

MSK US of the canine shoulder in athlete dogs

Giliola Spattini
DVM, GP Cardio, CCRT, PhD, DECVDI



Thank to www.imaios.com

Objectives

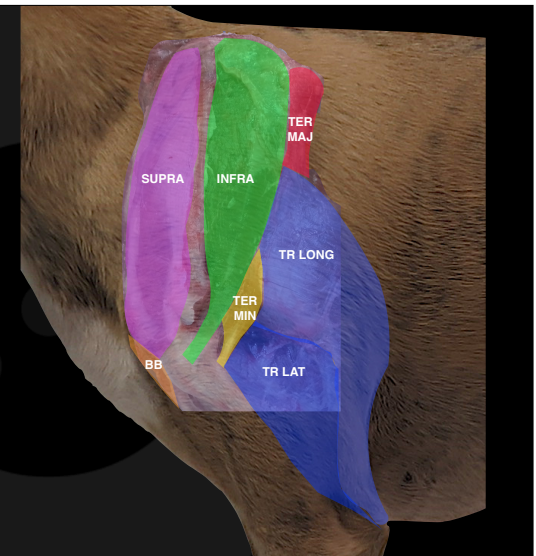
- Ultrasound has become an essential tool in the diagnosis of shoulder diseases
- A systematic approach is fundamental to increase the accuracy of the examination



Pain in shoulder region

Adapted from
"Canine Lameness", 2020

Ultrasonographic technique for the shoulder



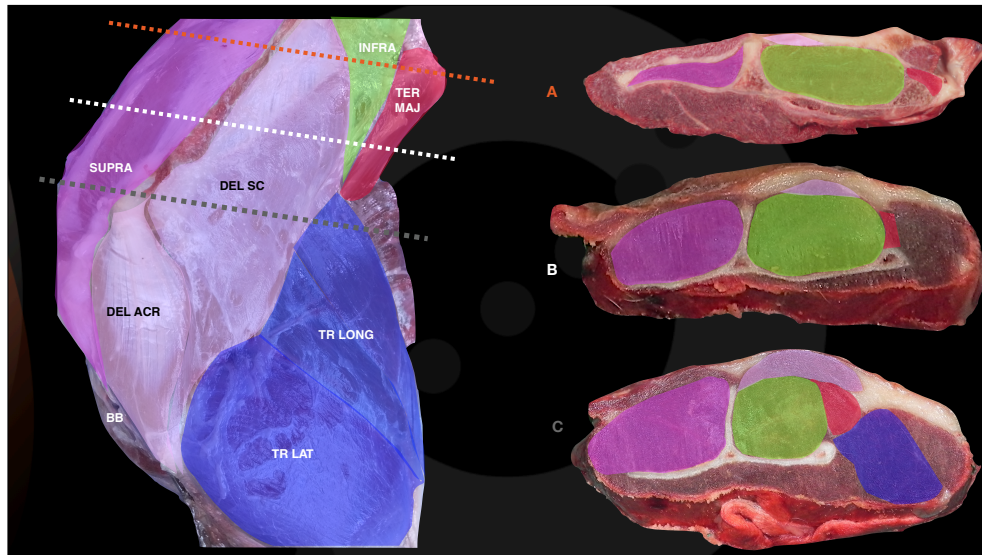
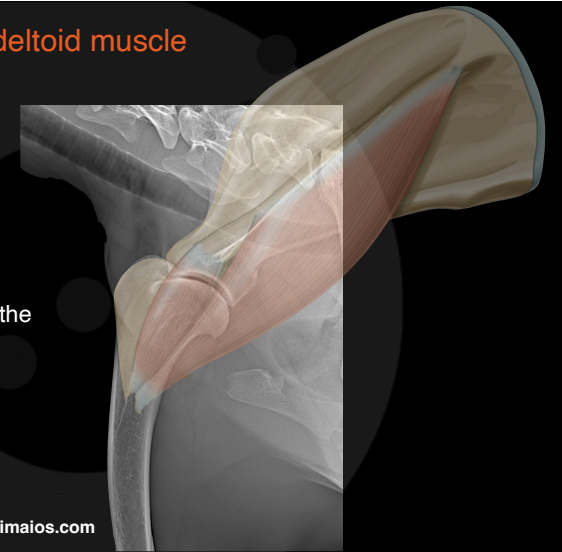
Gross anatomy of the shoulder

- Deltoides
- Infraspinatus
- Teres Major
- Triceps
- Supraspinatus
- BB
- Teres Minor



The deltoid muscle

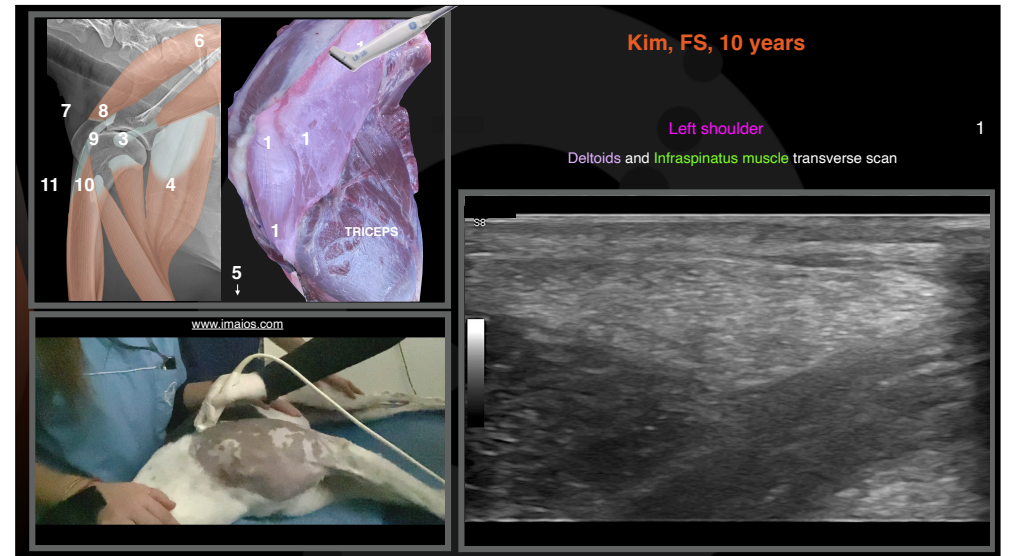
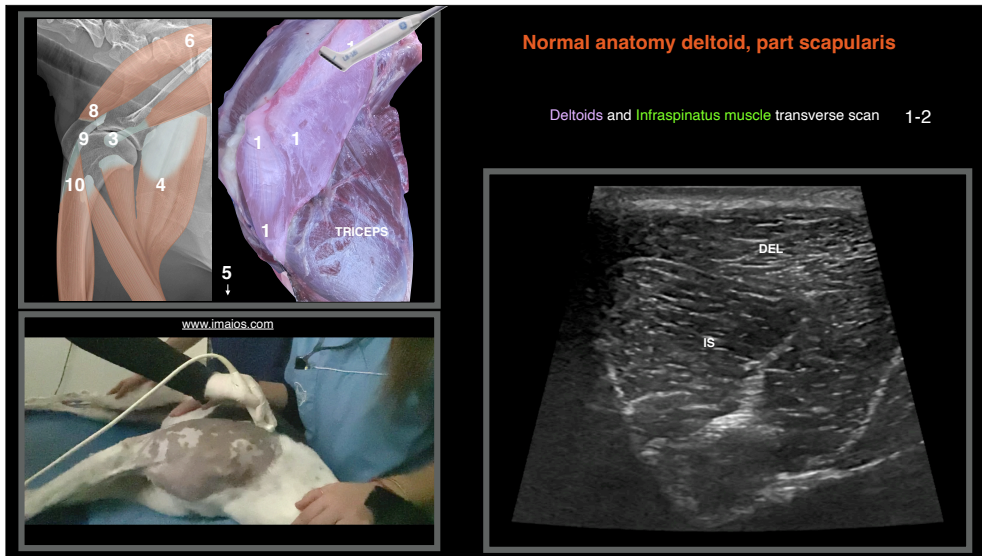
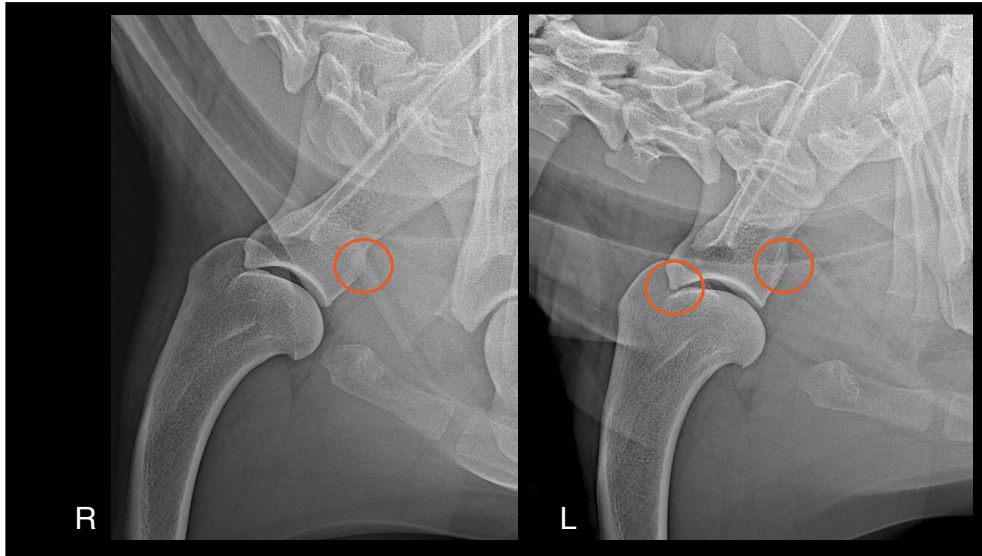
- Anti-gravity muscle
- Stabilises the shoulder when the foot is down (stance phase)

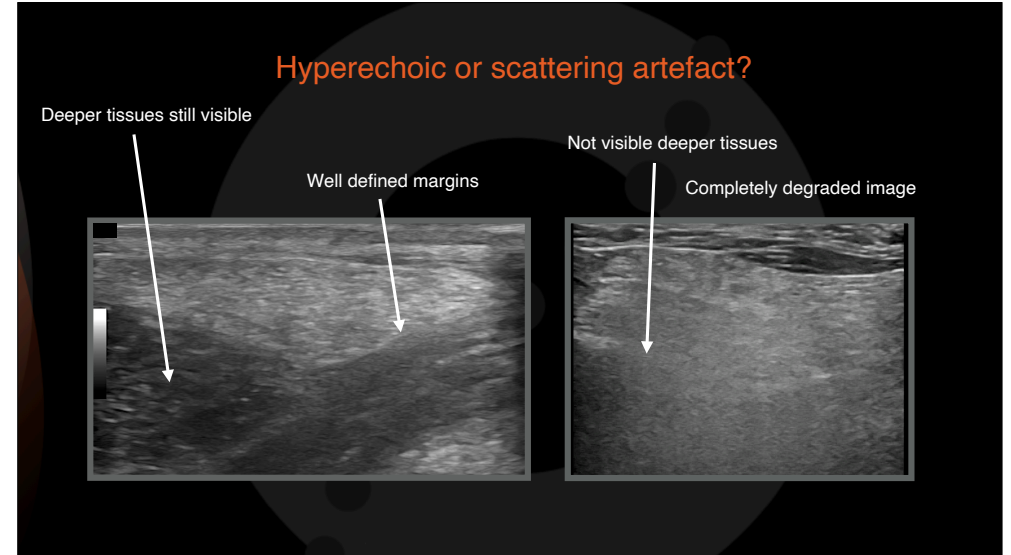
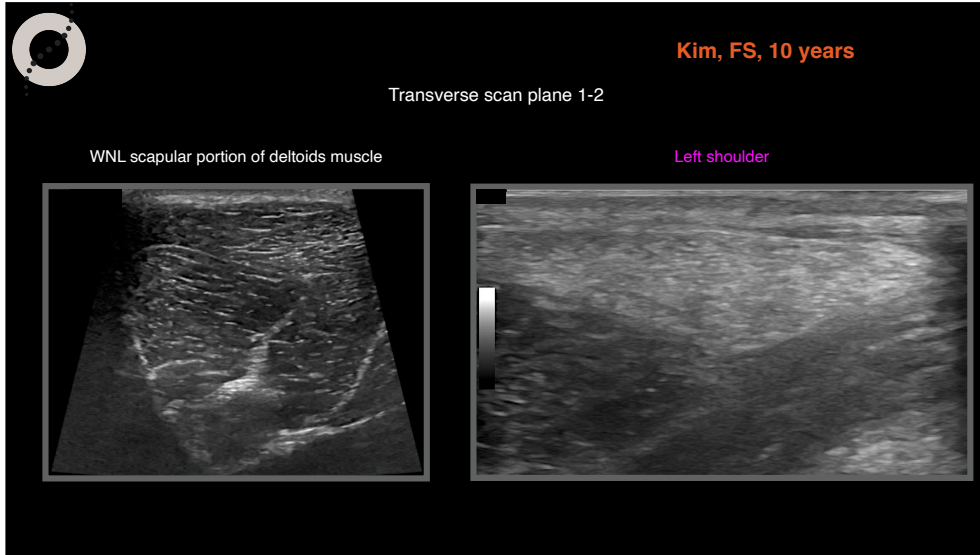


Kim, Golden, FS, 10 years

- For the last 3 months, lame on left front limb in the morning
- Pain in left shoulder and right elbow







PubMed

MUSCLE ECHOGENICITY

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MY CUSTOM FILTERS 922 results Page 1 of 93

RESULTS BY YEAR

1978 2025

PUBLICATION DATE

1 year 5 years 10 years Custom Range

1 Exploring the associations between skeletal **muscle echogenicity** and physical function in aging adults: A systematic review with meta-analyses.
Oranchuk DJ, Bodkin SG, Boncella KL, Harris-Love MO. J Sport Health Sci. 2024 Nov;13(6):820-840. doi: 10.1016/j.jshs.2024.05.005. Epub 2024 May 15. PMID: 38754733 Free PMC article.
However, relationships between **muscle echogenicity** and clinical functional assessments require authoritative analysis. Thus, we aimed to (a) synthesize the literature to assess the relationships between skeletal **muscle echogenicity** and physical functio ...

2 **Muscle Echogenicity** and Changes Related to Age and Body Mass Index.
Pereira AZ, Uezima CB, Zanella MT, Prado RRD, Gonzalez MC, Zheng J, Heymsfield SB. JPEN J Parenter Enteral Nutr. 2021 Sep;45(7):1591-1596. doi: 10.1002/jpen.2030. Epub 2020 Dec 8. PMID: 33111338
There was a positive correlation between age and thigh-**muscle echogenicity** ($r(p) = 0.534, P < .0001$) and a negative correlation between thigh-**muscle echogenicity** and thickness ($r(p) = -0.395, P < .0001$). There was high **muscle echogenicit**

sensors Sensors 2022, 22, 335. https://doi.org/10.3390/s22010335 MDPI

Article

Ultrasound Echogenicity as an Indicator of Muscle Fatigue during Functional Electrical Stimulation

Qiang Zhang ^{1,2}, Ashwin Iyer ^{1,2}, Krysten Lambeth ^{1,2}, Kang Kim ^{3,4,5,6} and Nitin Sharma ^{1,2,*}

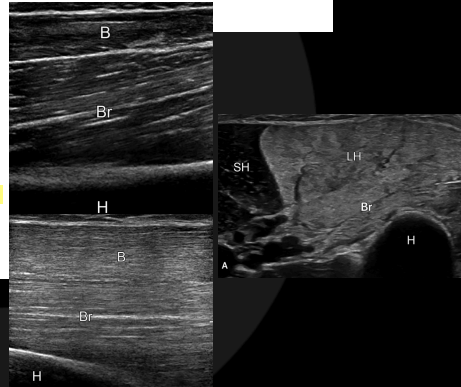
Grade I Grade II Grade III Grade IV

Ultrasound Findings of Delayed-Onset Muscle Soreness

©2016 by the American Institute of Ultrasound in Medicine | J Ultrasound Med 2016; 35:2517-2521 | 0278-4297 | www.aium.org

Victor Longo, DO, Jon A. Jacobson, MD, David P. Fessell, MD, Kenneth Mautner, MD

There are many causes of muscle pain, which include muscle strain, contusions, and tears; another cause of muscle pain is delayed-onset muscle soreness (DOMS), which is considered a type 1 muscle strain.^{1,2} Delayed-onset muscle soreness is the development of pain, soreness, or stiffness of the activated musculature after intense physical activity due to muscle microtrauma, resulting in inflammation and edema.² The onset of symptoms is approximately 24 hours after the activity, peaking at 48 to 72 hours, and resolving within 5 to 7 days after the inciting activity.^{2,3} Delayed-onset muscle soreness can predispose to increased risk of further injury,¹ hence the importance of accurate diagnosis.



Exploring the associations between skeletal muscle echogenicity and physical function in aging adults: A systematic review with meta-analyses

Dustin J. Oranchuk^{a,*}, Stephan G. Bodkin^{a,b}, Katie L. Boncella^a, Michael O. Harris-Love^a

^a Muscle Morphology, Mechanics, and Performance Laboratory, Department of Physical Medicine and Rehabilitation, University of Colorado Anschutz Medical Campus, Aurora, CO 80045, USA

^b Department of Physical Therapy and Athletic Training, University of Utah, Salt Lake City, UT 84108, USA

Received 11 January 2024; revised 18 February 2024; accepted 1 April 2024

Available online 15 May 2024

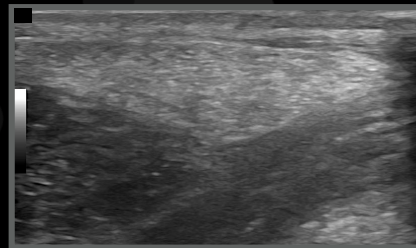
Assessment and quantification of skeletal muscle morphology and function within the aging population is vital for diagnosis, treatment, and injury/disease prevention. Sarcopenia, defined as the reduction in muscle mass and strength,¹ is a growing concern, with up to 25% of individuals over 70 years old receiving the diagnosis.² Early identification of the decline in skeletal muscle morphology and function can lead to appropriate therapies, such as exercise or nutritional interventions, which may improve patient outcomes.³ To date, screening measures to identify patients at risk for sarcopenia-related disability include patient-reported outcomes (such as the Strength, assistance with walking, rising from a chair, climbing stairs, and falls (SARC-F) questionnaire), objective

physical ability. We hypothesized that muscle echogenicity would be a moderate predictor of physical performance. Furthermore, we anticipated that the echogenicity of agonist muscle groups would correlate better with physical performance when compared to less obviously relevant muscle groups.

The results of this systematic review with meta-analyses demonstrate a consistent yet modest association between skeletal muscle echogenicity and physical function in aging adults. Additionally, sub-analyses show minimal between-muscle differences in correlations between echogenicity and physical function, suggesting that ultrasound-estimated muscle quality and composition are systemic. However, including multiple muscles tends

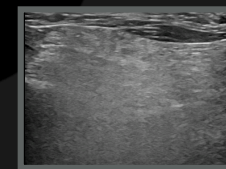
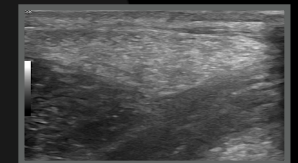
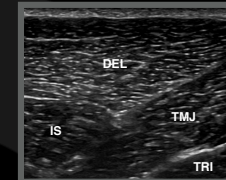
Muscle echogenicity

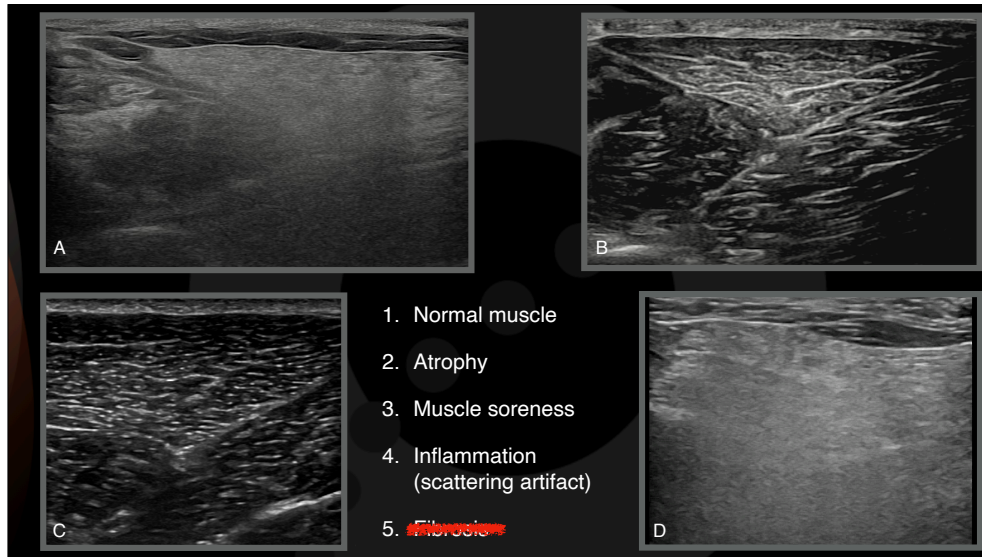
- One of the most common findings in MSK ultrasound
- Same change, different meaning
- Fundamental to differentiate between conditions





Increased echogenicity of Deltoid muscle:

- If there is no scattering artefact, consider atrophy
- If a scattering artefact is present: inflammation is there - check for pain





Increased echogenicity of Deltoid muscle. Meaning in our patient?


- Muscle soreness due to overuse? Very likely
- Check serratus ventralis - cervical and thoracic portions: antigravitational muscles

Kim was diagnosed with chronic left supraspinatus tendinopathy

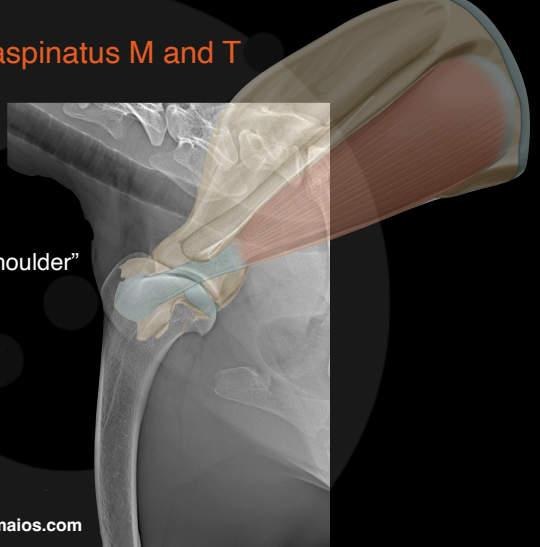
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Gross anatomy of the shoulder

- Deltoides
- **Infraspinatus**
- Teres Major
- Triceps
- Supraspinatus
- BB
- Teres Minor



The infraspinatus M and T



- “Lateral collateral ligament of the shoulder”
- Best tendon to start to scan

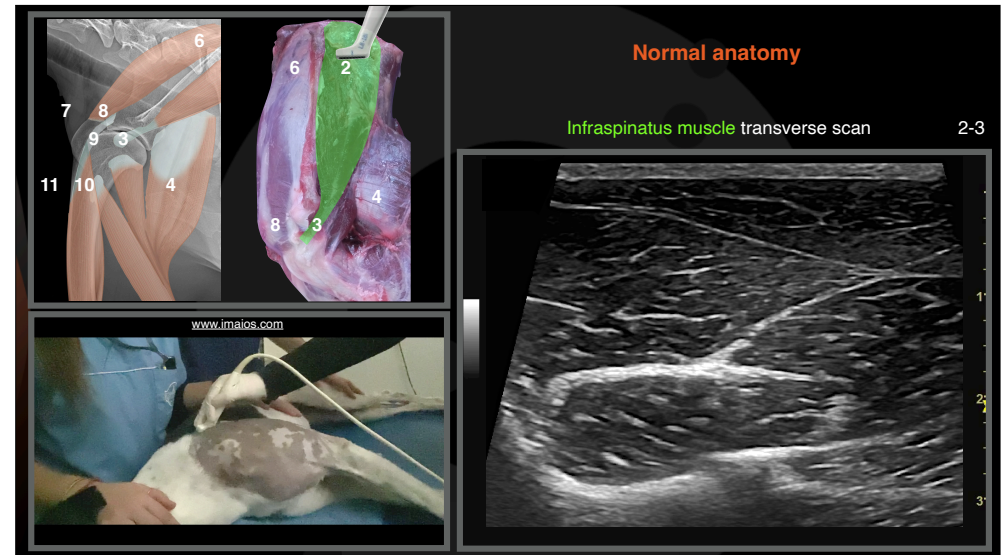
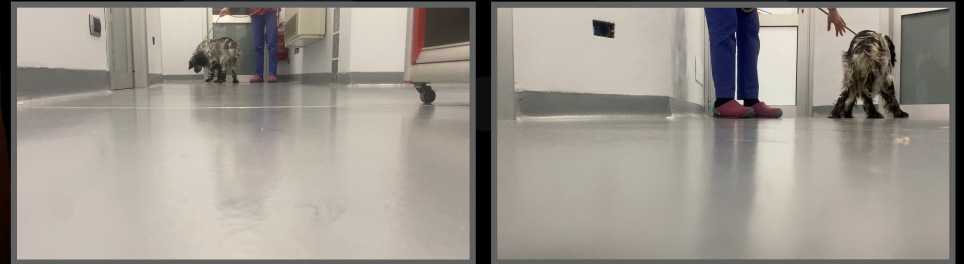
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Abbie, English Setter, FI, 7 years

- Suspected trauma three months ago
- Progressive left front lameness over the last three months
- Gait is unremarkable at rest but becomes abnormal after exercise
- Not responding to NSAID



Abbie, English Setter, FI, 7 years



Abbie, FI, 7 years
 Right shoulder
 Sound limb

Infraspinatus muscle transverse scan 2-3

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Abbie, FI, 7 years
 Left shoulder
 Affected limb

Infraspinatus muscle transverse scan 2-3

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Abbie, FI, 7 years
 Left shoulder

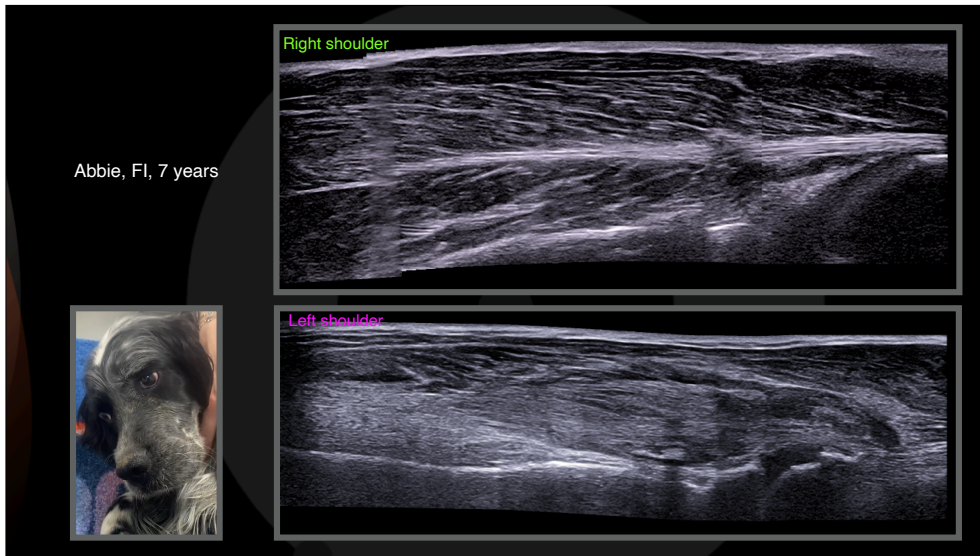
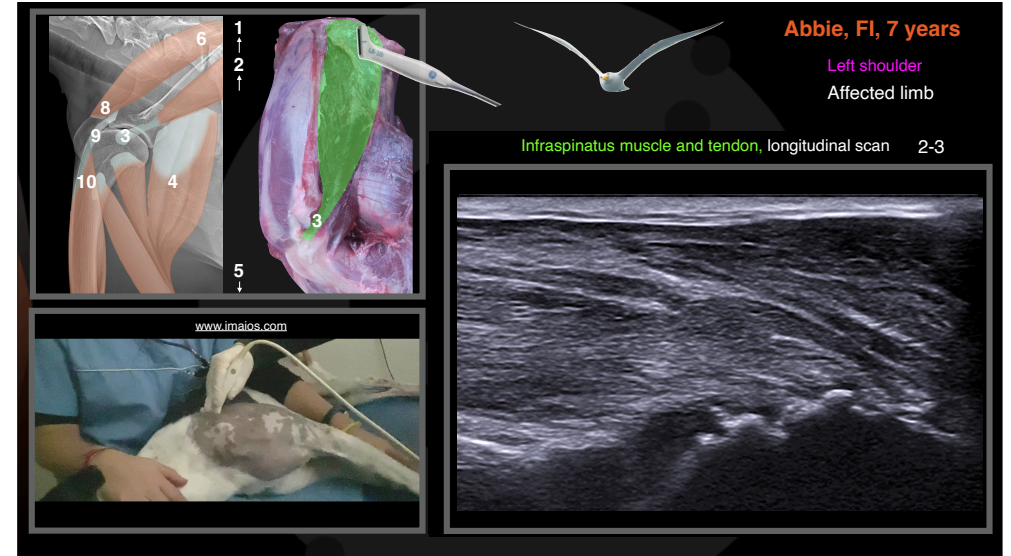
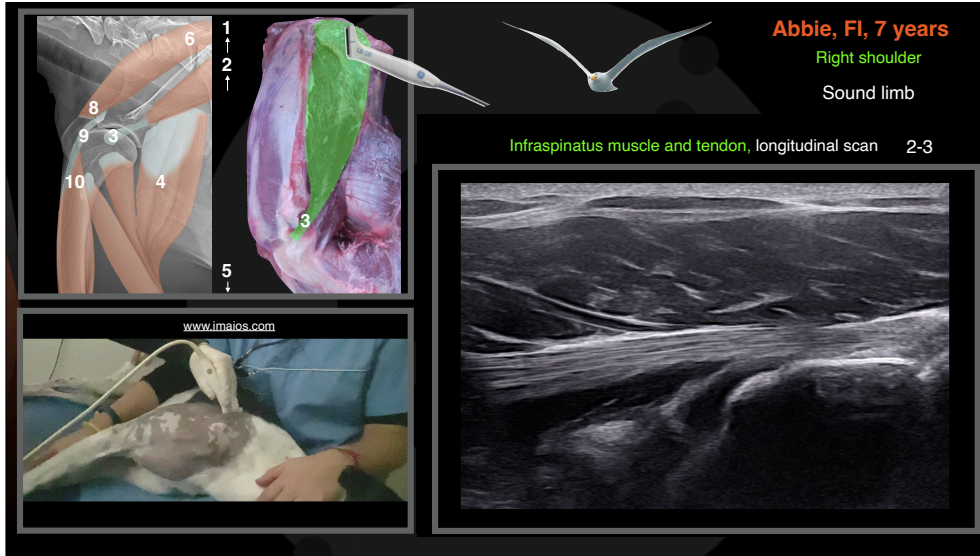
Infraspinatus muscle transverse scan 2-3

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Abbie, English Setter, FI, 7 years

Right shoulder
 Sound limb

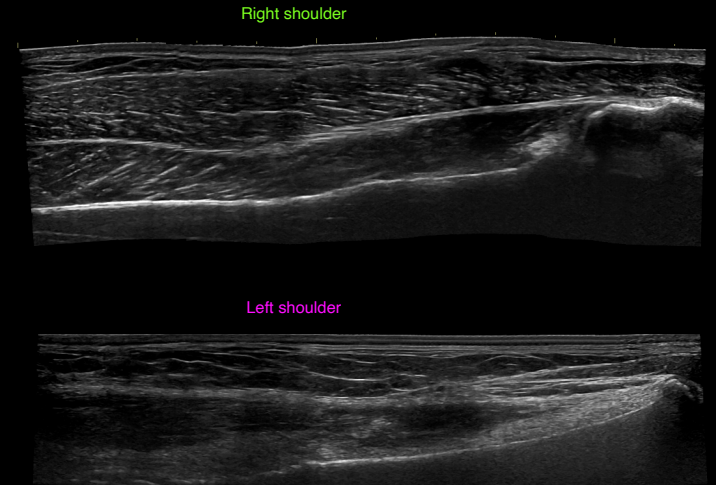
Left shoulder
 Affected limb



Abbie and Rena



Rena, FS, 5 years



- 1 year
- 5 years
- 10 years
- Custom Range

- Abstract
- Free full text
- Full text

- Infraspinus muscle contracture.**
1
Harasen G.
Cite
Can Vet J. 2005 Aug;46(8):751-2.
PMID: 16187723 [Free PMC article.](#) No abstract available.
- Fibrotic Contracture of the Infraspinus Muscle with or without Contracture of the Teres Minor Muscle: A Retrospective Study in Eight Dogs.**
2
Krystalli A, Papaefthymiou S, Panteli K, Sideri A, Pappa EI, Prassinos NN.
Animals (Basel). 2024 Sep 6;14(17):2589. doi: 10.3390/ani14172589.
PMID: 39272374 [Free PMC article.](#) Review.
(1) Background: Fibrotic contracture of the canine infraspinus muscle (FCIM) is considered an uncommon musculotendinous condition mainly affecting hunting dogs....The findings showed that 15 days post-operation, all dogs returned to full acti...
Cite
- The Shoulder Joint and Common Abnormalities.**
3
Stokes R, Dycus D.
Cite
Vet Clin North Am Small Anim Pract. 2021 Mar;51(2):323-341. doi: 10.1016/j.cvsm.2020.11.002. Epub 2021 Jan 11.
PMID: 33446362 Review.
This article provides an updated review of common canine shoulder pathologies, including osteochondrosis, bicipital and supraspinatus tendinopathies, infraspinus contracture, medial shoulder syndrome, and luxation...

Fibrotic Contracture of the Infraspinus Muscle with or without Contracture of the Teres Minor Muscle: A Retrospective Study in Eight Dogs

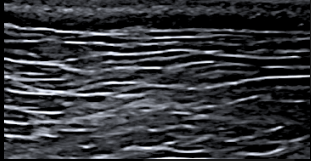
Androniki Krystalli ^{1,*}, Sofianos Papaefthymiou ¹, Kornilia Panteli ¹, Aikaterini Sideri ², Elena I. Pappa ² and Nikitas N. Prassinos ¹

Acute clinical signs include local pain, lameness, and swelling, which subside over one to four weeks after which the dogs progressively develop a persistent deformity, due to contracture [10,15]. In the standing position, they present elbow adduction and external rotation of the distal thoracic limb, and when walking, they show a characteristic circumducted gait abnormality of the distal limb with a carpal flip [6,11,17–19]. Atrophy of the spinatus muscle group and reduction in the range of shoulder flexion are frequently evident during orthopedic examination [8,13,20–22]. The causes of muscle contracture include repetitive strains and ischemia, infection, eosinophilic myositis, neoplasia, and myositis ossificans [14,15,23]. The most likely cause of FCIM appears to be trauma during exercise, leading to compartment syndrome, as hemorrhage, degeneration, atrophy, and fibrosis are the histological changes shown in infraspinus muscle biopsies [8,20].

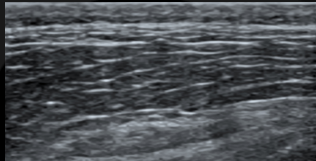
Radiographs of the shoulder joint appear normal, although, in some cases, they could show a narrowing of the scapulohumeral joint space [24], while ultrasonographic findings are a crucial diagnostic tool [8]. Biochemical blood analysis may show an elevation in CK [25]. The treatment consists of the tendon's tenotomy at its insertion and the breakdown of adhesions [8,19]. The prognosis is good, as the animals return to their vigorous life in one or two months [10,26].

Ultrasonographic correlation with histology

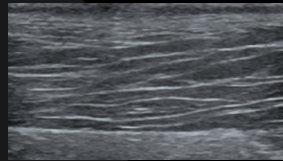
Fibrillar muscle pattern



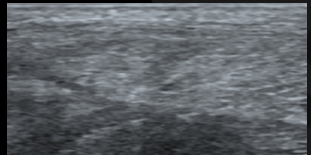
Moderate muscle atrophy



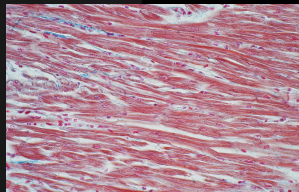
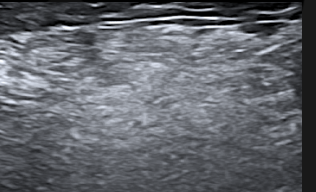
Severe muscle atrophy



Early phase muscle fibrosis



Late phase muscle fibrosis



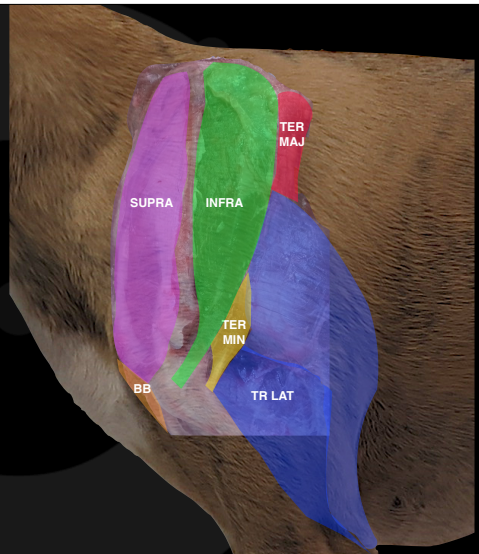
Abbie, English Setter, FI, 7 years

- Left infraspinatus muscle contracture
- Partially ruptured tendon
- Surgery?



Gross anatomy of the shoulder

- Deltoides
- Infraspinatus
- Teres Major
- Triceps
- Supraspinatus
- BB
- Teres Minor



Gross anatomy of the shoulder

- Deltoides
- Infraspinatus
- Teres Major
- Triceps
- Supraspinatus
- Biceps Brachii
- Subscapularis



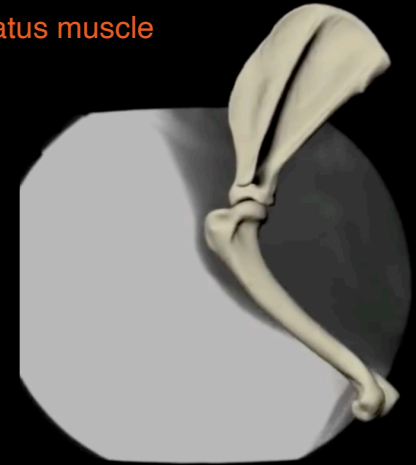
The supraspinatus muscle

- Carries the weight of the head
- Fibro-cartilagineous aponeurosis
- Low pain receptors density



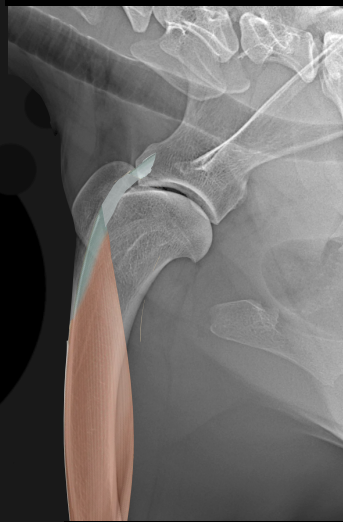
The supraspinatus muscle

- Stop the humerus from displacing cranially
- Carry the weight of the head



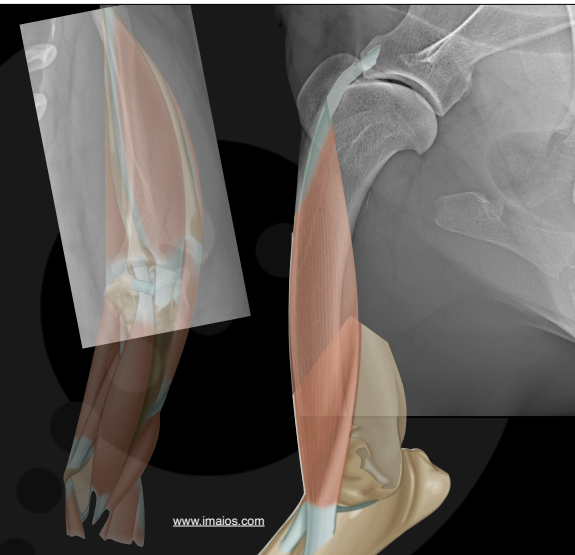
The biceps muscle

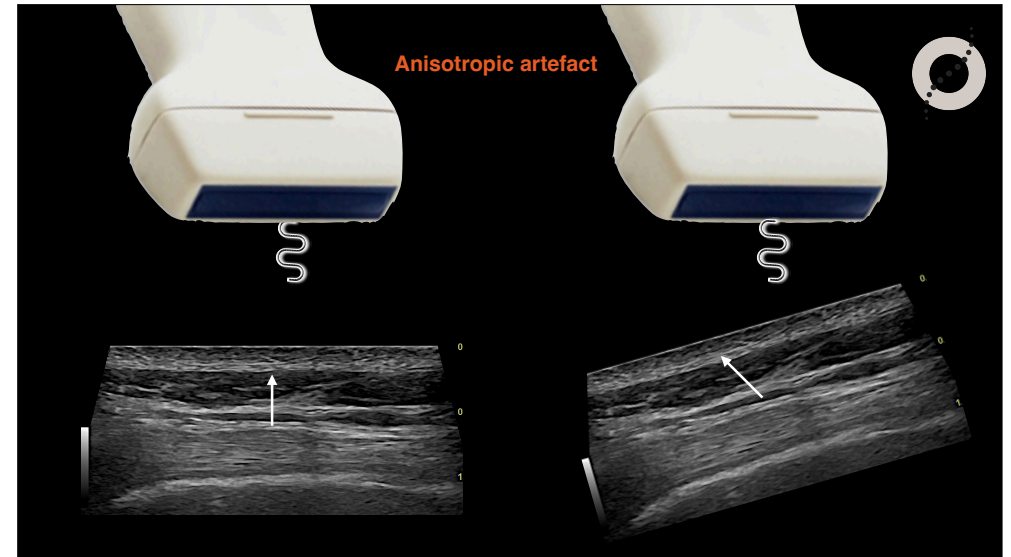
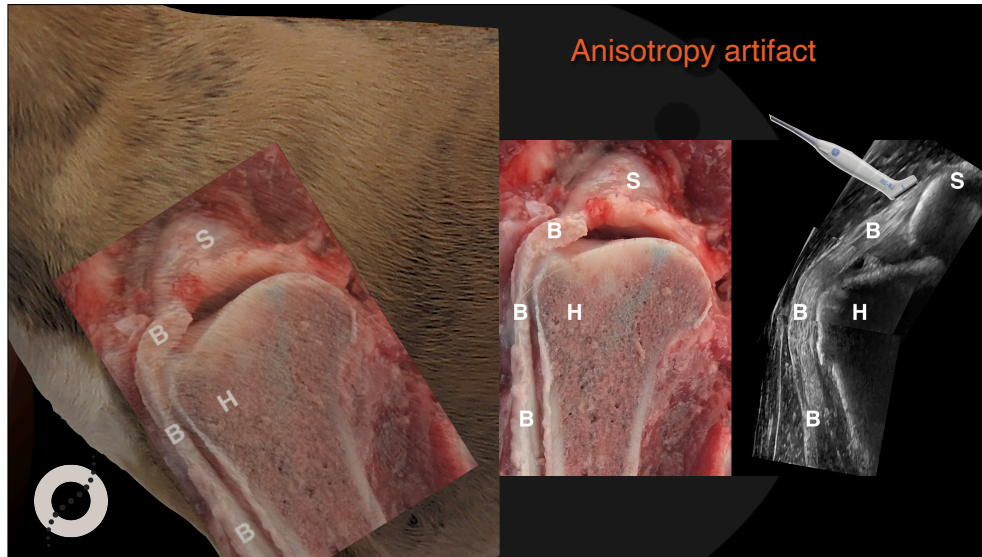
- A weak medial stabiliser of the shoulder
- Connect shoulder and elbow



The biceps muscle

- Connect shoulder and elbow
- Flex the elbow and extend the shoulder





Ultrasound of the normal canine supraspinatus tendon: comparison with gross anatomy and histology

Caroline Chloé Lassaigne¹, Charlotte Boyer², Lucile Sautier³, Olivier Taeymans³

Veterinary Record (2019) doi:10.1136/vetrec-2019-105552

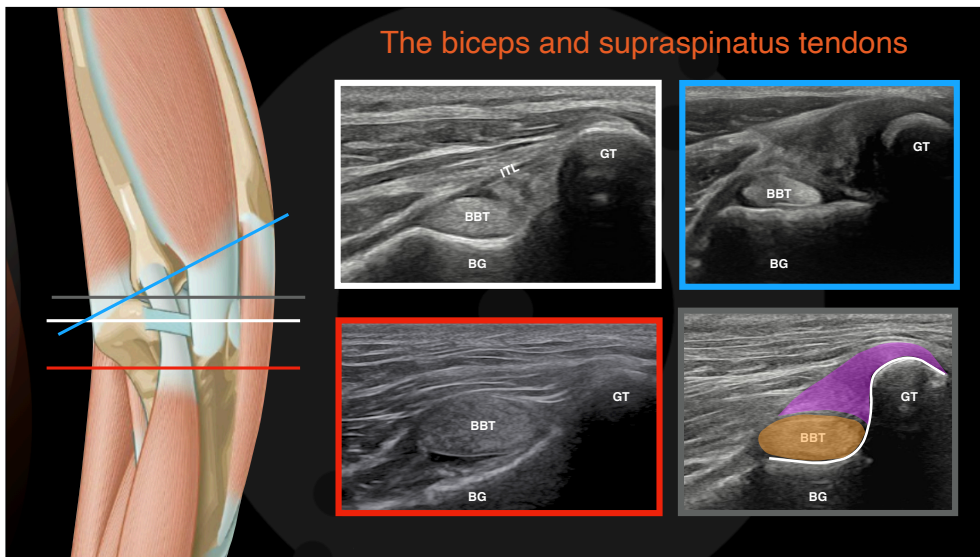
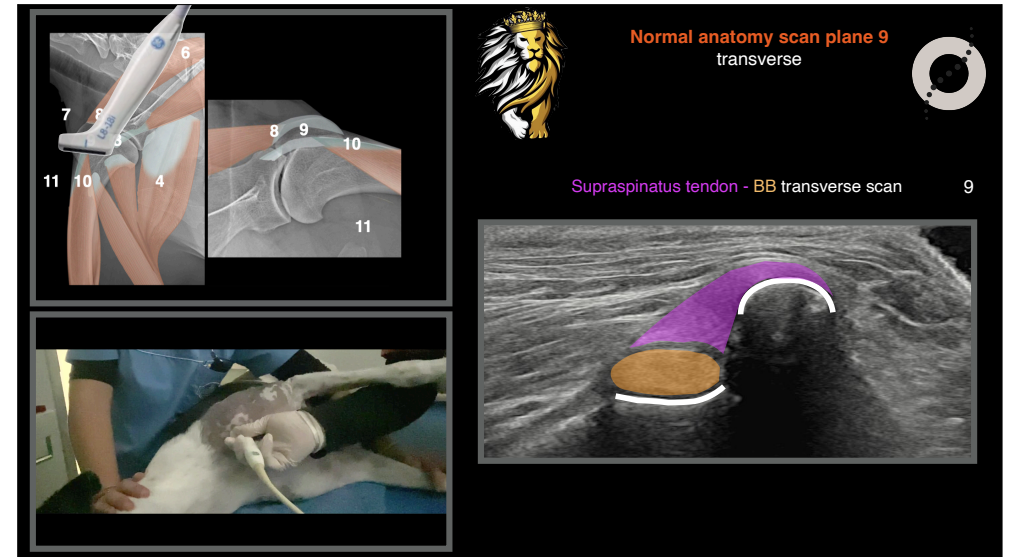
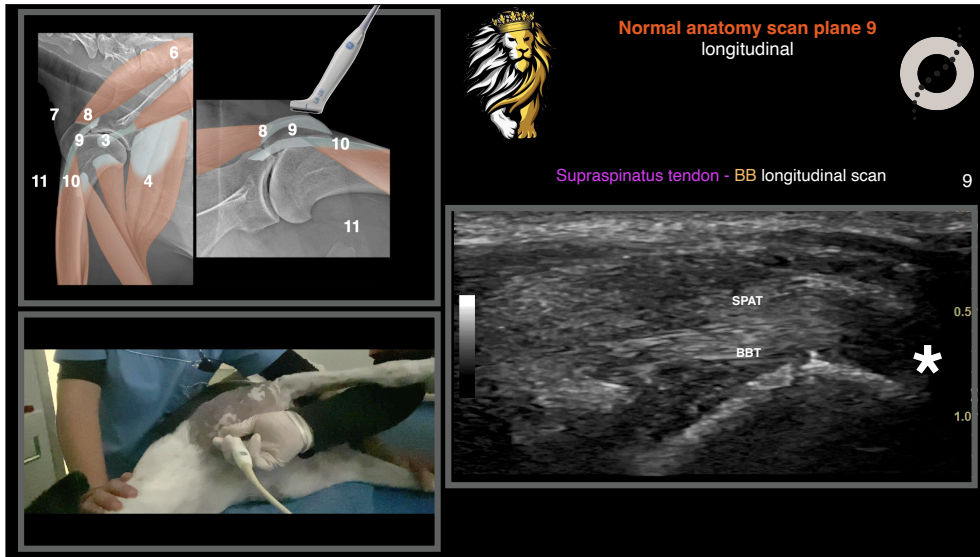
Supraspinatus tendon sustains 4,6 times the patient body weight during trot

There are few nervous terminations

Chronic supraspinatus tendinopathy in sportive dogs

- Repetitive traumas results in hemorrhages that mineralise
- The patient is usually asymptomatic but the tendon diameter increases
- The end result is an impingement syndrome on the adjacent biceps tendon

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Star, MI, 3 years
Right shoulder

6-8

2-3

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Star, MI, 3 years
Right shoulder
Affected

Supraspinatus muscle transverse scan

6-7

TRA

Star, MI, 3 years
Right shoulder
Affected

Supraspinatus muscle and tendon, longitudinal scan

6-8

Star, MI, 3 years
Right shoulder

Supraspinatus tendon - BB longitudinal scan

9

SPAT
BB

Star, MI, 3 years
Right shoulder

Supraspinatus tendon - BB transverse scan 9-10

The top left shows two anatomical diagrams of a dog's shoulder joint. The first diagram is a lateral view with labels 3 through 11. The second diagram is a transverse view with labels 8, 9, 10, and 11. Below these is a photograph of a dog on a treadmill. To the right is a large ultrasound image of the supraspinatus tendon in a transverse plane, with a small inset image of the dog on a treadmill.

Comparison

Normal anatomy scan plane 9 transverse

Star, MI, 3 years

The image shows two side-by-side ultrasound scans. The left scan is labeled 'Normal anatomy scan plane 9 transverse' and shows a normal supraspinatus tendon with a purple outline. The right scan is labeled 'Star, MI, 3 years' and shows a significantly thickened and irregular supraspinatus tendon.

Scar, Border Collie, MI, 3 years

Ultrasonographic diagnoses:

- Second degree supraspinatus tendinopathy
- Possible impingement syndrome

Conclusions

- Consider rehabilitation to reduce the supraspinatus diameter
- Consider to change the training exercises
- Consider to increase the muscle tone of the triceps

Follow up in two months

A circular inset image shows a dog on a treadmill. The text 'Follow up in two months' is overlaid on the image.

Scar, Border Collie, MI, 3 years

Two months later

- Doing great but not back to sport
- On physical examination good extension of the right shoulder
- Increased triceps tone

A circular inset image shows a dog sitting on a tiled floor. The text 'Two months later' is overlaid on the image.

Star, MI, 3 years
 Right shoulder
 Two months later

Supraspinatus tendon - BB longitudinal scan

Star, MI, 3 years
 Right shoulder
 Two months later

Supraspinatus tendon - BB transverse scan

Scar, MI, 3 years
 Supraspinatus-biceps tendon interface, transverse

Right shoulder Time zero

Right shoulder Two months later

Key points to diagnose chronic supraspinatus tendinopathy

- Check the supraspinatus and BB sliding on both views (long and transverse)
- Check the joint capsule
- Check the triceps tone
- Follow up in two months

Scar, Border Collie, MI, 3 years

Two months later

Ultrasonographic diagnoses:

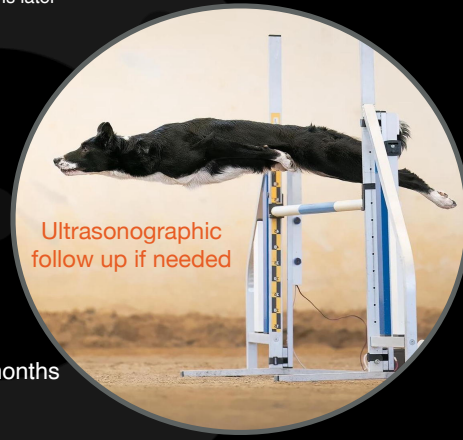
Improved second degree supraspinatus tendinopathy

No signs of impingement syndrome now

Conclusions

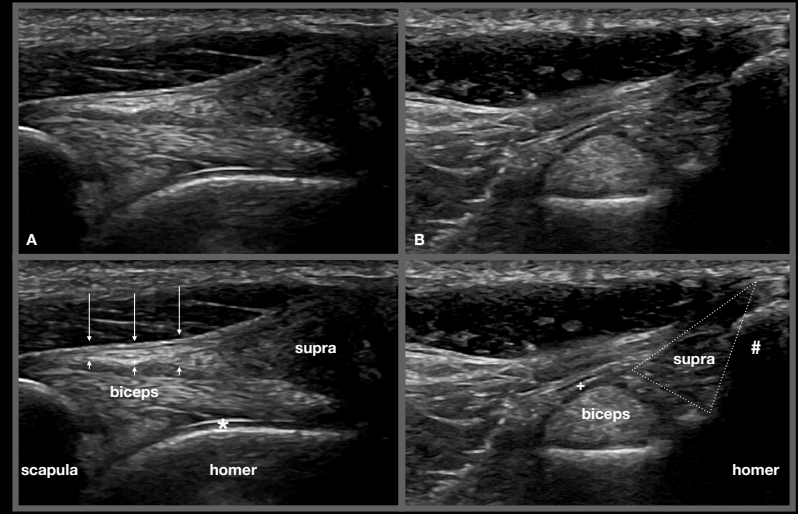
He went back to sport - He is winning

Recheck with the physiotherapist every three months

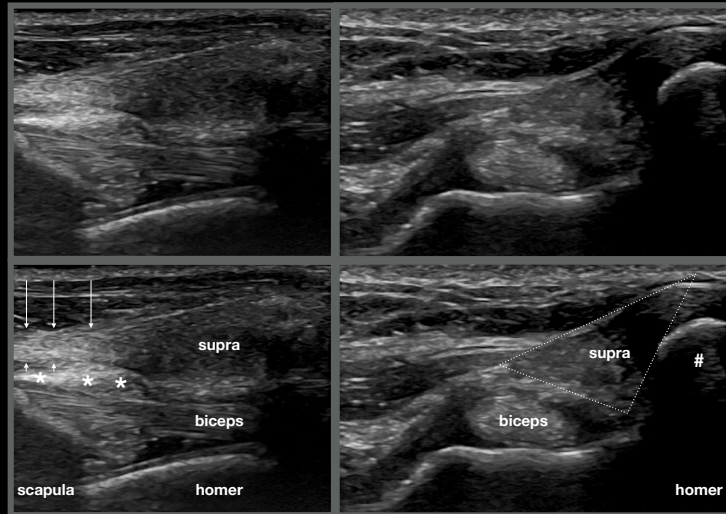


Ultrasonographic follow up if needed

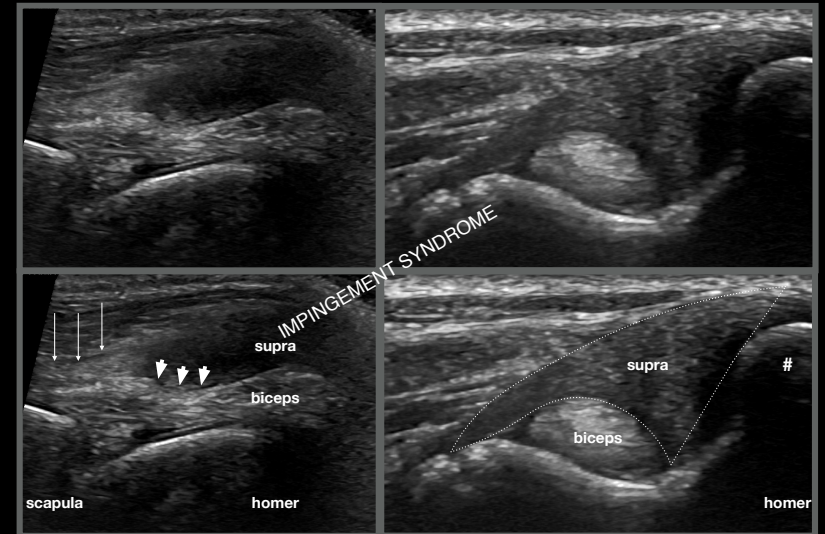
Unremarkable Supraspinatus

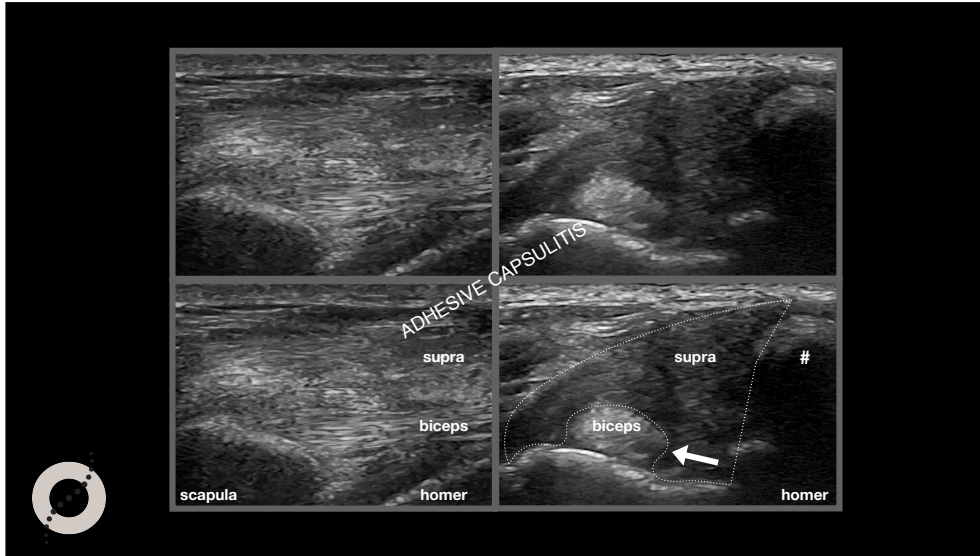


First degree of tendinopathy



Second degree of tendinopathy





Adhesive Capsulitis in Eight Dogs: Diagnosis and Management.

Carr BJ, Canapp SO, Canapp DA, Gamble LJ, Dycus DL.
 Front Vet Sci. 2016 Jul 14;3:55. doi: 10.3389/fvets.2016.00055. eCollection 2016.
 PMID: 27471728 **Free PMC Article**

Patient	Radiographs	Ultrasound	MRI	Arthroscopy	Cytology and histopathology
1	Normal	Supraspinatus disruption; biceps tendon sheath effusion	Marked joint effusion and synovitis; damage to the supraspinatus tendon and medial genoumeral ligament	Biceps tendinopathy; impingement of the biceps tendon; fraying and disruption of the subscapularis and of the MCL; disruption of joint capsule; grade III/IV cartilage erosion along the caudal humeral head and glenoid. RF treatment was performed	Mild mononuclear inflammation (76% large mononuclear cells and 24% small mononuclear cells) Negative culture

Mineralization of the supraspinatus tendon:

Prevalence of mineralisation of the tendon of the supraspinatus muscle in non-lame dogs.
 Abbey R, Pettitt R.
 J Small Anim Pract. 2021 Jun;62(6):450-454. doi: 10.1111/jasp.13298. Epub 2021 Jan 25.
 PMID: 33492697

Mineralization of the supraspinatus tendon in dogs.
 Flo GL, Middleton D.
 J Am Vet Med Assoc. 1990 Jul 1;197(1):95-7.
 PMID: 2370229

Clinically relevant or not?

Comparison between shoulder computed tomography and clinical findings in 89 dogs presented for thoracic limb lameness.
 Maddox TW, May C, Keeley BJ, McConnell JF.
 Vet Radiol Ultrasound. 2013 Jul-Aug;54(4):358-64. doi: 10.1111/vru.12043. Epub 2013 Apr 18.
 PMID: 23594097

Surgical treatment of mineralized and nonmineralized supraspinatus tendinopathy in twenty-four dogs.
 Lafuente MP, Fransson BA, Lincoln JD, Martinez SA, Gavin PR, Lahmers KK, Gay JM.
 Vet Surg. 2009 Apr;38(3):380-7. doi: 10.1111/j.1532-950X.2009.00512.x.
 PMID: 19573103

Mineralization of the supraspinatus tendon in dogs: a long-term follow-up.
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What the meaning of supraspinatus mineralization?

Conclusions

- A systematic approach helps to become confident in MSK ultrasound
- A multidisciplinary team is needed



Thank you



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