcutaneous layer was closed with the same suture material in a simple continuous pattern and the skin with nylon in either a simple interrupted (2 horses) or vertical mattress (6 horses) pattern. Limbs were protected for recovery from anesthesia with bandages.

Peri- and Postoperative Care

Procaine penicillin (22,000 U/kg intramuscularly) was administered immediately before, and 12 and 24 hours after surgery and either flunixin meglumine (1.1 mg/kg intravenously [IV]) or phenylbutazone (4.4 mg/kg IV) before surgery. Bandages were changed in sterile fashion every 3–4 days until the skin sutures were removed at 10–14 days. Horses were stall rested until suture removal and then hand walked, increasing time gradually over the first 6 weeks. Horses were reexamined at 8–10 weeks and if sound at the trot, recommendations were made to replace walking exercise with trotting over the next 4–8 weeks. If horses were still sound at this stage, then a gradual return to full work was recommended and pasture turnout was permitted. If a horse had residual lameness at reexamination, further walking exercise was prescribed.

Histopathology

Resected tissue was fixed in 10% formalin, embedded in paraffin wax, sectioned at 5 μ, and stained with hematoxylin and eosin for light microscopy.

Outcome

Follow-up information was obtained by telephone calls to owners and/or referring veterinarians.

RESULTS

Ten horses with fluid-filled structures associated with the digital sheath were identified; however 2 horses did not satisfy the inclusion criteria because they were not lame and so surgery was not performed. Because there is so little published information on these lesions, relevant findings are included in this report for completeness and comparison (Table 1).

History and Signalment

Horses were aged from 7 to 18 years (median, 8.5 years). Seven were heavy breed cob types, 1 was a Warmblood, and 2 were Thoroughbreds. Duration of lameness before referral ranged from 1 to 10 months (median, 4.5 months). There was no history of acute trauma before onset of lameness. Horses had been treated with box rest for 1–9 months with no improvement in lameness. Five lame horses had received systemic nonsteroidal antiinflammatory medication. Horse 3 was treated with intrathecal medication of the DFTS with methylprednisolone and hyaluronic acid 4 months before admission, without resolution of lameness.

Clinical Findings

All masses were located adjacent to the proximal aspect of the DFTS just proximal to the palmar/plantar annular ligament

Lame Horses. Masses were located in the hindlimb in 6 horses (5 medial, 1 lateral) and forelimb in 2 horses (1 medial, 1 lateral). Seven masses were clearly visible on inspection, palpable subcutaneously, and associated with the DFTS. In horse 3, the mass was not visible or palpable and was only detected ultrasonographically. Masses were generally circular in shape and 1.5–3 cm in diameter. They were all described as firm on palpation and in 6 horses, palpation elicited a pain response. DFTS effusion was present in 5 horses, 3 of which subsequently had additional pathology within the DFTS. Lameness was graded from 2/10 to 7/10 lame on the affected limb (0 = not lame to 10 = nonweightbearing[7]). Flexion tests in 7 horses and were markedly positive.

Nonlame Horses. One horse had the mass on the medial aspect of the left front limb, the other horse on the lateral aspect of the right hind limb. Both masses were clearly visible, of a similar size to the lame horses, but in contrast to the lame horses were fluctuant in nature and not painful on palpation. One horse had a mildly positive flexion test and the other was negative.

Response to Diagnostic Anesthesia (Table 2)

In 6 horses, lameness improved by $> 50\%$ with intrathecal DTFS anesthesia, whereas 2 were less positive but were further improved with perineural anesthesia just proximal to the cyst. In 1 of these horses, this was after no response to anesthesia of the plantar nerves at the level of the heel bulbs and the level of the proximal sesamoid bones and also after no response to metatarsophalangeal joint block.

Table 1 Summary of Clinical, Diagnostic, and Surgical Findings and Outcome in 10 Horses with Ganglion Cysts Associated with the Digital Flexor Tendon Sheath

Horse	Limb, Lameness	Ultrasound Findings*	Radiography		Surgical Findings		Histopathology	Outcome	
			Plain	Contrast†	Communication (ganglion—DFTS)	Other Findings		Improvement	Follow-up (years)
Lame									
1	3/10 RH	Thick-walled ganglion cyst Thickened PAL	NAD	Yes	Yes	Distal sesamoidean ligament tear	Fibrous connective tissue wall, no synovial tissue identified	Sound	2.5
2	2/10 LH	Thick-walled ganglion cyst	NAD	Yes	Yes	DDFT tear	Dense, fibrovascular tissue, no synovial tissue identified	Slight improvement, but still lame	Euthanatized 6 years later
3	5/10 RH	Ganglion cyst Thickened PAL	NAD	Yes	Yes	Manica flexoria tear	Fibrinoid necrosis, no synovial tissue identified	Sound	4
4 (5)	7/10 LH	Ganglion cyst Thickened PAL	NAD	Yes	Yes	None	Fibromyxoid tissue wall, no synovial lining	Sound	2
5 (6)	2/10 RF	Ganglion cyst	NAD	NP	Yes	None	Not performed	Sound	3.5
6 (8)	2/10 LH	Ganglion cyst	NAD	Yes	Yes	None	Dense fibrous connective tissue, no synovial lining	Sound	6
7 (9)	3/10 LH	Thick walled ganglion cyst	NAD	NP	Yes	None	Not performed	Sound	3.5
8 (10)	2/10 RF	Thick-walled ganglion cyst	NAD	NP	Yes	None	Not performed	Sound	2
Not lame									
9 (4)	LF	Ganglion cyst	NP	NP	NP	—	NP	Sound	3
10 (7)	RH	Ganglion cyst	NP	NP	NP	—	NP	Sound	2

*All cysts had a communication between the cyst and the digital flexor tendon sheath.
†Communication identified from DFTS to ganglion cyst.
PAL, palmar/plantar annular ligament; NAD, no abnormalities detected; NP, not performed; DDFT, deep digital flexor tendon; PAL, palmar/plantar ligament.

In the other horse, 90% resolution of the lameness occurred after uniaxial block of the plantar nerve on the affected side just proximal to the ganglion cyst.

Diagnostic Imaging Findings

Soft tissue swelling associated with the mass was the only abnormality identified on survey radiographs. On contrast tenography in 5 horses, communication was observed between the DFTS and mass (Fig 2) in each horse. On ultrasonography, a thick-walled mass attached to, and communicating with, the DFTS was identified in all 10 horses. In 3 horses, enlargement of the palmar/plantar annular ligament, recorded as > 2 mm measured at its insertion to the proximal sesamoid bone, was also identified. Three horses had other lesions identified at surgery within the DFTS; however, none of these were identified ultrasonographically.

Surgical Treatment

Five lame horses had tenoscopy of the affected DFTS because of the suspicion of concurrent pathology indicated by diagnostic anesthesia (positive digital sheath block) or ultrasonography. Three horses had concurrent pathology of fiber disruption to the surface of the distal oblique sesamoidean ligament (1) or DDFT (1), and a manica flexoria tear (1). The damaged ligament and tendon were debrided arthroscopically, and the torn manica flexoria was removed.

In all 8 horses, the mass was surgically resected as described.

Outcome

No postsurgical complications occurred. All horses were sound at a walk on the day of hospital discharge (2–5 days). At 8–10-week follow-up examination, 6 of the 8 horses were sound at the trot, horse 3 was markedly improved, and horse 2 had little improvement. Long-term outcome showed a return to previous levels of work in 7 surgically treated horses for a median of 3.5 years (range, 2–6 years). Horse 2, which had a tear of the DDFT, was still lame 8 months after surgery. A plantar annular ligament desmotomy at this stage improved the lameness and the horse temporarily returned to work; however, digital flexor tenosynovitis occurred in the contralateral limb 2 years later. At this stage, the horse was noted as being bilaterally hindlimb lame, and was eventually euthanized.

Histopathology

The walls of the structures were formed of fibrous or fibromyxoid tissue, and were devoid of synovial or epithelial lining. In 1 specimen, scattered blood vessels and small nerves were identified within the walls.

Table 2 Summary of Diagnostic Anesthesia and % Improvement in 8 Lame Horses

	Horse							
Diagnostic anesthesia technique	1	2	3	4	5	6	7	8
Palmar digital	—	—	—	—	0%	—	—	—
Abaxial sesamoid	30%	—	0%	—	30%	—	—	—
Metacarpophalangeal joint	—	—	0%	—	—	—	—	—
Digital flexor tendon sheath	80%	90%	40%	0%	60%	60%	100%	100%
Low 6 point	100%	—	100%	—	60%	—	—	—
Uniaxial Plantar Nerve	—	—	—	90%	—	—	—	—
Direct infiltration ganglion	—	—	—	—	60%	—	—	—
Tarsometatarsal joint	0%	—	0%	—	—	—	—	—

DISCUSSION

The fluid-filled masses resected at surgery had morphologic characteristics consistent with a ganglion cyst. The clinical, imaging, and surgical similarities in the other 5 horses were also consistent with ganglion cysts. In 2 horses, these masses were not associated with lameness, whereas in 8 horses, these lesions were associated with lameness that improved markedly with intrathecal anesthesia (6 horses) or subsequently with perineural anesthesia (2 horses). Surgical excision of the mass resolved lameness in 7 horses with return to athletic use for a median of 3.5 years (range, 2–6 years). Although intrathecal contrast radiography (5 horses) confirmed synovial communication between the DTFS and mass, it was confirmed in all 10 horses by ultrasonography, suggesting that this is the preferred diagnostic imaging modality for ganglion of the DFTS.

Most horses had localizing clinical signs to the DFTS; effusion or local pain on palpation of the ganglion adjacent to the DFTS. Two ganglion cysts were neither painful on palpation nor associated with lameness. With human wrist ganglia, the pain has been stated as arising from direct pressure on other tissues causing irritation or inflammation.[8] Forced flexion of the distal limb in 8 horses caused a marked increase in lameness in 7. Other sources of pain arising from the DFTS can cause a positive flexion response; however, 4 horses had no other pathology detected either ultrasonographically or at surgery.

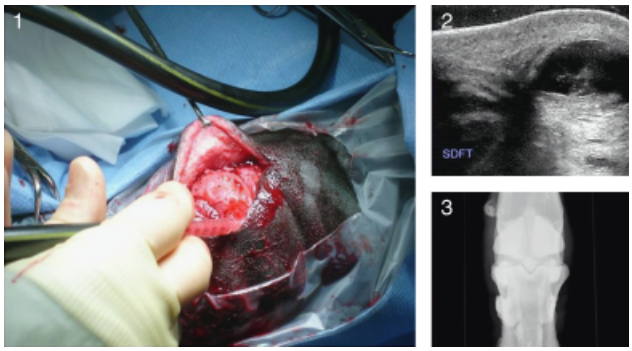

Figure 2 Horse 5. Clockwise from left. (1) Image from surgery of ganglion within tissue. (2) Ultrasound image, note the SDFT is off incidence to highlight communication with ganglion. (3) Contrast tenogram, note the contrast material within the subcutaneous tissue just proximal to the metatarsophalangeal joint.

Response to diagnostic analgesia with ganglion cysts has not been investigated. A digital sheath ganglion in a mare had no response to perineural regional analgesia at the level of the proximal sesamoid bones but a positive response to local infiltration around the ganglia.[4] Not all of our horses had a positive response to digital sheath anesthesia, whereas all had a positive response to analgesia of the palmar or plantar nerves and palmar/plantar metacarpal/tarsal nerves proximal to the lesion, suggesting the lameness does not always originate purely from within the DFTS. In horse 4, uniaxial perineural analgesia of the plantar nerve at the distal aspect of the metatarsus just on the affected side resulted in a 90% improvement in lameness and although this block effectively anesthetizes all structures distal to the nerve the marked pain response in this horse was immediately relieved and the horse was sound, suggesting that the source of the pain was local pressure or irritation of the surrounding soft tissue structures. Intrathecal anesthesia as well as anesthesia of the palmar or plantar nerves provides reliable anesthesia of digital sheath ganglion cysts but will also anesthetize other structures from within the digital sheath, indicating that diagnostic tenoscopy of the sheath is a valid adjunctive diagnostic, and therapeutic approach to rule out additional sources of lameness.

The presence of other pathologic lesions within the sheath in horses with DFTS ganglion cysts emphasizes the importance of full evaluation of the tendon sheath ultrasonographically, and tenoscopically even when no pathology is visible ultrasonographically. In a series of 77 tenoscopically diagnosed lesions in noninfected DFTSs, 71 of which were examined by ultrasound before surgery, the diagnosis was not made in 21 horses that had nonspecific ultrasonographic changes only.[9] Whereas this additional pathology may have been the cause of the lameness in these horses, it is impossible to differentiate between the two and certainly there were cases where the only pathology found was the cyst which together with localization with diagnostic anesthesia strongly suggests that they can be a cause of lameness. Cysts were also found in 2 nonlame horses, so careful diagnostic evaluation is necessary to establish their significance.

Treatment of human wrist ganglia has involved application of blunt trauma to rupture the cyst[10] and aspiration of the cyst and injection of corticosteroids.[11] Administration of corticosteroids into the DFTS was only used in 1 horse and although it was unsuccessful, it remains an alternative treatment option to surgery and was recommended initially to owners of other horses. There is chance of recurrence with this therapy however, and in a review of human wrist ganglia appeared to be only slightly more effective than no treatment.[12] That particular study had a 15% recurrence rate with surgery and recommended resection in symptomatic cases. In our horses, surgery resulted in a 75% resolution of lameness within 10 weeks of surgery and an 88% resolution long term without any recurrence within the follow-up period (median, 3.5 years). The horse that remained lame had additional pathology within the DFTS and although impossible to verify, the significance of this was likely contributory to the poor outcome.

Although we found no indication why, it was interesting to note that the ganglion cysts were all adjacent and communicated with the proximal aspect of the DFTS. Indeed location seems to be a consistent feature of human ganglion cysts but there appears to be no explanation. If necropsy examination were possible in a horse with a ganglion cyst, it would be interesting to compare the morphology of the tendon sheath throughout its entire length, perhaps to provide some information on the vulnerability in the area where the cysts form. It was also interesting to note that the palpation of these masses differed between the lame and nonlame horses, the nonlame horses having fluctuant rather than firm masses. This may be explained by the existence of a one-way valve in the lame horses that results in an accumulation of pressure that in turn causes local pressure and irritation in the surrounding tissues.[13,14,15] Perhaps, if the mass is soft and reducible, it is less likely to cause this pressure.

In human texts, ganglion cysts are defined as outpouchings from fluid-filled areas such as the fluid within the small joints of the wrist, or fluid within the sheath that surrounds the wrist tendons.[10,11,16,17] When synovial fluid leaks from these spaces, it can become a cystic structure. Our series confirm this definition of ganglion cyst from diagnostic imaging, intraoperative findings and histopathology which identified fibrous or fibromyxoid tissue without epithelial or synovial tissue lining the cyst. The proposed cause and suggested terminology of these cystic structures are schematically represented in Fig 1. Hernias result from a defect in the capsular tissue of a joint or tendon sheath through which the synovium can protrude.[18,19,20,21] Ganglion cysts do not possess synovium and the fibromyxoid lining could develop from the resultant inflammation created by the synovial fluid within the extra-capsular tissues.

We concluded that ganglion cysts associated with the DFTS are an uncommon source of lameness in the horse and require careful assessment by diagnostic anesthesia and ultrasonography to establish their clinical significance. Surgical resection has a good prognosis for soundness provided there is no concurrent pathology of the tendons, which can carry a poor prognosis, and which benefit from concurrent tenoscopic evaluation and treatment.

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