3. Lameness associated with the proximal palmar/plantar cannon bone region

TS Stashak, DVM, MS, Diplomate ACVS, Professor Emeritus Surgery, Colorado State University.

Lameness associated with the proximal palmar/plantar cannon bone region may be caused by proximal suspensory ligament desmitis (PSD), an avulsion fracture of the origin of the suspensory ligament (AFxSL), carpal (inferior) check ligament desmitis (CCD), incomplete stress fractures (ISFx), and desmitis of the interosseous ligament of a small metacarpal (splint) bone (DIL). Both forelimbs and hind limbs may be involved (exception ISFx – only forelimb). These conditions may present with similar clinical signs as those described for blind splints, and they occur most frequently in performance horses (ISFx primarily in racehorses).

Etiology

Overloading of the suspensory ligament (SL) or carpal check ligament (CCL) may cause sprain trauma. It is possible that hyperextension of the carpus in conjunction with overextension of the fetlock joint may be a factor in the forelimbs, and overextension of the fetlock may be the cause when these conditions occur in the rear limbs. The avulsion fracture that occurs at the proximal attachment of the suspensory ligament probably results from the bone being torn away. The periosteitis and enthesophyte probably results from tearing of the proximal suspensory ligament fibers from the bone. Working horses in deep soft arenas or exercise where there is excessive rotational movement of the limbs have both been implicated as causes. Incomplete stress fractures of the proximal cannon bone are thought to result from repeated stress and compression at a rate that exceeds the bone's ability to adapt. Why the medial side of the proximal cannon bone is affected more frequently is unknown. Desmitis of the Interosseous ligament may be caused by disproportionate axial compression being applied to a splint bone at its articulation with the carpus.

Clinical signs and diagnosis

Most horses with desmitis of the proximal suspensory ligament have a history of intermittent lameness of several days to months duration that is worsened by strenuous exercise. Horses with inflammation of the carpal check ligament or avulsion fractures at the origin of the suspensory ligament most frequently have a history of acute onset of moderate to severe lameness. Horses sustaining AFxSL and ISFx of the proximal cannon bone have often attained racing speeds in their workouts.

Visual observation of the affected limb is usually not informative but mild swelling of the proximal palmar/plantar cannon bone region and slight effusion in the middle carpal joint may be seen. On palpation, mild proximal swelling may be felt between the suspensory ligament and deep digital flexor tendon. The swelling is usually most prominent on the medial side. Heat is rarely appreciated but with pinpoint digital palpation of the origin of the suspensory ligament and carpal check ligament, pain can be elicited, which often results in increased lameness with exercise. To adequately palpate this region, the limb should be flexed at the carpus and fetlock. In this position, the flexor tendons are loose and can be displaced either laterally or medially (Fig 1). Generally, firm digital pressure applied to the proximal suspensory ligament region results in

a transient painful withdrawal of the limb, which fatigues rapidly in normal horses. Horses with PSD, AFxSL or ISFx do not exhibit this fatigue response to pressure.

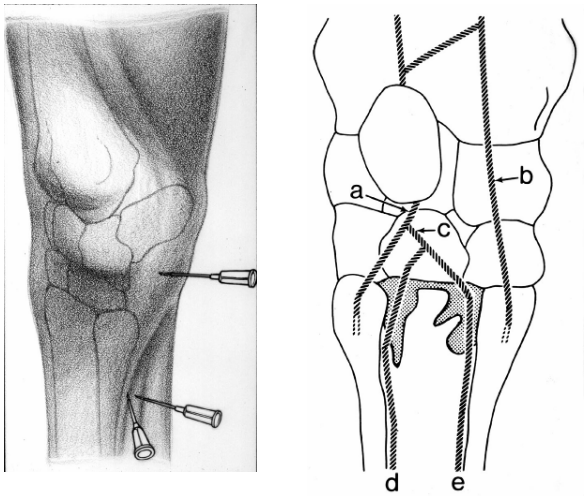
Fig 1 Notes:

At exercise, a moderate lameness (grade 2 to 2+/5) is usually apparent. The lameness may be most obvious and exacerbated at a trot in a circle with the affected limb on the outside of the circle. This is particularly true if the proximal suspensory ligament is involved.

Flexion of the fetlock and phalanges, carpus and hock may increase the lameness. In one study, flexion of the fetlock and phalanges accentuated lameness in 50% of forelimb or hind limb cases of PSD, and hock flexion accentuated lameness in 85% of hind limb cases.

Diagnostic anesthesia may be required to localize the pain resulting in lameness to the proximal palmar/plantar cannon bone region. Diagnostic anesthesia may also be confusing. Blocks that may desensitize this region include: high four-point block (proximal palmar/plantar nerves and metacarpal/metatarsal nerve); lateral palmar nerve block distal to the accessory carpal bone is preferred (Fig 2); and direct infiltration of local anesthetic in the region. Alternatively, the ulnar nerve may be blocked in the forelimb and the tibial nerve in the hind limb. Intrasynovial anesthesia of the middle carpal and distal intertarsal joints may also provide analgesia to this region.

Fig 2. Lateral palmar nerve block
Notes:



Diagnostic imaging of the region should include radiography (five views), ultrasound and, in cases where these imaging techniques do not identify the problem, nuclear medicine is recommended. Occasionally CT scan can be helpful.

Radiography

Proximal suspensory desmitis (PSD)

Radiographic abnormalities of the proximal aspect of the third metacarpal (metatarsal) bone associated with PSD include: bone sclerosis (dorsopalmar/dorsoplantar) projection; trabecular bone pattern alteration dorsal to the palmar (plantar) cortex with or without sclerosis (lateromedial view); palmar (plantar) enthesophyte formation at the proximal attachment of the SL (lateromedial view).

Radiographic abnormalities are seen more commonly in hind limbs than in forelimbs. This may reflect the tendency for these injuries to be more chronic. In forelimbs, the most common abnormality is sclerosis of the proximomedial half of MC3, whereas in the hind limb, sclerosis more commonly occurs centrally or laterally in MT3. Enthesophyte formation and alteration in the bone's trabecular pattern are thought to represent new bone formation from tearing of the proximal attachments of the SL.

Avulsion fractures (AFx)

Complete AFx's usually are best identified on flexed lateromedial or dorsopalmar (dorsoplantar) radiographic views, although sometimes slightly oblique dorsopalmar (dorsoplantar) views can be most informative. The AFx usually is seen as a displaced bone fragment (Fig 3A). Incomplete AFx's are seen as semicircular lucent lines in a dorsopalmar (dorsoplantar) projection (Fig 3B).

Fig. 3 A & B Notes:

Incomplete stress fractures (ISFx)

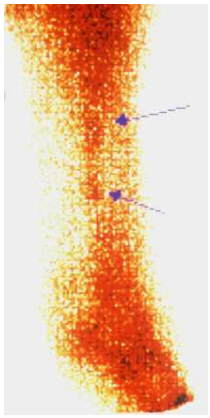
ISFx's occur in the proximal part of MC3 and they are best seen on the dorsopalmar view. The radiographic findings include: linear radiolucency in proximomedial MC3 that extends almost to the carpometacarpal joint and medullary sclerosis associated with the fracture line can be seen on the DP and LM views (Fig 4 A). On the LM view, an endosteal callus may also be seen (Fig 4 B).

Fig 4 A&B Notes:

Desmitis of the Interosseous ligament (DIL)

DIL occurs in the proximal third of the cannon bone region at the attachment of the small splint bones to MC3. The radiographic findings are best seen on the oblique views and include: an apparent increase in the space between the small metacarpal bone and MC3; and indistinct bone margins and osteoproliferative changes in the space occupied by the Interosseous ligament. Because the radiographic findings are somewhat vague, nuclear imaging is recommended to document the site of inflammation.

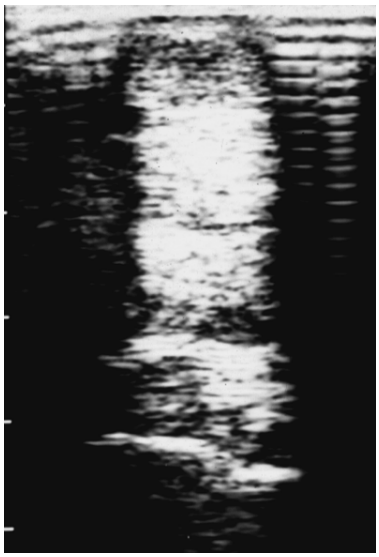
Fig 3 Notes:



Ultrasonography

Ultrasonographic abnormalities associated with PSD or CCD in either the forelimb or the hind limb include: enlargement in the median and/or transverse plane; poor definition of one or more of the margins, especially the dorsal margin; a well-circumscribed central hypoechoic area; one or more poorly defined hypoechoic areas, central or more peripheral; a larger area or areas of diffuse decrease in echogenicity involving part or all of the cross-section of the ligament; small focal hyperechoic spots; irregularity in the palmar (plantar) contour of the third metacarpal (metatarsal) bone with PSD; loss of definition between the RCL and DDFT suggestive of adhesions and concurrent desmitis of the RCL and SL, and tendinitis of the SDFT (Fig 4).

Fig 4 Illustrating desmitis of the suspensory ligament and tendonitis of the SDFT
Notes:



Careful comparison with the contralateral limb is important to document the abnormality and identify bilateral lesions. A very recent injury may be subtle, but it may become more obvious during the next two to four weeks.

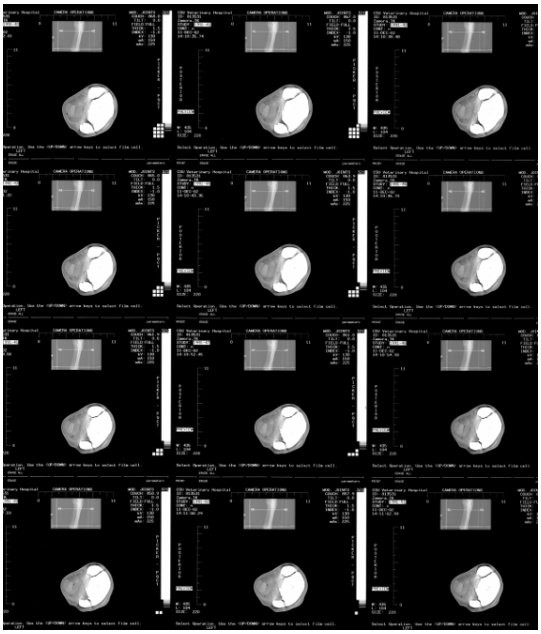
Nuclear imaging

Increased uptake of radionuclide will be seen in the palmar/plantar cortices with fractures and desmitis (stress reaction) of the proximal attachment of one SL. Selective increased uptake of radionuclide can also be seen at the attachment of the Interosseous ligament with DIL.

CT Scan

CT Scans may be useful in cases where no definitive lesion is found on radiographic or ultrasonographic examination. This is particularly true when a compartment syndrome develops due to thickening of the carpal sheath retinaculum and concurrent thickening of the proximal palmar cortex due to enthesiopathy (Fig. 5)

Fig 5 Notes:



Treatment

The treatment for all these entities involves variable periods of rest (box stall and controlled exercise) for three to six months. Absolute rest is recommended until the acute pain subsides. Because of the high risk of adhesions with CCD, controlled exercise is considered to be very important during the convalescent period. Avulsion fractures do not appear to separate appreciably and because of a good blood supply, they quite often will heal readily.

Anti-inflammatory therapy includes: phenylbutazone, cold and alternating temperature therapy, and local injections of anti-inflammatory. Phenylbutazone is recommended for its anti-inflammatory/analgesic effect. Cold and alternating temperature therapy is probably most effective for the treatment of PSD and RCLD in the acute and subacute phases. Although local injections of anti-inflammatory appear to be effective in reducing inflammation and lameness

associated with PSD and CCD, lameness often recurs if sufficient rest has not been given. It is postulated that local injections of anti-inflammatory may reduce adhesions between the carpal check ligament and DDFT associated with CCD. If pain returns after exercise has begun, a more prolonged convalescence period will be required.

Shockwave

Shockwave therapy appears to be a valuable treatment modality for chronic PSD, CCD and it may be beneficial for intraosseous ligament desmitis as well. Generally 4-6 treatments are given at weekly intervals. The hair is clipped, the skin is degreased with alcohol and the coupling gel is applied. One study using the Swiss Dolarclast Vet machine used 10 MHz and 1500-3000 impulses/treatment. In this report there appeared to be a benefit for chronic PSD of the fore and hind limbs, for RCLD and IOLD. Boening AAEP, 2000 reported that 86% of the horses with PSLD treated conservatively returned to performance whereas only 74% of the horses treated with shock wave returned to performance. The average lay up was 3-6 months. In contrast Quirion Rochester Eq Proc. 2003 reported on 45 horses with chronic hindlimb PSLD treated with shock wave of which 41% of the acutely affected horses and 73% of the more chronically affected horses returned to performance. This is in contrast to Dyson report 1994 on 35 horses with hindlimb PSLD where only 17% returned to performance following conservative treatment.

Bone Marrow injections

Bone marrow is aspirated from the sternabrae and injected into the lesion. Herthel, AAEP 2001 reported on results in a 100 cases and found that 84% of the horses treated by injection with bone marrow returned to performance compared to the controls of which only 15% receiving conservative treatment only returned to performance.

ACell

ACell vet, an acellular membrane matrix that is derived from the urinary bladder of pigs. This matrix has the ability to regenerate/reconstruct most tissues by stimulating the host stem cells to migrate to the site it is implanted in. It is being evaluated as an injectable in cases of desmitis and tendonitis. Initial results are encouraging.

Stem cells

Injection of; bone marrow aspirates, ex-vivo cultured bone marrow stem cells and extracellular matrix (ACell) to promote host stem cells to heal the ligament site more rapidly with tissue that resembles the normal ligament structure is being evaluated at the time of this writing.

Plasma rich platelet gel (PRP)

Injection of PRP is being used to enhance healing of tendons suffering from tendonitis and ligaments suffering from desmitis. Several systems are available, all of which have special claims as to the ease of collection, increased harvest of platelets and cost advantage. To my knowledge no studies have clearly proven the superiority of PRP compared to Stem cell injections in the healing rates of tendons and ligaments. A few of the companies that have collection systems are listed: Magellan Platelet Gel), Harvest SmartPReP^{TM} 2 and Biomet GPS III. Theoretically the combination of PRP, injected first followed by the injection of Stems cells should provide superior healing compared to either, used alone.

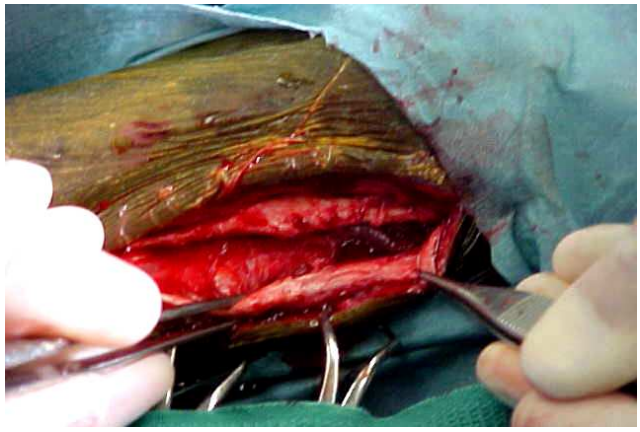
Evaluation of healing

Repeated ultrasound examinations (at six weeks and three months) are most helpful in documenting healing of ligaments, and repeated radiographs and nuclear scans are beneficial in deciding when fracture healing is complete. In both cases, these examinations ultimately decide when the horse is ready to return to work.

Surgical treatments

Surgical transaction of the carpal and tarsal retinaculum has been recommended for chronic cases of PSLD associated with enthesiopathy and thickening of the retinaculum.

Fig 6 Example of transaction of a thickened carpal canal retinaculum.



Two cases of ISFx treated surgically have been reported. One case was treated with a transcortical (lateral to medial) screw. However, no benefit over rest was seen with this case. In another case, surgical forage was used to treat multiple intracortical fractures of the proximal palmar cortex of MC3 that were unresponsive to prolonged rest. Forage was successful in returning this horse to work in three months.

Prognosis

Proximal suspensory ligament desmitis (PSD)

The prognosis for PSD appears better for the forelimb than the hind limbs and the incidence of recurrence may be related to use, lesion size, and the presence of other lesions. In one study on 29 horses with forelimb PSD, 86% of the horses returned to full work after three to six months rest. Speed of resolution of the problem was related to lameness duration prior to beginning treatment--the longer the duration of lameness, the longer the convalescence. Follow-up on 35 horses with hind limb PSD found that 17% resumed full work. Proposed reasons for the poorer prognosis for hind limb (PSD) are: the chronicity of the injury prior to treatment; a tendency for the lesions to be more diffuse in the hind limb; a different biomechanical requirement for the SL of the hind limb; and the development of a compartmental-type syndrome resulting from the limited space available between the prominent splint bones for the inflamed SL to expand into. It is theorized that as the SL expands, it causes neural compression.

Pathology studies have documented perineural fibrosis, loss of nerve fibers and Renaut's bodies in the nerves of the lame limb, which is consistent with this compression theory.

In another study, dressage and show jumping horses had the highest recurrence rate of PSD, which was 37% and 46% respectively, compared to racehorses (27%), show hunters (19%) and field hunters (18%). One study found that the larger the SL lesion, the greater the incidence of recurrence. A greater tendency for recurrence of PSD was seen when the percent of total SL area was > 34% versus < 24% for nonrecurring. Follow-up in another study found that the incidence of recurrence of lameness one year after successful treatment was low, but when lameness did recur, the prognosis was guarded for return to work even with appropriate treatment.

Follow-up in several studies found a reduced prognosis of PSD was associated with other lesions such as tendinitis of the SDFT, DDFT or RCLD.

Avulsion fractures of the origin of the SL (AFxSL)

Most horses have an uneventful recovery and return to full work after a treatment period of three to six months without recurrent lameness. A good blood supply is felt to be the reason that these fractures heal so readily. There is a report on one case where this fracture developed a sequestrum.

Radial check ligament desmitis (RCLD)

Follow-up on 13 horses with uncomplicated RCLD found 10/13 resumed full work three to nine months after treatment was initiated. Three horses that had RCLD and concurrent tendinitis of the SDFT did not return to full work. The development of adhesions between the RCL and the DDFT is associated with a poor prognosis for return to use. Horses that develop these adhesions have a tendency to stand with the heel slightly elevated and the fetlock is held slightly flexed (more upright). Some of these horses may develop a flexural deformity associated with the fetlock, which, at least in one case, could not be corrected by RCL desmotomy.

Incomplete stress fractures (ISFx)

Follow-up on 7 horses with ISFx found that 6 horses returned to full work after rest (> 3 months). One of the 6 horses was treated with a transcortical (L-M) screw. In another study on 10 horses with ISFx, 9/10 returned to work following convalescence of 1 to 12 months.

It is unlikely that ISFx are related to PSD. In a study of 25 horses with unilateral or bilateral ISFx examined clinically, radiographically and ultrasonographically, all horses had radiographic evidence of a fracture, but no horse had abnormalities of the SL detectable ultrasonographically.

Desmitis of the interosseous ligament

Realistically, there are too few cases where a definitive diagnosis was made and there is adequate follow-up available to establish a prognosis.

Selected references

1. Bramlage L, Gabel A, Hackett R: Avulsion fractures of the origin of the suspensory ligament in the horse. J Am Vet Med Assoc, 1980, 176:1004-1010.

2. Cowles RR, Johnson LD, Holloway PM: Proximal suspensory desmitis: A retrospective study. Proc AAEP, 1994, 4:183-185.

3. Dyson S: Some observations on lameness associated with the proximal metacarpal region. Equine Vet J, 1988, 6(suppl):43-52.

4. Dyson S: Proximal suspensory desmitis: Clinical, ultrasonographic and radiographic features. Equine Vet J, 1991, 23:25-31.

5. Dyson S: Suspensory ligament desmitis. Vet Clin North Am, 1995, 11:177-214.

6. Edwards RB, Ducharme NG, Fubini SL, Yeager AE, et al: Scintigraphy for diagnosis of avulsions of the origin of the suspensory ligament in horses: 51 cases (1980-1993). J Am Vet Med Assoc, 1995, 207:608-611.

7. Ford T, Ross M, Orsini P: A comparison of methods for proximal palmar metacarpal anesthesia in horses. Vet Surg, 1988, 18:146-150.

8. Gillis C, Meagher DM, Balesdent A: Suspensory ligament desmitis and associated fractures. Proc AAEP, 1994, 40:187-188.

9. Kent Lloyd KC, Koblik P, Ragle C, Wheat JD: Incomplete palmar fracture of the proximal extremity of the third metacarpal bone in horses: Ten cases (1981-1986). J Am Vet Med Assoc, 1988, 192:798-803.

10. Leeth BD: Outcome of injuries to the palmar supporting structures in show hunters. Proc AAEP, 1994, 40:189-190.

11. Mazan MR, Merriam JG: Treatment and diagnosis of lameness due to proximal metacarpal pain in the sport horse. Proc AAEP, 1994, 40:191-192.

12. Moyer W, Ford TS, Ross MW: Proximal suspensory desmitis. Proc AAEP, 1989, 34:409-412.

13. Munroe G, Marr C: A case of flexural deformity of the metacarpophalangeal and distal interphalangeal joints in an adult horse. Equine Vet Edu, 1989, 1:33-38.

14. Pleasant RS, Baker JB, Muhlbauer MC, Foreman JH, et al: Stress reactions and stress fractures of the proximal palmar aspect of the third metacarpal bone in horses: 58 cases (1980-1990). J Am Vet Med Assoc, 1992, 201:1918-1923.

15. Ross M, Ford T, Orsini P: Incomplete longitudinal fracture of the proximal palmar cortex of the third metacarpal bone in horses. Vet Surg, 1988, 17:82-86.

16. Wright IM, Platt D, Houlton JEF: Management of intracortical fractures of the palmaroproximal third metacarpal bone in a horse by surgical forage. Equine Vet J, 1990, 22:142-144.