Diagnostic Reliability of Stifle Arthroscopy of Pathological Changes in Cruciate Deficient Knee

A. NEČAS, R. SRNEC, H. KECOVÁ

Department of Surgery and Orthopaedics, Small Animal Clinic,
University of Veterinary and Pharmaceutical Sciences, Brno, Czech Republic

Received October 30, 2001
Accepted June 19, 2002

Abstract

Nečas A., R. Srnec, H. Kecová: *Diagnostic Reliability of Stifle Arthroscopy of Pathological Changes in Cruciate Deficient Knee.* Acta Vet. Brno 2002, 71: 249–254.

Arthroscopy is becoming a modern mini-invasive method of diagnosis and therapy of cranial cruciate ligament rupture in the stifle of the dog. This study was engaged in the arthroscopically assisted diagnosis and therapy of 42 cases of the cranial cruciate ligament rupture. Every arthroscopic operation was turned to arthrotomy for the purpose of verifying the correctness of findings. Comparing stifle arthrotomy and arthroscopy, the diagnostic accuracy of arthroscopic findings ranged in dependence on the kind of lesion and intraarticular tissue affected in the stifle with CCL rupture from 92 to 100%. Hundred percent reliability of arthroscopic findings was noted when evaluating the integrity of the cranial cruciate ligament. The diagnosis was wrong in two out of 25 cases of medial meniscal damage. Arthroscopic evaluation of the articular cartilage and synovial membrane was very precise and more detailed than during arthrotomy.

Arthroscopy, after routine mastering of the technique, can thus be a reliable diagnostic method ensuring mini-invasiveness of evaluation of intraarticular structures in the stifle affected with CCL rupture.

Cranial cruciate ligament, meniscus, dog

Cranial cruciate ligament (CCL) rupture is one of the most common pathological disorders affecting the stifle in the dog (Arnoczky and Marshall 1977; Barnes 1977; Doverspike et al. 1993; Johnson et al. 1994; Nečas et al. 2000; Whitehair 1993). As in other joint disorders, mini-invasive approach and early convalescence of the patient is becoming the main criterion for the selection of diagnostic and therapeutic procedures. A precise definition of "mini-invasive methods" has not yet been published. In our opinion, mini-invasive is such a method which, during and after the performance, does not result in macroscopic or functional damage of examined or treated tissues. No scale of "mini-invasiveness" has yet been determined.

Arthroscopy, no doubt, can be included into mini-invasive surgical techniques. In view of joint disease diagnosis and therapy, it has been the standard in human and equine orthopaedics for the past two decades (Bertone and McIlwraith 1987; Bertone et al. 1987; Knezevic and Wruhs 1977; Mc Ilwraith 1990; Nixon 1987).

Arthroscopy in the dog was first mentioned in late 1970s and early 1980s (Knezevic and Wruhs 1977; Siemering 1978; Kiwumbi and Bennet 1981). Small animal orthopaedics specialists started showing interest in the endoscopic assisted joint surgery as small diameter arthroscopes were available (Goring and Price 1987; Mc Laughlin et al. 1989; Miller and Presnell 1985; Person 1986; Person 1989a; Person 1989b; Taylor 1999). Excellent visualization, minimal joint trauma, decreased operative time, and lower patient morbidity are all cited as positive aspects of arthroscopy. Every diagnostic and therapeutic procedure, however, can have some disadvantages and, therefore, becomes suitable for clinical use only when the positive aspects outweigh the negative ones.

Address for correspondence:
Doc. MVDr. Alois Nečas, Ph.D.
Department of Surgery and Orthopedics, Small Animal Clinic
University of Veterinary and Pharmaceutical Sciences
Palackého 1-3, 612 42 Brno, Czech Republic

Phone: +420 602 74 24 84
Fax: +420 5 41 56 23 44
E-mail: necas@eurosat.cz
http://www.vfu.cz/acta-vet/actavet.htm

The purpose of this study was to establish arthroscopy as a diagnostic and surgical procedure in dogs with cranial cruciate ligament rupture in our clinical practice and evaluate its reliability in the diagnosis of intraarticular pathological changes in cruciate deficient stifles.

Material and methods

A pilot study using ten cadavers was first done in order to become familiar with the normal arthroscopic anatomy of the canine stifle. Arthroscopic assisted stifle surgeries in 40 dogs suffering from the cranial cruciate ligament rupture were performed at the Department of Surgery and Orthopedics (Small Animal Clinic of the University of Veterinary and Pharmaceutical Sciences) from September 2000 to August 2001. Two patients were diagnosed with bilateral CCL lesions; thus, a total of 42 stifle joints were examined and treated using the arthroscopically assisted procedure. Each arthroscopy was turned to lateral arthrotomy (Piermattei and Greeley 1979) for the purpose of verifying the correctness of arthroscopic findings. This ensured correct interpretation of arthroscopically found pathological lesions in the stifle joint.

For a clear arrangement of diagnoses of individual intraarticular structures´ lesions in the stifle joint associated with the cranial cruciate ligament rupture, findings were included into one of the following five groups of pathological changes:

1. cranial cruciate ligament rupture
2. medial meniscal damage associated with CCL rupture
3. lesions of both medial and lateral menisci associated with CCL rupture
4. secondary degenerative changes of the articular cartilage (osteophytes and erosions of articular cartilage surface in osteoarthritis)
5. signs of synovitis in the stifle (hyperaemia and hyperplasia of the synovial membrane).

Procedures of arthroscopy and arthrotomy were performed under inhalation anaesthesia. During the arthroscopic procedure of the knee patients were positioned differently to arthrotomy (lateral recumbency with the affected limb up). The patient was positioned in dorsal recumbency in such a way that the affected limb was over the edge of the table what enabled good maneuverability during arthroscopy. The operation site was aseptically prepared in a routine way. The distal part of the limb was wrapped in a sterile bandage Coban (3M). Single use waterproof drapes Foliodrape (Hartmann) were used to cover the operation site. A stockinette (3M) was put on the limb and covered by adhesive drape Ioban (3M).

Arthroscopy of the stifle joint in large and medium dog breeds was performed using 2.7 mm diameter arthroscope with the working length of 140 mm and lens angle of 30° (Dyonics, Smith Nephew, Inc.). This arthroscope was used in a combination with a sleeve of 4 mm diameter and a blunt obturator. In small breeds of dogs (under 10 kg of body weight) we used 1.9 mm arthroscope with 110 mm long tubular part and lens angle of 30° (Dyonics, Smith & Nephew, Inc.). The arthroscopic sleeve and blunt obturator for this arthroscope had 2.8 mm in diameter. We used xenon light source of 100 W, camera system with the control unit CCU HD 900 PAL Camera, and Camera head HD 900 equipped with C-Mount endoobjective supplied by Dyonics, Smith Nephew, Inc. The arthroscopic image was visualised on a standard 21“ monitor. A digital videocamera was used to record arthroscopic images. A fluid pump (Smith & Nephew Arthroflow) was used to maintain a steady and precise rate of fluid flow (Ringer´s solution) to achieve optimal visualisation during arthroscopy. An intraarticular single valve egress cannula (Dr. Fritz) of 4.0 mm in diameter was essential to maintain fluid outflow. The infrapatellar fat pad was removed by a motorised shaver Dyonics Power with a 4.5 mm full radius or incisor plus blade.

Prior to the operation, the stifle joint was punctured by a 21G needle and the synovial fluid sampled using a 5 ml syringe for purposes of other studies. The site of insertion was located lateral to the patellar ligament midway between tuberositas tibiae and the distal pole of patella. After sampling the synovial fluid, Ringer´s solution (10-15 ml) was instilled through the needle to distend the joint capsule which enables insertion of the arthroscope.

Lateral to the patellar ligament, approximately midway between tuberositas tibiae and the distal pole of patella, an arthroscopic portal was created. A No. 11 blade was used to make a small entry wound through the skin and superficial soft tissues to the level of the joint capsule at this site. With the stifle joint in extension, a sharp trocar of the egress cannula was inserted into this incision transversely through the joint space in a laterodistal-medioproximal direction. It was inserted over the femoropatellar compartment of the joint into the medial part of the suprapatellar joint recession so that the sharp point of the trocar exit the skin proximomedially from the patella. The skin at this site was incised and egress cannula was put on the trocar in a retrograde way and inserted into the joint cavity medial to the medial femoral condyle. The trocar was removed and, at this site, the joint was entered first with the sleeve of the arthroscope with a blunt obturator on and then with the arthroscope. A systematic arthroscopic examination of the stifle joint started in the suprapatellar compartment with the joint in extension and as the joint was gradually flexed, lateral and medial trochlear ridges were examined. The infrapatellar fat pad limits further visualisation of intercondylar fossa of the femur, cruciate ligaments and menisci. A viewing window through the fat pad has to be made using a motorised shaver with a 4.5 mm full radius blade. An instrument portal, which the shaver entered the joint through, was established medial to the patellar ligament at the same proximodistal level as the arthroscopic portal. As the infrapatellar fat pad was removed, cruciate ligaments and menisci were examined. Remnants of ligaments were removed with a motorised shaver. The medial meniscus was revised with the stifle in flexion and valgus position, and after bending the stifle into a varus position, the lateral meniscus was examined. Menisci were evaluated with respect to their fraying or presence of tears.

Results

Arthroscopy and the subsequent arthrotomy for the verification of the diagnosis of pathological changes associated with CCL rupture in 42 stifle joints resulted in finding 40 unilateral and 2 bilateral (4.76% of cases) CCL ruptures. The left and right stifle joints were affected in 27 (64.29%) and 15 (35.71%) cases, respectively. Complete CCL rupture was diagnosed in 30 stifle joints (71.43%). The rest of 12 stifle joints (28.57%) were affected with partial CCL rupture. Meniscal damage was associated to the CCL rupture in 26 cases (61.90% of stifle joints operated on). Lesions of the medial meniscus were found in 25 cases, while only one joint was affected with damage to both the medial and lateral meniscus. Following pathological changes of intraarticular structures in association with the CCL rupture were found during arthroscopy and verified by arthrotomy:

1. CCL rupture without any meniscal damage (Plate XII, Fig 1) was diagnosed in 16 stifle joints (38.10%). This finding was verified by arthrotomy in all cases.
2. Medial meniscal damage associated with CCL rupture was arthroscopically diagnosed in 25 cases (59.52%). Based on the arthrotomy findings only 23 of those were correct and following two cases were incorrectly diagnosed by arthroscopy (Tab. 1). The first one was a bucket-handle lesion of the caudal horn of the medial meniscus (Plate XII, Fig. 2). The damaged part of the meniscus, cranially displaced by medial femoral condyle, was during arthroscopy mistaken for the cranial edge of medial meniscus and thus incorrectly considered as a normal meniscus. The second fault in the arthroscopic evaluation of medial meniscus was made due to the flounce appearance of the inner edge of the meniscus in stifle joint flexion (Plate XIII, Fig. 3). This appearance was mistaken for a transverse meniscal tear.

Table 1
Success of the arthroscopic diagnosis of pathological changes in the stifle evaluated on the basis of verification by arthrotomy

	diagnosed during AS	Incorrectly diagnosed during AS	% of diagnostic accuracy
CCL rupture	16	0	**100**
MMI + CCL rupture	23	2	**92**
MMI + LMI + CCL rupture	1	0	**100**
Degenerative lesions of joint cartilage	33	0	**100**
Synovitis	35	0	**100**

Legend: AS = arthroscopy; CCL = cranial cruciate ligament; MMI = medial meniscal injury; LMI = lateral meniscal injury.

3. Lesions of both medial and lateral menisci associated with CCL rupture was found only once (2.38% of cases). This patient suffered also from osteochondrosis of the lateral femoral condyle. These findings were also confirmed by arthrotomy.
4. Secondary degenerative changes of the articular cartilage (osteophytes and erosions of articular cartilage surface in osteoarthritis; Plate XIII, Fig 4) were diagnosed by arthroscopy in 33 stifle joints (78.57%). These findings were verified by arthrotomy in all instances.
5. Signs of synovitis in the stifle (hyperaemia and hyperplasia of the synovial membrane) were found in 35 stifle joints (83.33%) affected with CCL rupture (Plate XIV, Fig 5). All these diagnoses were confirmed by arthrotomy.

Table 1 presents arthroscopic diagnoses and percentage of correct arthroscopic findings verified by arthrotomy of the stifle joint.

Discussion

Arthroscopy seems to be a suitable method for diagnosis of such joint disorders, which manifest to at least some degree of morphological changes of intraarticular structures. CCL rupture, no doubt, belongs to such disorders. Arthroscopy is advantageous as a diagnostic method in the CCL rupture because of minimal invasiveness, high specificity of findings and the possibility of visualisation of all changes in the joint without the necessity of opening the joint. The reliability of arthroscopic diagnosis, as a rule, is not in association with imperfection of the method, but depends on excellence of its performance and correct interpretation of findings. This fact was also verified by our prospective study. Findings were misinterpreted in two cases (4.76%) out of 42 arthroscopic procedures. The first fault concerned a bucket-handle lesion of the caudal horn of the medial meniscus, part of which was displaced cranially by the medial femoral condyle and due to inexperience mistaken for the cranial edge of a normal meniscus during arthroscopy. The second fault in the arthroscopic meniscal evaluation was due to the flounce appearance of the inner edge of the meniscus in flexion mistaken for a transverse meniscal rupture. Both errors in the diagnosis were associated with the misinterpretation of medial meniscus condition. This fact can be explained by difficulties in the examination of the caudomedial joint compartment. The success of the arthroscopic diagnosis depends, above all, on experience with this surgical procedure. Arthroscopy is very demanding with respect to the practical experience and initial failures often provide great temptation to perform arthrotomy. Structures that are hard to access, such as the menisci (often covered by remnants of infrapatellar fat), may be difficult to examine. Above all, this is true in the caudal horns of menisci. Even in human medicine, these are not always accessible for precise examination during arthroscopy. This may cause up to more than 23% of false negative diagnoses when these parts of menisci are affected (Wagner-Manslau 1988). Also Van Gestel (1985) mentioned inaccuracies in arthroscopic diagnosis of meniscal lesions in cases evaluated by inexperienced surgeons. The improvement of reliability of arthroscopic diagnosis is highly related to increasing experience of the surgeon in arthroscopy. From our results it is clear that relatively well accessible structures can be completely examined with the same certainty as during arthrotomy (CCL rupture, signs of osteoarthritis on the articular cartilage and joint capsule) even when one is beginning to learn arthroscopy. In spite of this, longterm experience and routine performance of arthroscopy considerably improve the sensitivity of this method and decrease the time necessary to perform the procedure.

Arthroscopy offers many advantages especially in the early diagnosis of partial CCL rupture. In such cases there is a possibility to find even minor changes in the ligament function due to the loss of its functional integrity, as well as to examine the menisci (Hulse 2001a). It also considerably contributes to the diagnosis pathological changes in the knee, because it is easy to visualise the synovial membrane of the joint capsule, which cannot be reliably evaluated by commonly used diagnostic methods (clinical and radiographic examination, arthrocentesis, synovial fluid examination).

The ability to examine joint structures depends not only on the technique of the procedure but also on the construction of the arthroscope. The optical system of the arthroscope is arranged to provide the best viewing field. The terminal lens of the arthroscope is diverted from the long axis usually by 30°. The viewing range can thus be enlarged to about 115° by rotating the arthroscope around its long axis (Taylor 1999). It is a compromise between the best viewing range and spatial orientation ability. If the viewing range is smaller, it does not markedly enlarge the view of the scope, while greater range distorts the reality. In both cases there can be orientation problems in the intraarticular space and difficulties in instrument manipulation under arthroscopic control, because the long axis of the arthroscope is considerably diverted from the viewing angle. That is why we use almost exclusively lens angles of 25-30° in small animal arthroscopy. Dimensions of the working part of the telescope play also an important role. Arthroscopes of smaller diameters can be used to examine smaller joints. Larger rigid arthroscopes, on the other hand, do not provide this possibility especially in smaller canine patients (Hulse 2001b). However, one must consider, that the smaller the diameter the more fragile the arthroscope.

According to our experience with arthroscopy of the stifle it is necessary to conclude that visualisation of intraarticular structures within the stifle joint is considerably decreased by infrapatellar fat. Removal of the fat pad by a shaver is quite inevitable. The selection of improper or smaller shaver blades can not only considerably prolong the time of surgery, but also decrease the quality of visualisation by insufficient fat pad removal. Achieving some skills, it is possible to quickly remove the fat pad and increase the efficiency of the procedure.

A fluid pump is indispensable for stifle arthroscopy. It provides precise dosage of fluid flow through the joint. It maintains the selected fluid flow and pressure throughout the operation. Even though these parameters seem be banal in comparison to others, in our opinion it is the appropriate and continual fluid flow that limits the reliability of the arthroscopic diagnosis. Low flow is inadequate to flush the joint and so the visualisation is poor. For example, fragments created when removing lesions of cartilage and bleeding make further continuation of the procedure impossible. On the other hand, high pressure of the fluid may escape into the periarticular space and cause joint capsule collapse, and thus totally impairing further work with the arthroscope within the joint. It is then necessary to abort arthroscopy and perform an open arthrotomy in order to finish required surgical procedure. Fluid accumulating in the subfascial space can cause complications such as ischemia of periarticular soft tissues. The fluid pressure is therefore increased only temporarily at times of sudden bleeding into the joint or low visualisation due to other reasons. Thorough lavaging of the joint cavity during arthroscopy proved advantages for the patient, because it removes inflammatory mediators and soothes the post op inflammation. Non-saline solutions such as the Ringer´s or lactated Ringer´s solution are generally used to flush the joint during arthroscopy because, contrary to the saline ones, they cause less damage to chondrocytes (Reagan and McInery 1983).

Arthroscopy in the CCL rupture diagnosis, when routinely mastered, is relatively time sparing and brings about relevant diagnostic results. In our study the results almost agreed with the examination of intraarticular structures during arthrotomy. Positive aspects of arthroscopy are both minimal trauma to the patient and relatively quickly obtained results of high informative value. Disadvantages are the high financial cost of the equipment, personnel requirements and a long and demanding way to get skilled (Taylor 1999). The fact that this surgical technique needs skill and experience is witnessed by diagnostic faults we made introducing it into clinical practice.

Spolehlivost artroskopické diagnostiky patologických změn v kolenním kloubu při ruptuře předního zkříženého vazu

Artroskopie se stává moderní miniinvazivní metodou diagnostiky a terapie ruptury předního zkříženého vazu v kolenním kloubu u psů. V této studii byly artroskopicky asistovanou technikou diagnostikovány a řešeny čtyřicet dva případy jeho ruptury. Každá artroskopická operace byla převedena na artrotomii pro ověření správnosti nálezů. V porovnání s artrotomií kolenního kloubu se spolehlivost artroskopicky zjištěných nálezů pohybovala podle typu diagnostikované léze a postižené nitrokloubní tkáně v kolenním

kloubu s rupturou CCL od 92 % do 100 %. Stoprocentní spolehlivost artroskopických nálezů byla zaznamenána při hodnocení integrity předního zkříženého vazu. Chybná diagnóza byla stanovena ve dvou z 25 případů poškození mediálního menisku. Artroskopické hodnocení stavu kloubní chrupavky a synoviální membrány bylo velmi přesné a detailnější než při artrotomii.

Artroskopie tedy při rutinním zvládnutí její techniky může být spolehlivou diagnostickou metodou zaručující současně miniinvazivitu při vyšetření intraartikulárních struktur v kolenním kloubu s rupturou CCL.

Acknowledgements

This work was supported by the Ministry of Education, Youth and Sports of the Czech Republic (Research Project No. 161700002).

References

ARNOCZKY, SP, MARSHALL, JL 1977: The cruciate ligament of the canine stifle: an anatomical and functional analysis. Am J Vet Res **38**: 1807-1814
BARNES, AJ 1977: Rupture of the anterior cruciate ligament of the dog: A survey from practices in the Kent region BSAVA. J Small Anim Pract **18**: 55-57
BERTONE, AL, MC IlWRAITH, CW 1987: Arthroscopic surgical approaches and intraarticular anatomy of the equine shoulder joint. Vet Surg **16**: 312-317
BERTONE, AL, MC IlWRAITH, CW, POWERS, BE, TROTTER, GW, STASHAK, TS 1987: Arthroscopic surgery for the treatment of osteochondrosis in the equine shoulder joint. Vet Surg **16**: 303-311
DOVERSPIKE, M, VASSEUR, PB, HARB, MF, WALLS, CM 1993: Contralateral cranial cruciate ligament disease in the dog. J Am Anim Hosp Assoc **29**:167-170
GORING, RL, PRICE, C 1987: Arthroscopical examination of the canine scapulohumeral joint. J Am Anim Hosp Assoc **25**: 55l-555
HULSE, DA 2001a: Arthroscopy of the knee. Proceedings of practical course in arthroscopy and endosurgery, Milovy, Czech Republic, pp. 11-12
HULSE, DA 2001b: Equipment and instrumentation for arthroscopically assisted joint surgeries. Proceedings of practical course in arthroscopy and endosurgery, Milovy, Czech Republic, pp.11-12
JOHNSON, JA, AUSTIN, C, BREUR, GJ 1994: Incidence of canine appendicular musculoskeletal disorders in 16 veterinary teaching hospitals from 1980 through 1989. Vet Comp Orthop Trauma **7**: 56-69
KIVUMBI, CW, BENNETT, D 1981: Arthroscopy of the canine stifle. Vet Rec **109**: 241-249
KNEZEVIC, PF, WRUHS, O 1977: Arthroscopy in the horse, ox, pig, and dog. Vet Med Rev. **1**: 55-63
MC IlWRAITH, CW 1989: Diagnostic and surgical arthroscopy in the horse, 2nd ed. Lea & Febiger, Philadelphia, 227 p.
MC LAUGHLIN, RM, HURTIG, RM, FRIES, CL 1989: Operative arthroscopy in the treatment of bilateral stifle osteochondritis dissecans in a dog. Comp Cont Edu Pract Vet **4**: 58-l6l
MILLER, CW, PRESNELL, KR 1985: Examination of the canine stifle: arthroscopy versus arthrotomy. J Am Anim Hosp Assoc **21**: 625-629
NEâAS, A, ZATLOUKAL, J, KECOVÁ, H, DVO¤ÁK, M 2000: Breed predisposition of dogs to the cranial cruciate ligament rupture. Acta Vet Brno **69**: 305-310
NIXON, AJ 1987: Diagnostic and surgical arthroscopy of the equine shoulder joint. Vet Surg **16**: 44-52
PERSON, MW 1986: Arthroscopy of the canine shoulder joint. Comp Cont Edu Pract Vet **8**: 557-548
PERSON, MW 1989a: Arthroscopy of the canine coxofemoral joint. Comp Cont Edu Pract Vet **11**: 950-935
PERSON, MW 1989b: Arthroscopic treatment of osteochondritis dissecans in the canine shoulder. Vet Surg **18**: 175-189
PIERMATTEI, DL, GREELEY, RG 1979: An atlas of surgical approaches to the bones of the dog and cat. 2nd ed. W.B. Saunders, Philadelphia, pp. 164-165
REAGAN, BF, MC INERY, VK 1983: Irrigation solutions for arthroscopy. J Bone Joint Surg **65A**: 629-631
SIEMERING, GB 1978: Arthroscopy of dogs. J Am Vet Med Assoc **172**: 575-577
TAYLOR, RA 1999: Arthroscopy. In: TAMS, TR: Small animal endoscopy. 2nd ed. Mosby, London, pp. 461-470
VAN GESTEL, MA 1985: Diagnostic accuracy of stifle arthroscopy in the dog. J Am Anim Hosp Assoc **21**: 757-763
VAN RYSSEN, B, VAN BREE, H 1989: Mogelijkheden voor het gebruik van de arthroscoop bij kleine huisdieren: een literatuuroverzicht. Vlaams Diergeneeskd Tijdschr **58**: 184-189
WAGNER-MANSLAU, C, RUPP, N, PAAR, O, RODAMMER, G 1988: Computer tomography of the menisci. ROFO Forschr. Geb Rontgenstr Nuklearmed **149**: 392-395
WHITEHAIR, JG, VASSEUR, PB, WILLITS, NH 1993: Epidemiology of cranial cruciate ligament rupture in dogs. J Am Vet Med Assoc **203**: 1016-1019

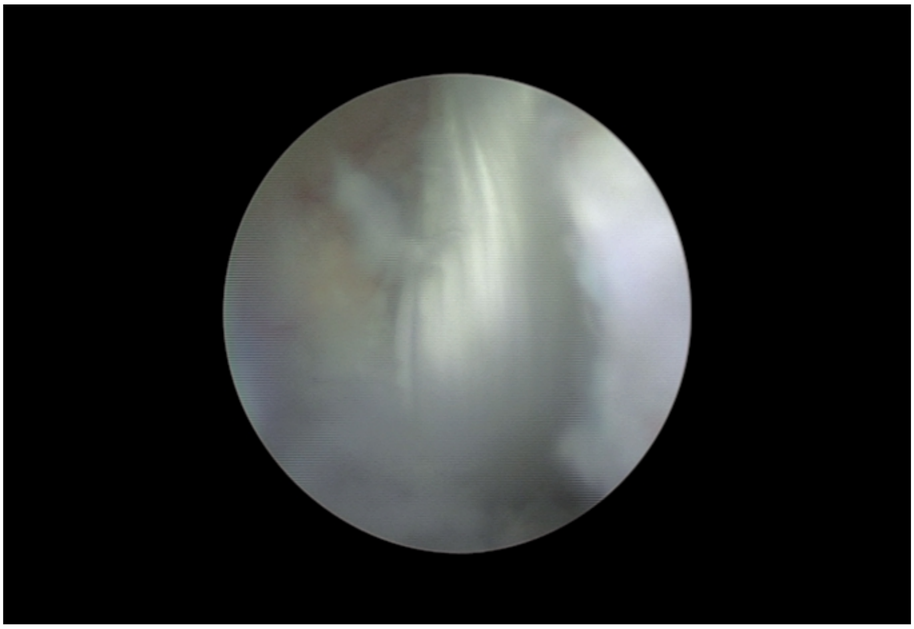

Fig 1. Fibrous remnants of the cranial cruciate ligament after its rupture; the caudal ligament stays intact.

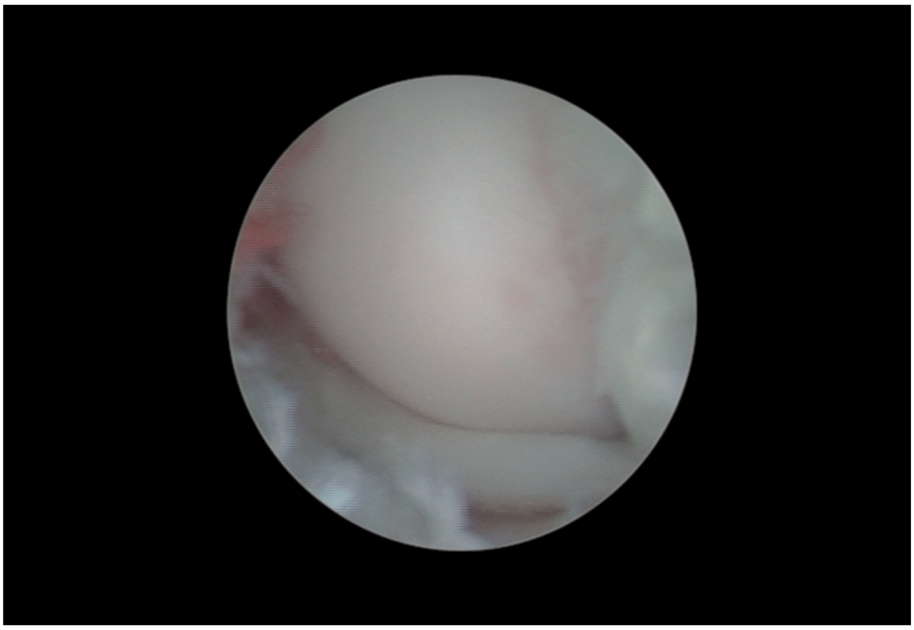

Fig 2. Arthroscopic view of the cranially displaced part of the caudal horn of the medial meniscus in bucket-handle lesions.

Plate XIII

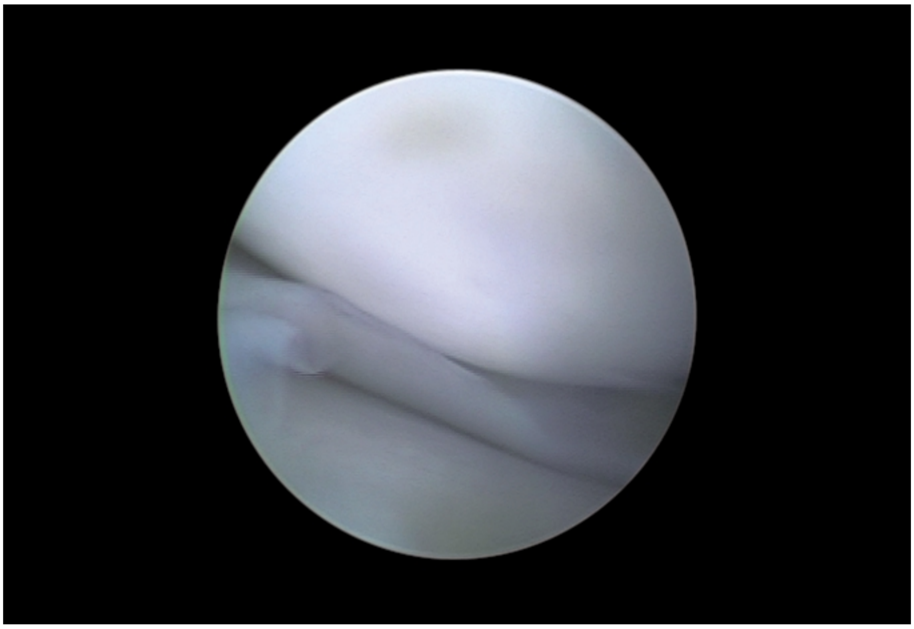

Fig 3. Flounce appearance of the inner edge of a normal medial meniscus in a flexed stifle.

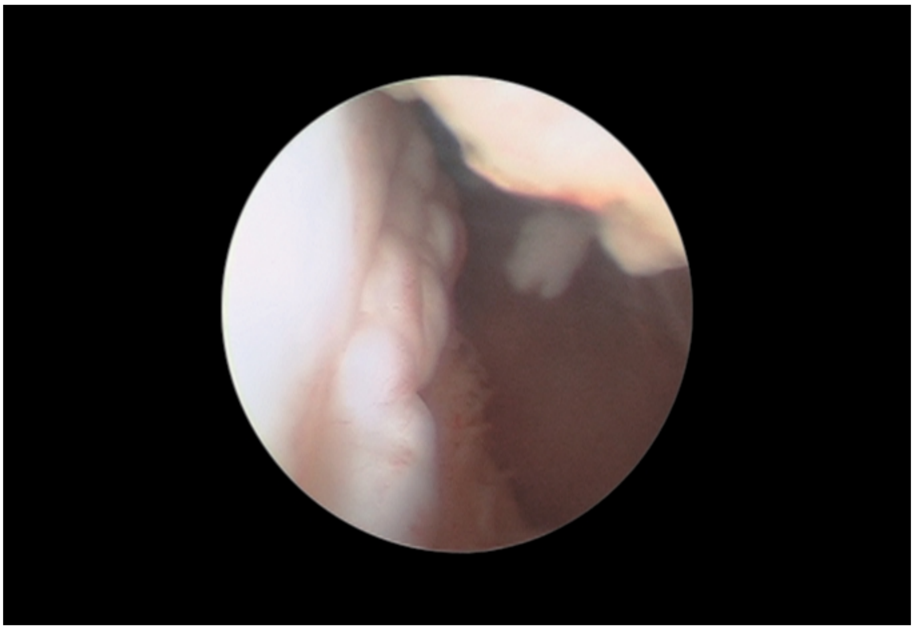

Fig 4. Osteophytes on the lateral femoral condyle in the stifle with CCL rupture.

Plate XIV

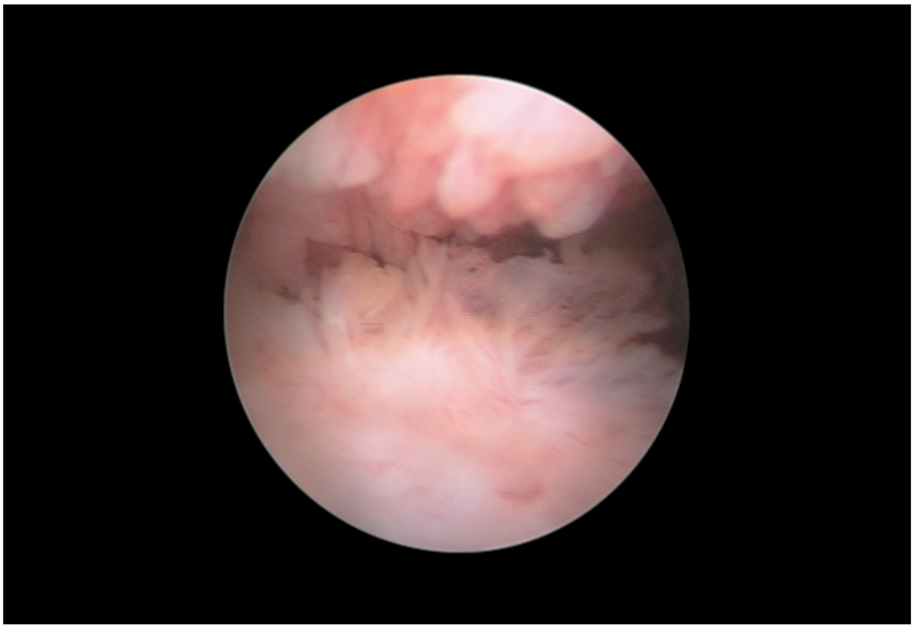

Fig 5. Multiplication and hyperaemia of synovial folds of the joint capsule in the stifle with CCL rupture.