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Tenoscopy of the Navicular Bursa: Endoscopic Approach and Anatomy

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SUMMARY

Objectives: Our objectives were to describe an endoscopic technique of the navicular bursa, describe the endoscopic anatomy, assess its feasibility on live horses undergoing an exploratory endoscopy, and assess the usefulness of standard arthroscopic instruments introduced via a contralateral portal.
Study design: This was an anatomic study on cadaver limbs and endoscopic observation on clinical cases associated with problems of the navicular bursa and/or navicular bone.
Animals or sample population: The sample population was 4 cadaver forelimbs of 2 horses weighing 300 to 450 kg and 8 live horses and one pony weighing 180 to 550 kg with navicular bursa disease.
Methods: One cadaver limb was left untouched; the 3 others were dissected in a different way. Dissection and endoscopy of the navicular bursa were performed on the cadaver limbs with 4-mm and 2.7-mm 30° forward oblique arthroscopes. Relative positions of the arthroscope and of various arthroscopic instruments in the bursa were observed. Then, exploratory endoscopy of the navicular bursa was performed on live horses suspected of navicular bursa disease after clinical, radiographic, and/or sonographic examination. Visualization with saline solution and carbon dioxide was compared. Standard arthroscopic instruments were introduced according to the lesions observed. Some lesions were treated and a lavage of the navicular bursa was performed in all horses. Postoperative recovery was followed until 3 months after surgery.
Results: Most parts of the anatomic structures of the navicular bursa could be observed with the 4-mm or 2.7-mm arthroscope, and standard arthroscopic instruments could be introduced into the bursa. A lavage of the bursa could be performed in all horses and no iatrogenic damage or postoperative complications were noted.
Conclusion: Endoscopy of the navicular bursa with standard arthroscopic instruments is a feasible technique in horses and could be a useful diagnostic modality in suspected disease of this area.
Clinical application: Diagnostic endoscopy in horses suspected of navicular bursa disease can be used to complement other diagnostic means. It already is used for treatment of septic bursitis; endoscopy of the navicular bursa could have other therapeutic applications in the future.

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INTRODUCTION

Arthroscopy of the dorsal aspect of the distal interphalangeal joint in horses was used for removal of extensor process fractures and for diagnosis examination of this joint.[1] Arthroscopy of the palmar (plantar) aspect of the distal interphalangeal joint was described for removal of fibrin, intra-articular lavage in septic arthritis, and to access some fractures of the distal sesamoid (navicular) bone and middle and distal phalanges.[2]

Endoscopy of the bursa podotrochlearis (navicular bursa) was recently described for treatment of septic bursitis.[3] In this procedure, the instruments were mostly introduced through the original penetrating wound at the frog and through the flexor digitorum profundus (deep digital flexor tendon). In another study,[4] the authors observed the navicular bursa in cadaver limbs and compared the endoscopic observation with pathologic findings.

Lesions of the navicular bursa and contiguous anatomic structures (deep digital flexor tendon, palmar/plantar fibrocartilaginous facies flexoria [flexor surface] of the navicular bone, ligamentum sesamoideum distale impar [impar ligament], and ligamenta sesamoidea collateralia [collateral sesamoidean ligament]) can be associated with navicular syndrome.[5-7]

Conventional radiographs allow evaluation of osseous lesions of the navicular bone (loss of cortico-medullary

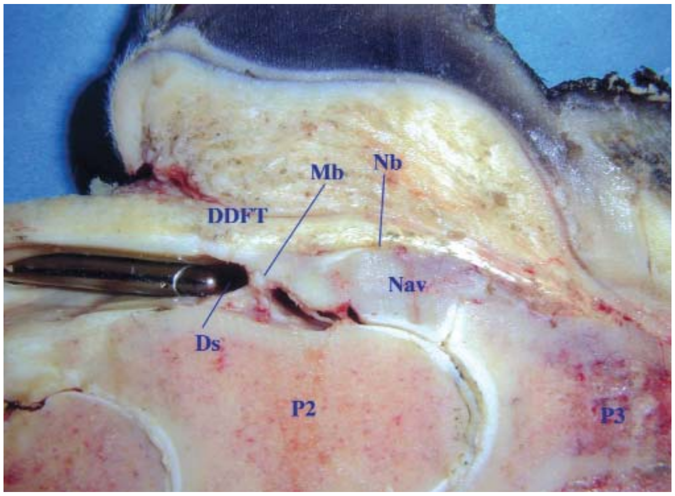

Fig 1. Third dissected limb cut in a sagittal way. The 4-mm arthroscope is introduced into the digital sheath and its progression to the navicular bursa is observed. *DDFT,* Deep digital flexor tendon; *Ds,* digital sheath; *Mb,* separating membranes (Ds synovial layer + connective tissue + Nb synovial layer) between the digital sheath and the navicular bursa; *Nav,* navicular bone; *Nb,* navicular bursa; *P2,* 2nd phalanx; *P3,* 3rd phalanx.

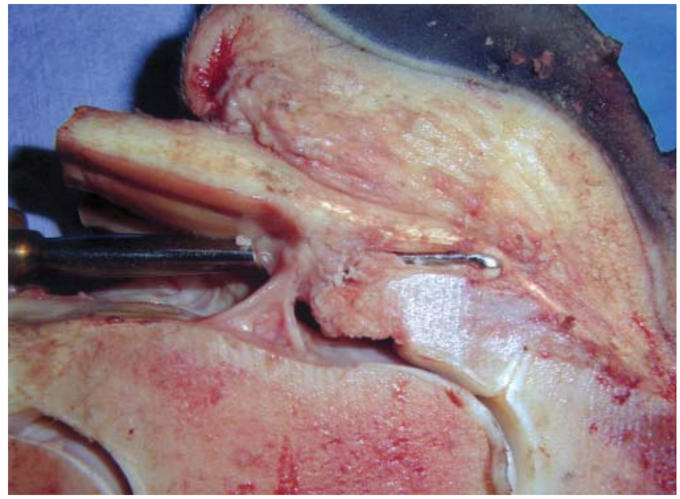

Fig 2. Same limb as in Fig 1. Sagittal view of the 4-mm arthroscope introduced lateral to the DDFT into the navicular bursa. *DDFT,* Deep digital flexor tendon; *Ds,* digital sheath; *Mb,* separating membranes (Ds synovial layer + connective tissue + Nb synovial layer) between the digital sheath and the navicular bursa; *Nav,* navicular bone; *Nb,* navicular bursa; *P2,* 2nd phalanx; *P3,* 3rd phalanx.

definition, irregularity of the sagittal ridge of the facies flexoria, and irregularity or thickening of the flexor cortex)[5,8,9] but are less sensitive for soft tissue evaluation.

Ultrasonography allows the evaluation of some soft tissue lesions.[10] It can be performed at the palmar aspect of the pastern or by a transfurcal approach.

Scintigraphy is more sensitive than radiography in the evaluation of navicular syndrome, and it can complete an inconclusive radiographic examination.[11]

Magnetic resonance imaging (MRI) and computed tomography (CT) scan are also valuable diagnostic means for navicular syndrome in revealing some osseous abnormalities undetectable with conventional radiographs[8,12] and, for MRI, in providing a reliable evaluation of soft tissues.[13-15]

The objectives of this study were to document an endoscopic approach to the navicular bursa, describe the endoscopic anatomy, assess the usefulness of standard surgical instruments introduced via a contralateral portal (which could have potential benefits in diagnosis or treatment of lesions in this area), and finally, to assess the feasibility of this technique in live horses undergoing an exploratory endoscopy.

INSTRUMENTATION

The procedure was performed at 2 different clinics with different sets of instruments. Equipment used included two 4-mm (Dyonics or Storz) and one 2.7-mm (Optomed) 30° forward oblique arthroscopes connected to a light cable (Optomed or Storz) and light source (Stryker or Storz). The arthroscope was connected to a camera (Stryker or Storz) and a video system, which allowed recording and printing of endoscopic views. Various surgical instruments were used: a blunt tendon knife for splitting surgery, motorized synovial resector blades (Dyonics), straight and curved curettes (Sontek), Basket type synoviectomy forceps (Acufex), and Ferris-Smith rongeurs (Sontec).

PROCEDURE

Cadaver limbs. Four distal forelimbs from 2 French Warm Blood equine cadavers weighing 300 to 450 kg with no lameness history were examined. Radiographs of the navicular bone were previously performed to document the absence of preexisting lesions. Three views were used: Dorso (60°) proximal-palmarodistal oblique, lateromedial, and palmaro (45°) proximal-palmarodistal oblique.

The first limb was partially dissected (skin and subcutaneous tissue were removed) and the navicular bursa was examined by introducing the 4-mm arthroscope lateral to the deep digital flexor tendon.

Navicular bursa endoscopy was performed in a similar way on the second undissected limb. The procedure was recorded on videotape and endoscopic photographs were printed. Various instruments were introduced by a medial approach, symmetrically to the arthroscope portal.

The third limb was partially dissected like the first and cut in a sagitttal way with a sharp circular saw. The 4-mm arthroscope was introduced into the bursa and its progression from the skin to the bursa was observed by a sagittal view (Figs 1 and 2). The limb was flexed and anatomic modifications were observed.

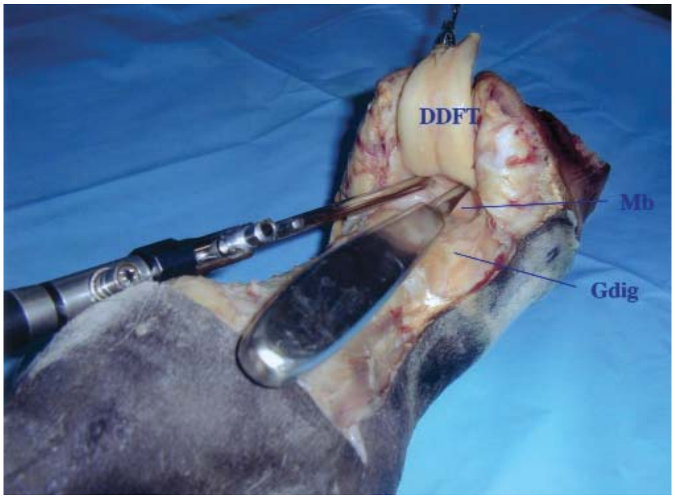

Fig 3. Fourth dissected limb. The tendon of the deep digital flexor tendon is transversally cut and reflected distally to expose the synovial membranes separating the digital sheath from the navicular bursa. The arthroscope is introduced laterally and various instruments are introduced medially. *DDFT,* Deep digital flexor tendon; *Ds,* digital sheath; *Mb,* separating membranes between the digital sheath and the navicular bursa.

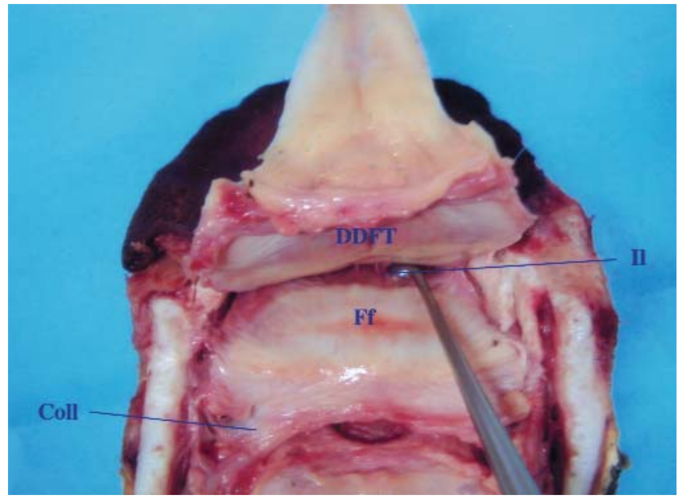

Fig 4. Same limb as in Fig 3. The synovial membranes separating the digital sheath from the navicular bursa is removed and the position of various instruments on the fibrocartilagineous facies flexoria of the navicular bone is observed. *DDFT,* Deep digital flexor tendon; *Coll,* collateral sesamoidean ligament; *Ff,* facies flexoria of the navicular bone; *Imp,* impar ligament.

The fourth limb was dissected; skin, subcutaneous tissue, distal digital annular ligament, digital sheath, and the tendon of the flexor digitorum superficialis (superficial digital flexor) were removed at the palmar pastern level. The hoof, the palmar part of the cartilaga ungulara (ungular cartilage), and the bulbs of the heels also were removed. The tendon of the deep digital flexor was transversally cut at half-pastern level and reflected distally to expose the narrow synovial structures (both digital sheath and navicular bursa synovial layers and connective tissue) separating the digital sheath from the navicular bursa.

First, the arthroscope was introduced laterally and various instruments were introduced medially. The portals and relative axis of the arthroscope and instruments were observed in a proximo-distal view (Fig 3). Then, the synovial structures separating the digital sheath from the navicular bursa were removed and the position of various instruments on the fibrocartilaginous facies flexoria of the navicular bone was observed (Fig 4).

Animals. An exploratory endoscopy of the navicular bursa was performed on 8 live horses and a pony from 4 to 12 years of age weighing 180 to 550 kg. These horses presented clinical and radiographic or sonographic signs of navicular bursa disease associated with lesions of the navicular bone or the distal interphalangeal joint. These cases are shown in the Table.

Surgical technique. The day before surgery, the hoof of the limb to be operated on was trimmed and the hoof was rasped. The hoof and the distal part of the limb up to the proximal limit of the cannon bone were aseptically prepared and covered by a double bandage.

Horses were sedated with xylazine (1.1 mg/kg intravenously administered) or romifidine (0.08 mg/kg intravenously administered). Anesthesia was induced with ketamine (2.2 mg/kg intravenously administered) and maintained with oxygen and halothane. Horses were placed in dorsal recumbency. The limb to be operated on was prepared again for aseptic surgery. An adhesive dressing was applied on the palmar aspect of the pastern, then a sterile glove was placed over the foot, without completely covering the bulbs of the heels. A sterile stockinette and an impermeable arthroscopic drape were then applied. A sterile lack (mountaineering equipment) connected to a winch allowed the limb to be placed in extension.

A 5-mm skin incision was made 2.5 cm proximal to the lateral collateral ungularis cartilage on the abaxial margin of the deep digital flexor (DDFT), palmar to the palmar digital neurovascular bundle. A blunt tendon knife for splitting procedures was then introduced toward the dorsal border of the DDFT in a distal direction. Subcutaneous tissue and the digital sheath were then penetrated. The arthroscope cannula with a conical obturator was advanced distally and slightly axially dorsal to the deep digital flexor tendon to enter the bursa. Following entry into the bursa, the obturator was withdrawn and replaced by the 4-mm 30° forward arthroscope.

Systematic examination of the navicular bursa was performed. At first this examination could be done without any distension with fluid or gas (circulation of fluid was diffi-

Table Description of horses undergoing exploratory endoscopy: preoperative diagnosis, endoscopic finding, and treatment

Case No.	Breed	Sex/age (y)	Lesion and preoperative diagnosis	Endoscopic images of the navicular bursa	Treatment
1	FWB	F/ 14	Septic bursitis on RH	Necrotic tissues, fibrin; focal fibrillation of the navicular fibrocartilage	Debridement of necrotic tissues; curettage of the fibrocartilage; lavage
2	FWB	G/ 9	Fragmentation of the extensor process on LF, early DJD of both distal interphalangeal joints; navicular sclerosis and bilateral enthesiopathy of the DDF on P3	Degenerative aspect of the navicular fibrocartilage with cartilage fibrillation	Lavage of the navicular bursa associated with distal interphalangeal joint arthroscopy; extensor process fragment removal and curettage of the defect on LF
3	QH	G/ 5	Bilateral sclerosis of the navicular bone with irregularity of the facies flexoria at conventional radiographic and positive contrast examination	Degenerative aspect of the fibrocartilage with fibrillation; synovitis	Lavage + partial synoviectomy using a motorized synovial resector
4	Pony	M/ 4	Chronic septic bursitis on RH	Necrotic tissues; focal cartilage defect; synovitis	Debridement of necrotic tissues; curettage of the defect; lavage
5	FWB	G/ 11	Enthesiopathy of the DDF on P3 on LF; irregularity and notch on the facies flexoria at transfurcal ultrasonographic examination; bursagram: normal	Adherence between the facies flexoria and the DDF; degenerative aspect of the fibrocartilage with fibrillation; synovitis	Section of the adherence; curettage of the fibrocartilage at the adherence level; tendon debridement; lavage
6	FWB	F/ 15	Septic bursitis on LH	Synovitis	Lavage
7	FWB	G/ 13	Navicular syndrome with cyst on the distal side of both navicular bones; communication of the cyst with the facies flexoria on LF; bursagram not effected	Endoscopy of the left navicular bursa only; adherence between the facies flexoria and the DDF; cartilage defect facing the adherence	Section of the adherence + curettage of the defect; lavage
8	FWB	G/ 12	Navicular syndrome without any major radiographic changes (moderate thickening of the flexor cortex) on LF	Cartilage defect and synovitis	Lavage
9	FWB	M/ 8	LF navicular syndrome with distension of navicular bursa and deep calcification of DDFT at ultrasonographic examination	Synovitis and DDFT calcification	Lavage

DDF, Deep digital flexor tendon; DJD, degenerative joint disease; F, female; FWB, French Warm Blood; G, gelding; LF, left forelimb; LH, left hindlimb; M, male; QH, Quarter Horse; RH, right hindlimb; P3, third phalanx.

cult before a second portal had been effected). The arthroscope lens was just cleaned with a small volume of saline solution injected with a syringe connected to the arthroscopic cannula. The fibrocartilaginous facies flexoria of the navicular bone was examined at level of the sagittal ridge (Fig 5), then medially and laterally. The DDFT was also observed facing the navicular bone (Fig 6). The arthroscope was withdrawn proximally to examine the proximal border of the navicular bone (Fig 7). Moving the arthroscope medially and laterally, we could observe part of the medial and lateral collateral ligaments (Fig 8) linked together sagittally and covered by the synovial membrane. The arthroscope was then pushed distally and part of the impar ligament was examined (Fig 9).

The same procedure of entering the navicular bursa was then performed through a portal medial to the DDFT. This second portal was used for the passage of various instruments according to the lesions observed: A blunt obturator was introduced first, then various straight and curved curettes, motorized synovial resector blades (Dyonics), Basket forceps, and Ferris-Smith rongeurs (Fig 10).

Once the instrument portal was made, bursal distension was maintained with a sterile saline solution using an arthropump. Then, fluid was removed and observation was done with carbon dioxide circulation using an insufflator.

At the end of the procedures, the bursa was lavaged with saline solution, the skin was sutured, and a sterile bandage was placed. Bandages were changed at 24 hours and

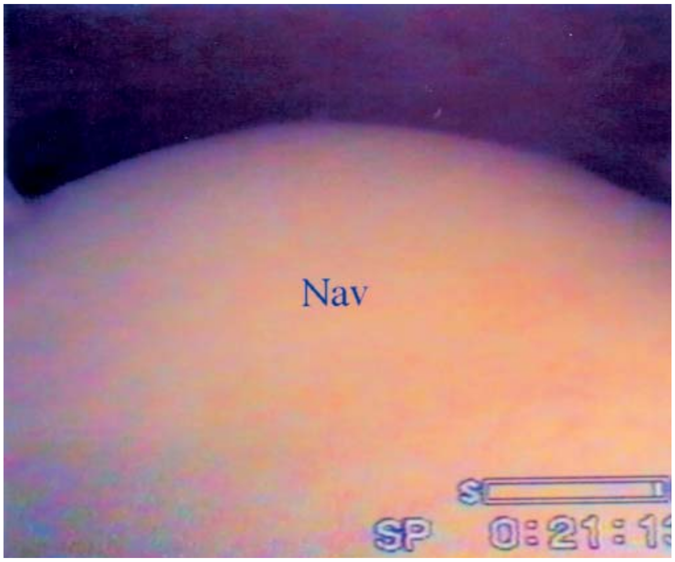

Fig 5. Endoscopic views of the navicular bursa of a normal horse. *DDFT,* Deep digital flexor tendon; *Imp,* impar ligament; *Lcl,* lateral collateral sesamoidean ligament; *Nav,* navicular bone (sagittal ridge); *Prox,* proximal border of the navicular bone.

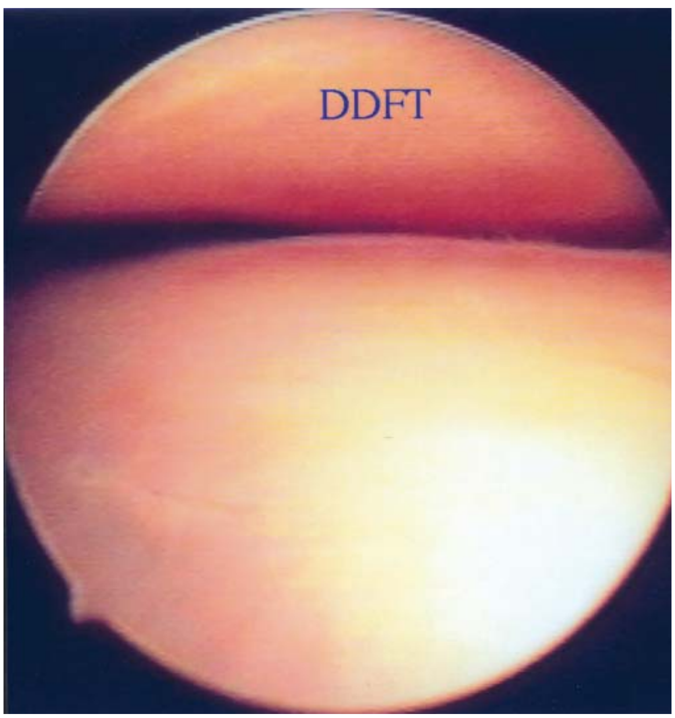

Fig 6. Endoscopic views of the navicular bursa of a normal horse. *DDFT,* Deep digital flexor tendon; *Imp,* impar ligament; *Lcl,* lateral collateral sesamoidean ligament; *Nav,* navicular bone (sagittal ridge); *Prox,* proximal border of the navicular bone.

8 days postoperatively. Sutures were removed on day 14. Horses were regularly examined clinically until 3 months

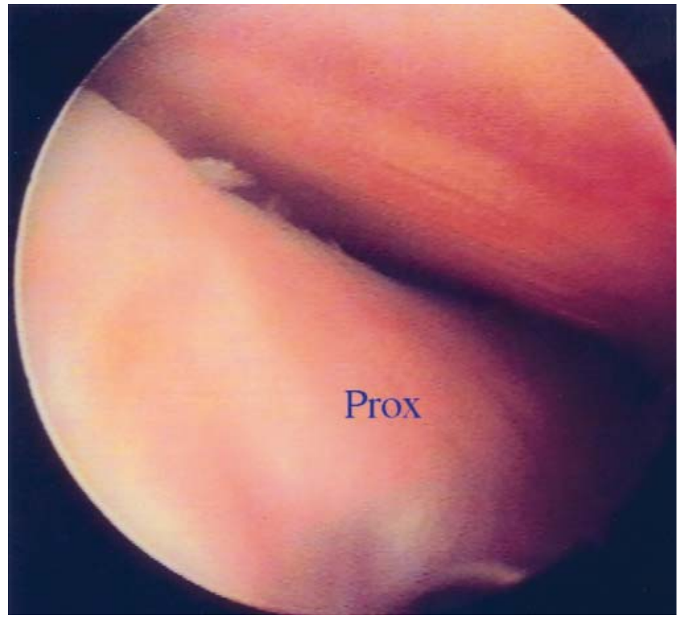

Fig 7. Endoscopic views of the navicular bursa of a normal horse. *DDFT,* Deep digital flexor tendon; *Imp,* impar ligament; *Lcl,* lateral collateral sesamoidean ligament; *Nav,* navicular bone (sagittal ridge); *Prox,* proximal border of the navicular bone.

after surgery. Radiographs were taken 3 months after surgery.

RESULTS

Experiments on cadaver limbs. We could observe that the digital sheath was penetrated in all cases. The blunt tendon knife allowed penetration into the subcutaneous tissue and the digital sheath without any bleeding. Progression into the bursa was achieved with the arthroscope cannula and the blunt obturator, which could penetrate the membranes separating the digital sheath and the navicular bursa.

Many standard arthroscopic instruments could be introduced into the bursa. Because of the restriction of instrument movements, curved instruments (synovial resector blades and curettes) allowed a wider contact with the fibrocartilage of the navicular bone and the DDFT but were sometimes difficult to enter. The contact with the impar ligament was possible but the contact of the most medial or lateral structures remained difficult.

The 2.7-mm arthroscope and small instruments made the procedure easier but were sometimes not sturdy enough to be moved easily into the bursa.

Exploratory endoscopy on live animals. Most parts of the anatomic structures of the navicular bursa could be observed through the lateral portal. The whole fibrocartilage of the facies flexoria could be examined. The dorsal part of the DDFT, the medial collateral sesamoidean ligament, and the impar ligament also could be seen easily.

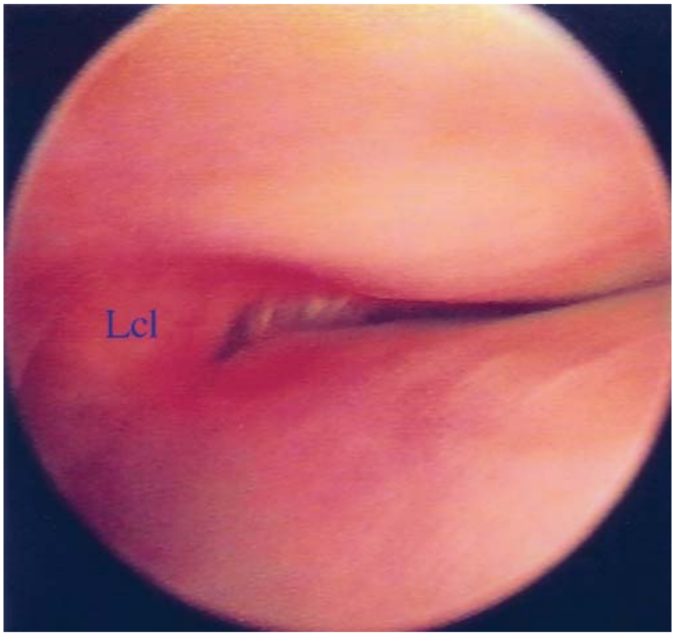

Fig 8. Endoscopic views of the navicular bursa of a normal horse. *DDFT,* Deep digital flexor tendon; *Imp,* impar ligament; *Lcl,* lateral collateral sesamoidean ligament; *Nav,* navicular bone (sagittal ridge); *Prox,* proximal border of the navicular bone.

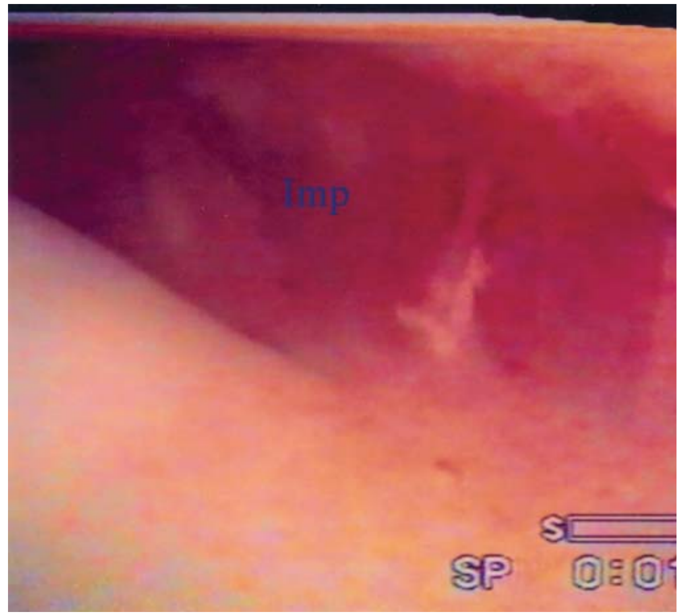

Fig 9. Endoscopic views of the navicular bursa of a normal horse. *DDFT,* Deep digital flexor tendon; *Imp,* impar ligament; *Lcl,* lateral collateral sesamoidean ligament; *Nav,* navicular bone (sagittal ridge); *Prox,* proximal border of the navicular bone.

The lateral collateral sesamoidean ligament could not be entirely observed by the lateral portal, and a medial portal was necessary to complete visualization.

We observed the lesions described in the Table. Two horses (cases 5 and 7) had an adhesion between the deep digital flexor tendon and the fibrocartilage of the navicular bone (Fig 11). These lesions were not visible on the preoperative examination.

Distension of the bursa by saline solution did not allow a real wider visualization (compared with the absence of distension) but allowed a regular lavage of the bursa and enabled us to rid the field of vision of synovial fragments when a second portal was created. Distension by carbon dioxide did not increase the visualization.

A lavage of the bursa could be performed in all horses. In cases 5 and 7, the adhesion between the deep digital flexor tendon and the navicular bone was transected with Basket-type synoviectomy forceps. In cases of septic bursitis (cases 1, 4, and 6), debridement of necrotic tissues was performed with the motorized synovial resector.

No bleeding was noted during the procedures. There were no postoperative complications.

DISCUSSION

Because vital structures are small and closely spaced, a precise positioning of instruments portal and orientation according to the anatomic elements is necessary to achieve the procedure.

The axis of the arthroscope cannula during progression into the bursa seemed crucial to allow penetration into the bursa. We found that the portal that allows easiest access progress into the navicular bursa was about 2.5 cm proximal to the ungular cartilage, palmar to the digital neurovascular bundle palpable at this level. It seemed important to progress dorsally to the deep digital flexor and to stay close to it. The extension of the foot made progression into the bursa easier by keeping the facies flexoria and the deep digital flexor tendon parallel. When the limb is placed in flexion, the obturator and cannula come against the fibrocartilage of the facies flexoria and may damage it. On the contrary, penetration into the palmar pouch of the distal phalangeal joint is easier with the limb in flexion. It is then possible to enter and explore this joint with the same skin portal.

In the literature, previously described cases involved navicular septic bursitis.[3] Horses were placed in lateral recumbency and most of the time the instrumental portal was passed through the original penetrating wound at the frog level. In our cases, horses were placed in dorsal recumbency, which gave a good visualization of pastern and relative axis of arthroscope and instruments.

During observations on dissected limbs, we noticed that the penetration area to enter the navicular bursa was narrow because of the collateral structures that linked the navicular bone, the deep digital flexor tendon, and the third phalanx and the distal digital annular ligament. For this reason, it seemed important to us that the arthroscope and in-

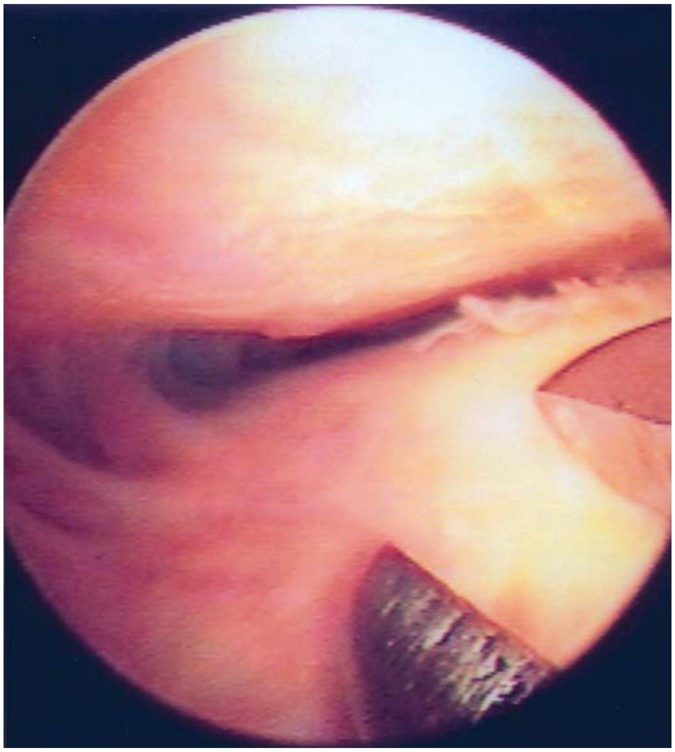

Fig 10. Endoscopic view: Introduction of the ferris-Smith rongeur via the contro-lateral portal. *DDFT,* Deep digital flexor tendon; *Lcl,* lateral collateral sesamoidean ligament; *Nav,* navicular bone.

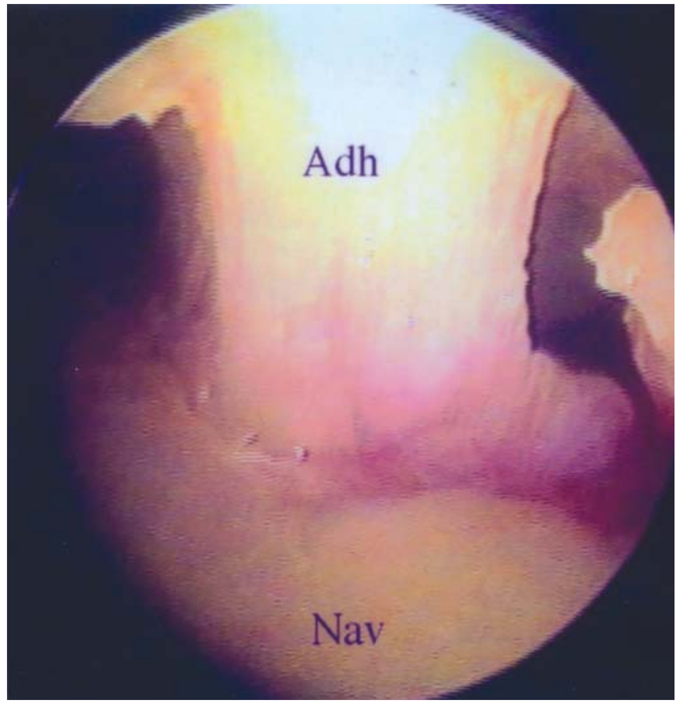

Fig 11. Case No. 7. Endoscopic view. Adhesion between the deep digital flexor tendon and the facies flexoria of the navicular bone with cartilage defect. *Adh,* Adhesion; *Nav,* navicular bone.

struments progressed in a slight axial direction not to interfere with each other. The proximal ends of the arthroscope and the instruments are then close to the palmar aspect of the fetlock, which can interfere with manipulations.

Because of the proximity of the hoof and risk for bacterial contamination, preparation of the hoof on the day before surgery and meticulous draping seemed vital. The distal part of the digital sheath was penetrated during entrance, which is a potential risk particularly in case of sepsis. In this case, it is important to perform a lavage of this sheath at the end of the procedure.

The palmar aspect of the distal interphalangeal joint can be explored by the same skin portal by removing the arthroscope from the navicular bursa and redirecting it more dorsally. This allows exploration of other parts of the navicular bone: the dorsal aspect of the proximal border, the dorsal articular surface, and the dorsal aspect of the proximal border of the navicular bone with the dorsal aspects of the collateral sesamoidean ligaments. This can be a useful complement to navicular bursa exploration performed during the same procedure.

CONCLUSION

This technique allowed good visualization of the anatomic structures of the navicular bursa and could be an interesting diagnostic and prognostic element in case of suspected disease in this area. The use of standard arthroscopic instruments is possible, but specialized instruments for this very small pouch (eg, instruments that could be angulated inside the bursa, arthroscope with flexible end) should be useful. The enlargement of portals in the synovial structures between the digital sheath and the navicular bursa may allow wider movements of arthroscope and instruments, but the consequences of this procedure have to be evaluated.

The efficiency of lavage in case of septic bursitis has been previously demonstrated.[3] In our cases, we could observe some lesions that were sometimes treated (curettage of the fibrocartilage defect, section of adhesion between the deep digital flexor tendon and the navicular bone, debridement of tendon fibrillation). However, the efficiency of our various surgical procedures have to be examined using a larger number of cases.

Endoscopy of the navicular bursa gives future interesting therapeutic prospects: adhesion debridement (cases 5 and 7), cyst curettage, and tendinous and ligament lesion debridement.

The parallel development of veterinary research[16] and diagnostic imaging techniques, especially ultrasonography, CT scan, and MRI, should enhance the evaluation of navicular bursa disease and give new indications of tenoscopic evaluation or surgical treatment.

We thank Pr Nathalie Crevier-Denoix.

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