ULTRASONOGRAPHIC, COMPUTED TOMOGRAPHIC, CT-ARTHROGRAPHIC DESCRIPTION OF NORMAL INTRA-ARTICULAR ANATOMY OF THE CANINE STIFLE: A CADAVERIC COMPARATIVE STUDY

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Figure 1. Cranial longitudinal ultrasonographic scan of the Cranial cruciate ligament (asterisk) and Patellar tendon (white arrow).

Figure 2. Lateral longitudinal scan of the lateral meniscus.

AIM OF THE STUDY

This comparative Ex-Vivo study allowed us to improve our knowledge of ultrasound anatomy of the main intra-articular structures of the dog's healthy knee, with the aim of analyzing the strengths and weaknesses of this diagnostic method.

MATERIALS AND METHODS:

We performed at first an ultrasound examination focusing on the CCL, the patellar tendon and the menisci; then we performed a CT scan and CT- arthrography (CTA) examination on the same joint.The CT images were read using both hard and soft tissue algorithms, and the image quality was carefully evaluated depending on which CT algorithm was used. For CTA images, the distribution pathway of the contrast agent was described. Furthermore, in order to adequately understand the CCL sonoanatomy, a comparison between ultrasound images, CT and CTA scans has been performed. In order to prove the ultrasound identification of the CCL, the ligament was stained with methylene blue by means of a spinal needle inserted into the joint crossing the CCL fibers via ultrasound guidance; the right identification of the ligament was confirmed by the execution of an arthrotomy.
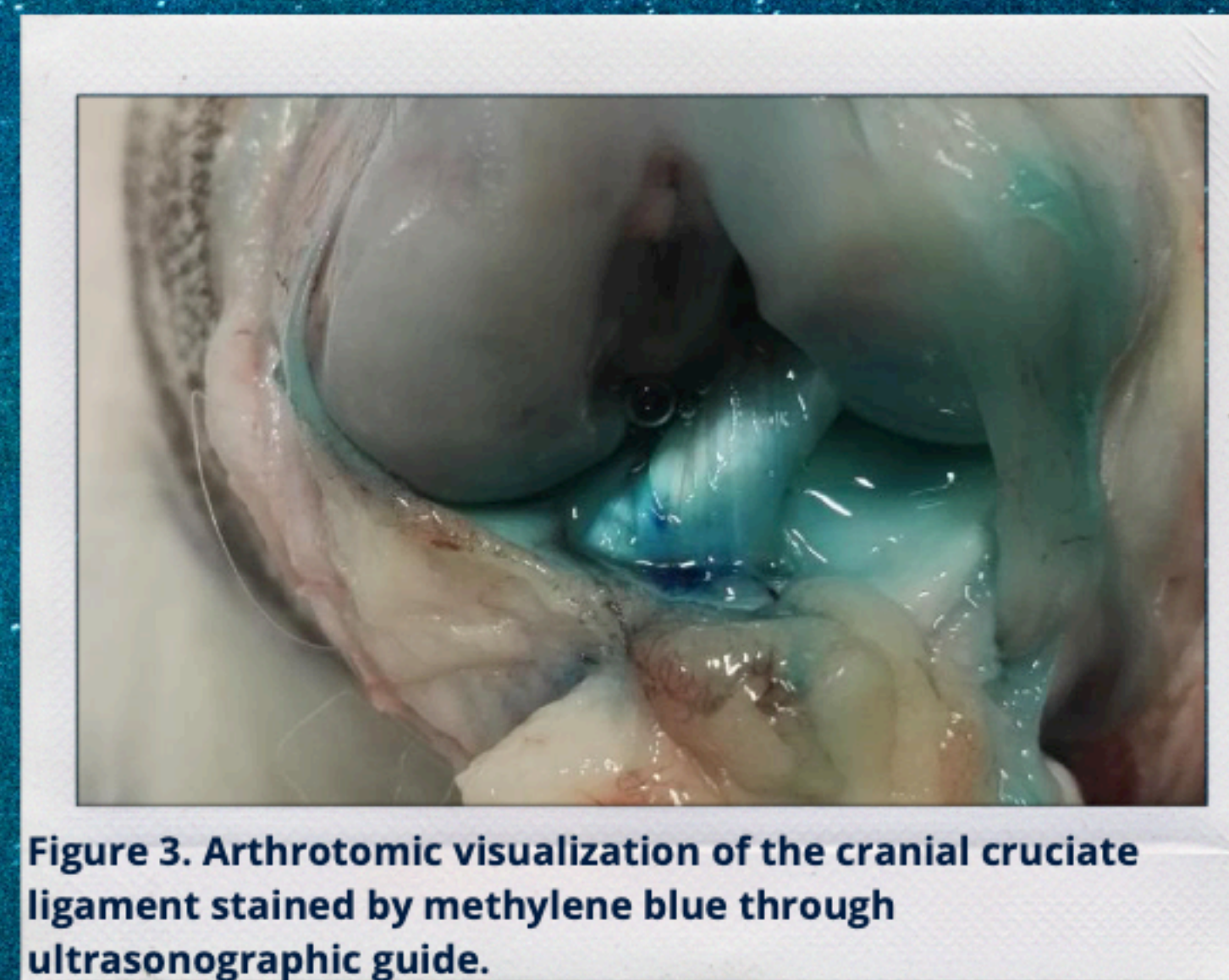

Figure 3. Arthrotomic visualization of the cranial cruciate ligament stained by methylene blue through ultrasonographic guide.

Structure	Criteria	Ultrasound
Cranial Cruciate Ligament	Overall visibility	0: Not visible
		1: Visible
Patellar Tendon	Visibility of the contour	0: Not visible
		1: Barely visible
		2: Moderately visible
		3: Clearly visible
	Linearity of the contour	0: Irregular outline
		1: Regular outline
	Appearance of the internal structure	0: No longitudinal echoes detected
		1: Moderate longitudinal pattern
		2: Clear longitudinal pattern
Menisci	Overall visibility of the external portion of the meniscal body	0: Not visible
		1: Barely visible
		2: Moderately visible
		3: Clearly visible
	Appearance of the internal structure	0: Non Homogeneous
		1: Homogeneous
	Shape	0: Not triangular
		1: Partially triangular
		2: Clearly triangular

Table 1. Evaluation criteria used for ultrasound to evaluate the menisci, patellar tendon and cranial cruciate ligament.

Criteria	Ultrasound examination	Medial Meniscus	Lateral Meniscus
Overall visibility of the external portion of the meniscal body	Not visible	0	0
	Barely visible	2	2
	Moderately visible	2	3
	Clearly visible	9	8
Appearance of the internal structure	Non Homogeneous	10	9
	Homogeneous	3	4
Shape	Not triangular	1	2
	Partially triangular	2	4
	Clearly triangular	10	7

Table 4-5. Ex-vivo results of the ultrasonographic evaluation of the cranial cruciate ligament (CrCL) and patellar tendon (PT) and menisci.

Criteria	Ultrasound examination	CrCL	PT
Overall visibility	Not visible	0	
	Visible	14	14
Visibility of the contour	Not visible	0	0
	Barely visible	3	0
	Moderately visible	0	0
	Clearly visible	8	14
Linearity of the contour	Irregular outline	3	
	Regular outline	11	14
Appearance of the internal structure	No longitudinal echoes detected	1	0
	Moderate longitudinal echo-pattern	4	0
	Clear longitudinal echo-pattern	9	14
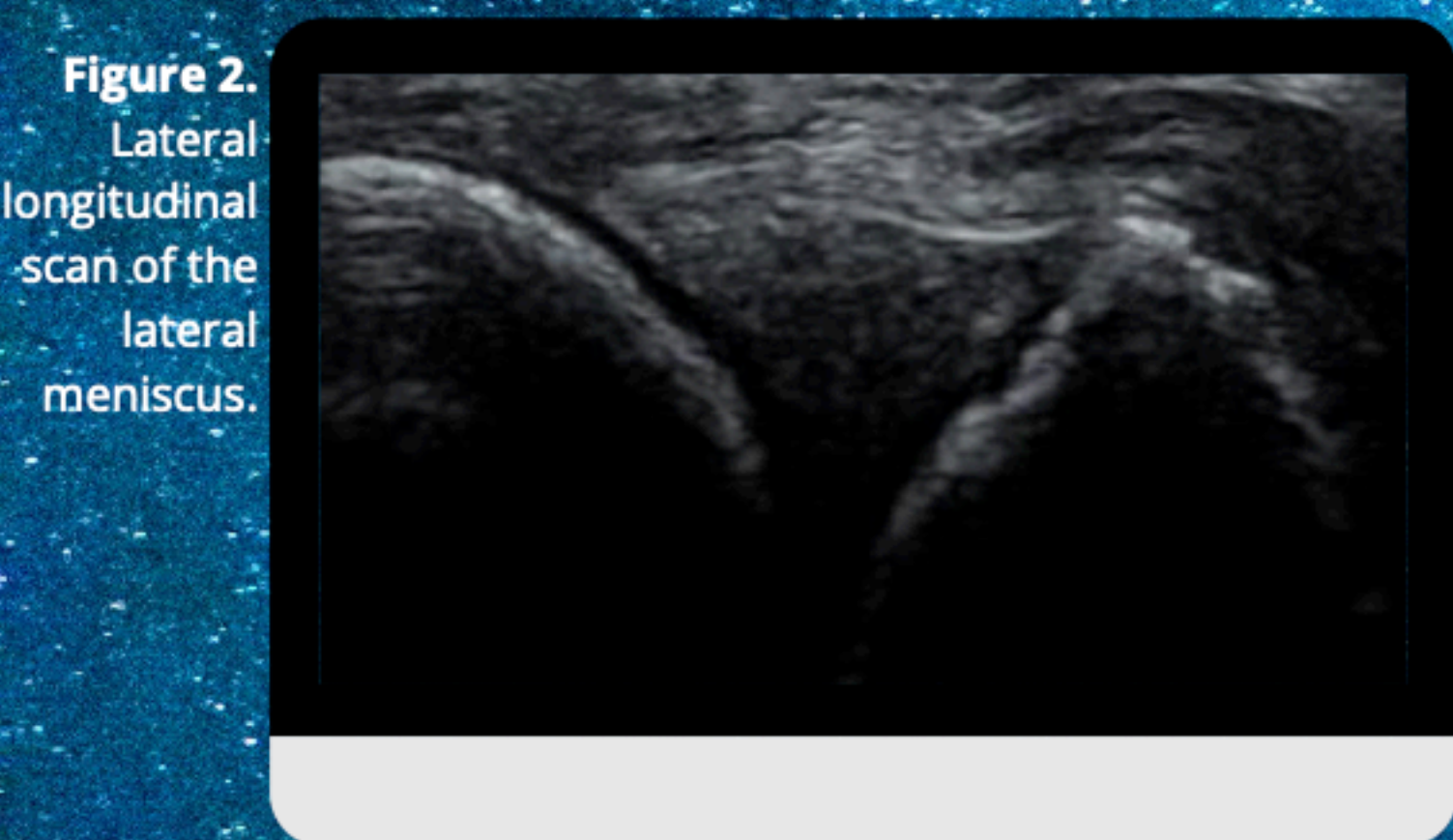
Criteria	CTA	CrCL	CaCL	LMFL	MM	LM
Overall visibility	Not visible	0	0	2	0	0
	Barely visible	3	3	2	7	5
	Moderately visible	5	5	4	4	6
	Clearly visible	3	3	3	0	0
Distribution of the contrast medium	Low	0	0	2	1	0
	Moderate	5	6	3	8	9
	Good	6	5	6	2	2
Appearance of the internal structure	Non Homogeneous	1	2	1	0	1
	Homogeneous	10	9	8	11	10

Criteria	TC-HAlgo	CrCL	CaCL	LMFL	MM	LM
Overall visibility	Not visible	3	3	5	3	2
	Barely visible	5	5	3	8	9
	Moderately visible	3	3	3	0	0
	Clearly visible	0	0	0	0	0
Visibility of the contour	Not visible	3	3	5	3	2
	Barely visible	7	7	5	8	9
	Moderately visible	1	1	1	0	0
	Clearly visible	0	0	0	0	0
Appearance of the internal structure	Non Homogeneous	0	0	0	0	0
	Homogeneous	8	8	6	8	9

Table 6-8. EX-vivo results of the tomographic evaluation with Hard tissue algorithm (Halgo) scans, Soft tissue algorithm (Salgo) scan and CT-artrograpghy (CTA) of Cranial (CrCL) and Caudal (CaCL) cruciate ligament, lateral meniscus-femoral ligament (LMFL), medial (MM) and lateral meniscus (LM)

Criteria	TC-SAlgo	CrCL	CaCL	LMFL	MM	LM
Overall visibility	Not visible	2	1	1	2	2
	Barely visible	3	4	6	6	6
	Moderately visible	6	6	4	3	3
	Clearly visible	0	0	0	0	0
Visibility of the contour	Not visible	2	1	1	2	2
	Barely visible	4	6	7	7	7
	Moderately visible	5	4	3	2	2
	Clearly visible	0	0	0	0	0
Appearance of the internal structure	Non Homogeneous	1	2	2	4	4
	Homogeneous	8	8	6	5	5

Structure	Criteria	CT
Cranial cruciate ligament	Overall visibility	0: Not visible
Caudal cruciate ligament		1: Barely visible
		2: Moderately visible
Lateral menisco-femoral ligament		3: Clearly visible
	Visibility of the contour	0: Not visible
		1: Barely visible
		2: Moderately visible
		3: Clearly visible
Menisci	Appearance of the internal structure	0: Non Homogeneous
		1: Homogeneous

Table 2 Evaluation criteria used for Computed Tomography (CT) to evaluate the cranial and caudal cruciate ligament, menisci and lateral menisco-femoral ligament.

Structure	Criteria	CTA
Cranial cruciate ligament	Overall visibility	0: Not visible
		1: Barely visible
Caudal cruciate ligament		2: Moderately visible
		3: Clearly visible
Lateral menisco-femoral ligament	Distribution of the contrast medium	0: Low
		1: Moderate
		2: Good
Menisci	Appearance of the internal structure	0: Non Homogeneous
		1: Homogeneous

Table 3. Evaluation criteria used for Computed Tomography Arthrography (CTA) to evaluate the cranial and caudal cruciate ligament, menisci and lateral menisco-femoral ligament.

Figures 4. Tomographic aspect of the CrCL (arrow) in para-sagittal scan with hard tissue algorithm. CT- Arthrography aspect of the Cranial Cruciate Lig. and lateral meniscus with length and width measurements (green lines).

Length: 2.244 cm

Length: 4.757 mm

Length: 2.487 cm

CONCLUSIONS: AWARE OF THE LIMITATIONS OF PERFORMING AN EX-VIVO STUDY, AN ULTRASONOGRAPHY EXAMINATION AND COMPARISON WITH HEALTHY AWAKE DOGS WAS PERFORMED. FINALLY, AN INNOVATIVE ULTRASOUND APPROACH TO THE STIFLE JOINT HAS BEEN TESTED AND DESCRIBED FOR THE FIRST TIME IN VETERINARY MEDICINE: THE CAUDAL FEMORAL- TIBIAL SCAN. THE RESULTS OBTAINED INDICATE THAT IN DOGS WEIGHING MORE THAN 25 KG, ULTRASONOGRAPHY IS A VALID DIAGNOSTIC METHOD FOR VISUALIZING THE CRANIAL-DISTAL PART OF THE CCL RUPTURE, WITH A CLEAR AND WELL-DEFINED MANNER. SIMILARLY, ULTRASONOGRAPHY EXAMINATION IS A DIAGNOSTIC TECHNIQUE CAPABLE OF ASSESSING THE STRUCTURE OF BOTH MENISCI WITH A HIGH ANATOMICAL DETAIL.

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