

Morpho-functional approach of shoulder and elbow ultrasound in 12 scan planes

Infraspinatus-Triceps

Giliola Spattini

DVM, GP Cardio, CCRT, PhD, DECVDI



Diagnostic Mindset



Clinica Veterinaria
CASTELLARANO



Thank to www.imaios.com

Objectives

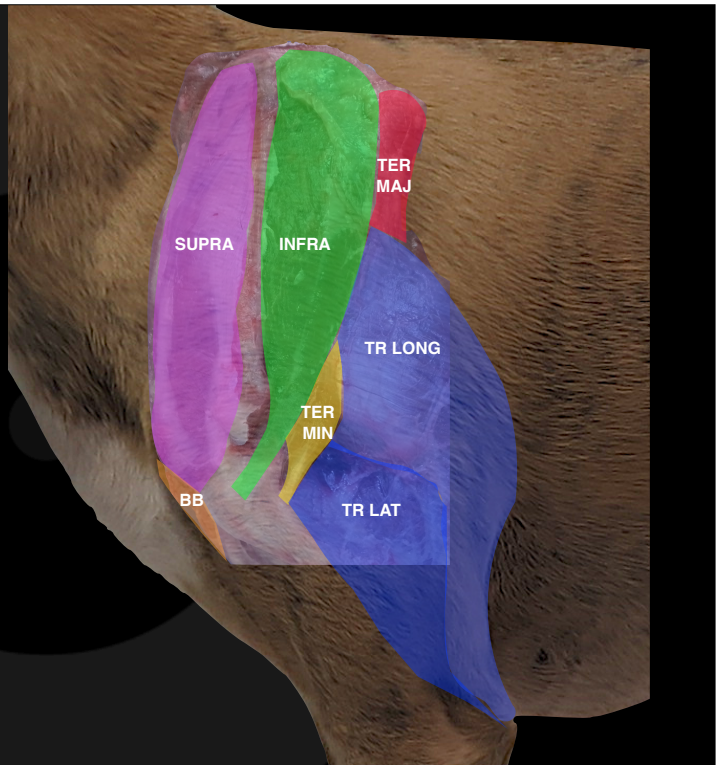
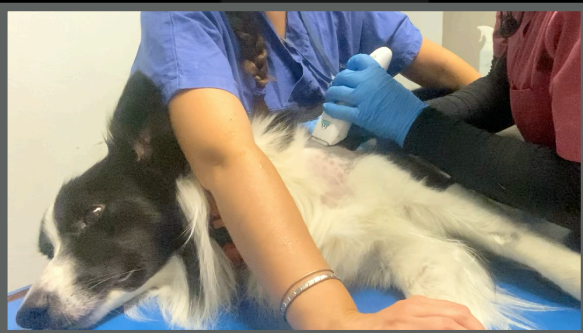
- Ultrasound has become an essential tool in the diagnosis of shoulder diseases
- A systematic approach is fundamental to increase the accuracy of the examination



Pain in
shoulder
region

Adapted from
"Canine Lameness", 2020

Ultrasonographic technique for the shoulder



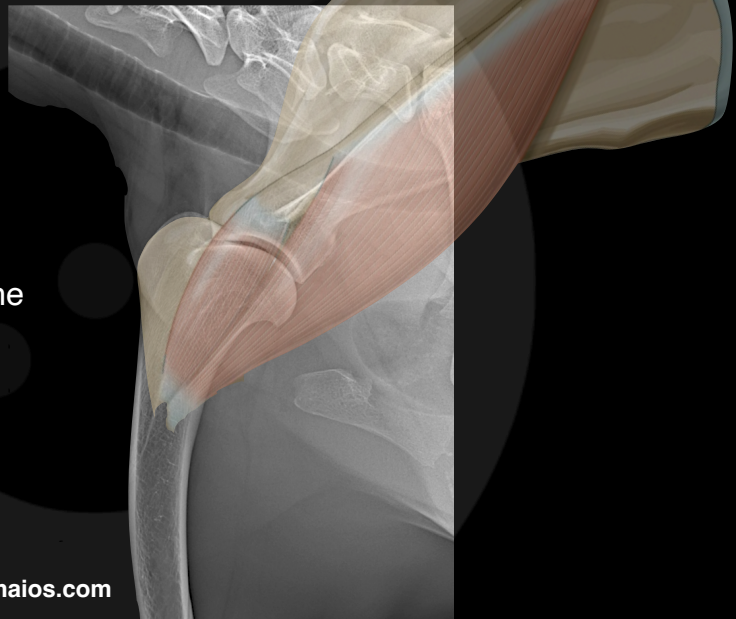
Gross anatomy of the shoulder

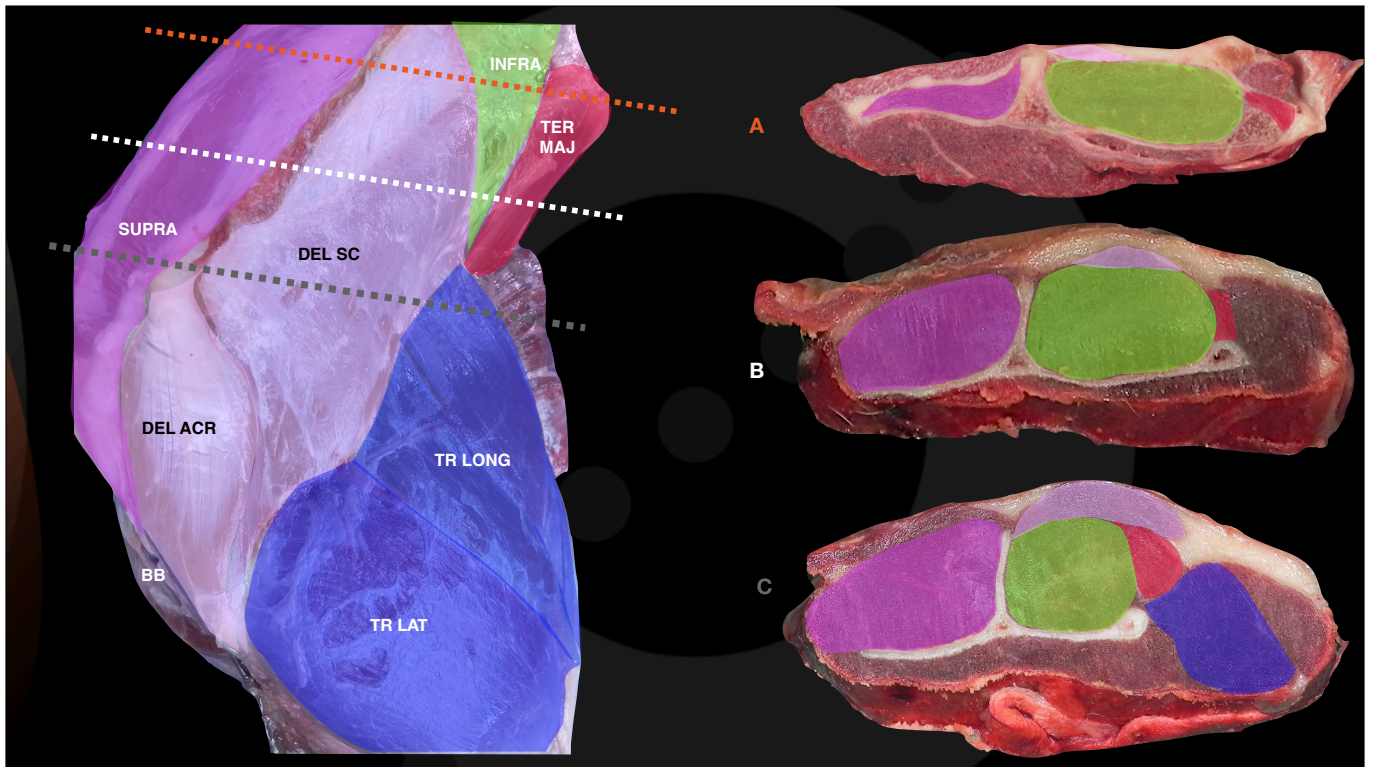
- Deltoideus
- Infraspinatus
- Teres Major
- Triceps
- Supraspinatus
- BB
- Teres Minor



The deltoid muscle

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

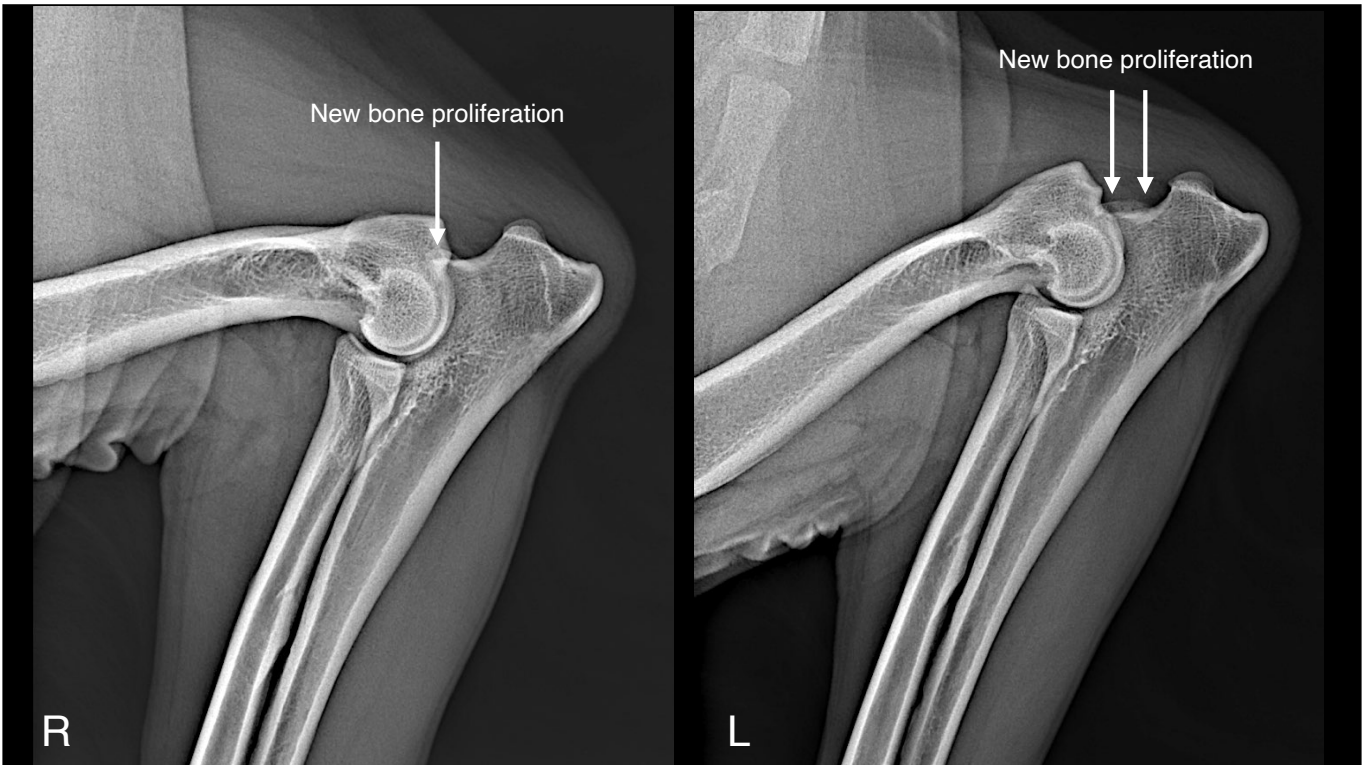
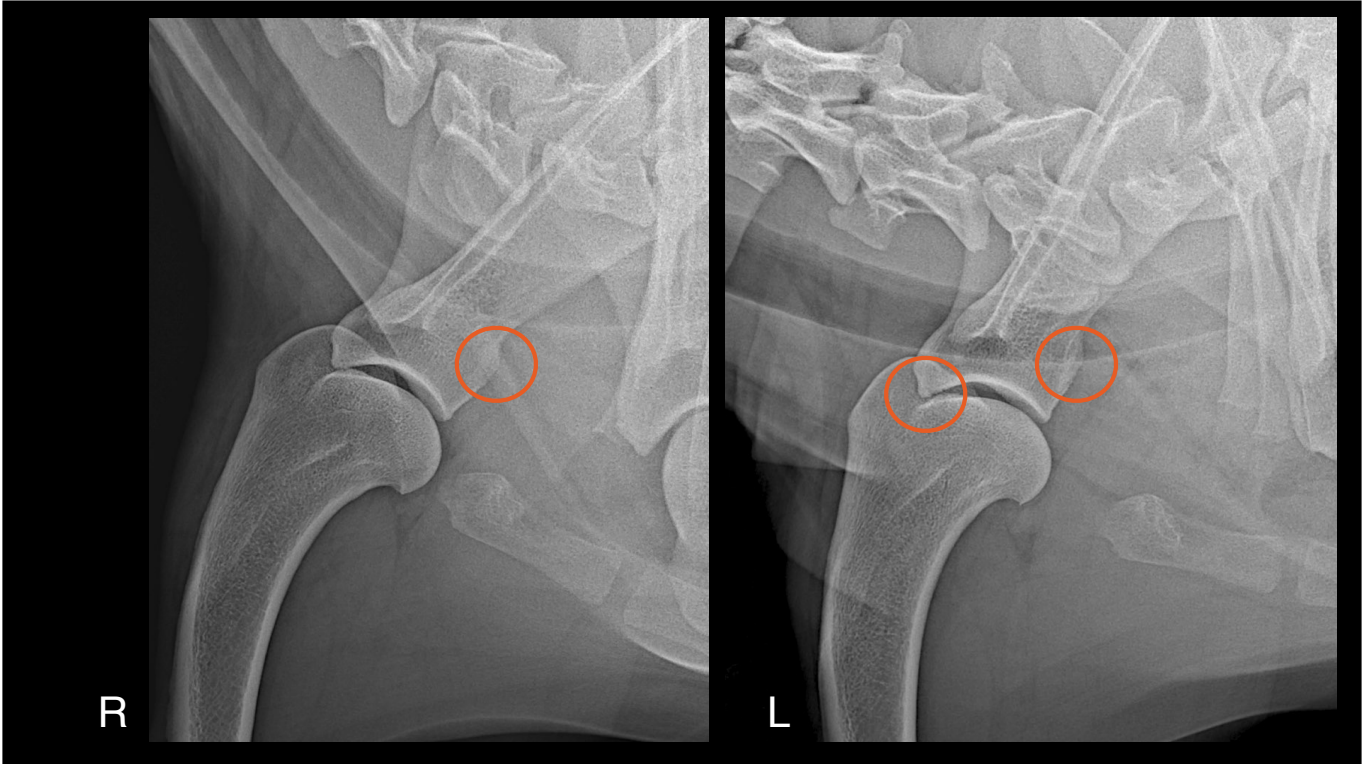


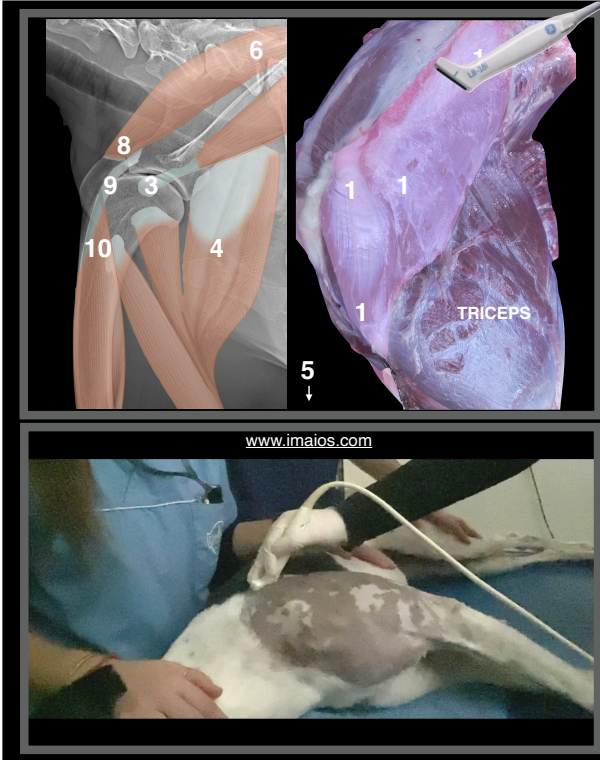


Kim, Golden, FS, 10 years

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

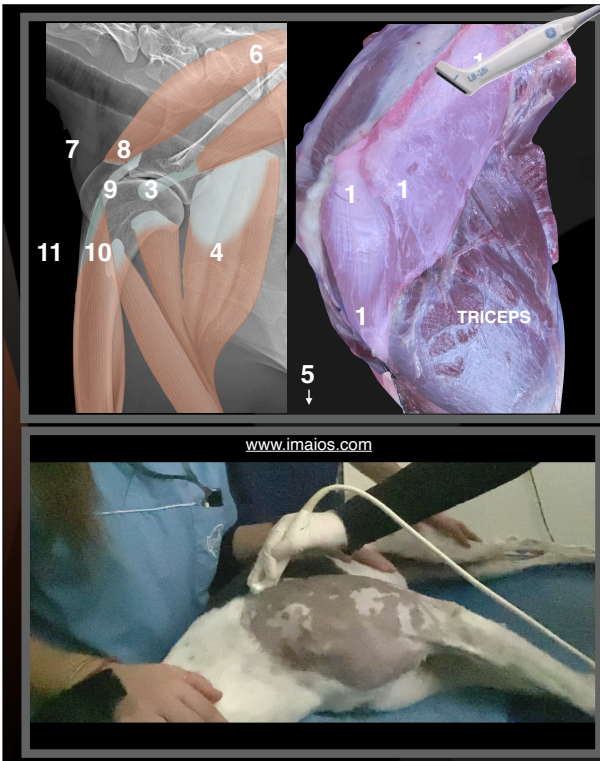
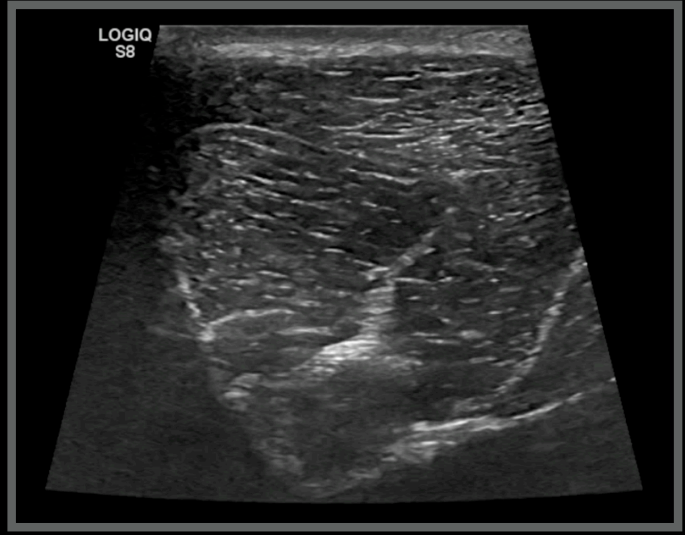






Normal anatomy deltoid, part scapularis

Deltoids and **Infraspinatus muscle** transverse scan 1-2

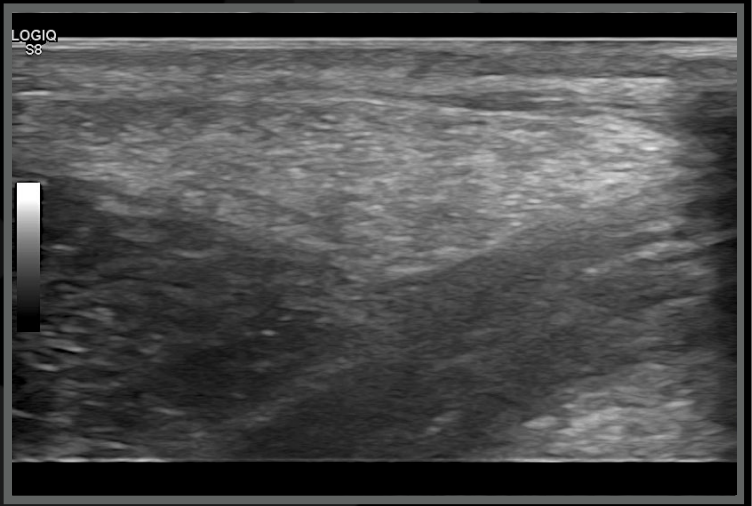


Kim, FS, 10 years

Left shoulder

Deltoids and **Infraspinatus muscle** transverse scan

1



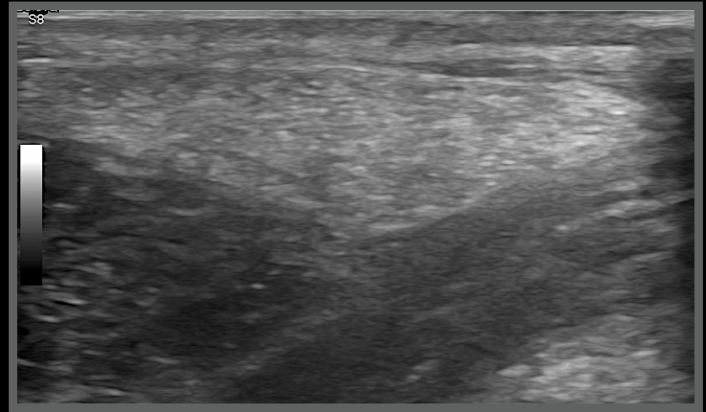
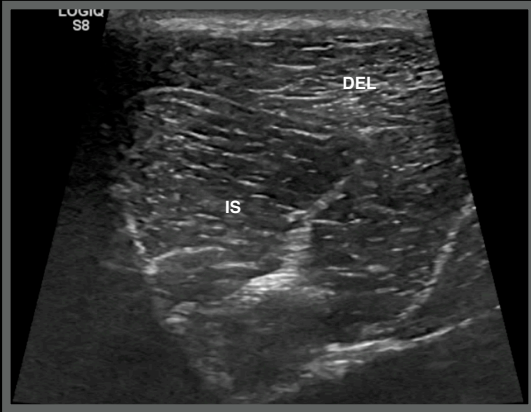


Kim, FS, 10 years

Transverse scan plane 1-2

WNL scapular portion of deltoids muscle

Left shoulder



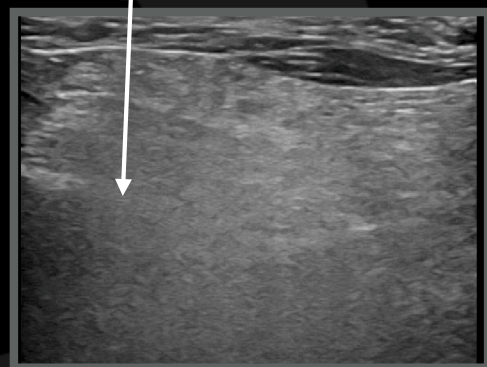
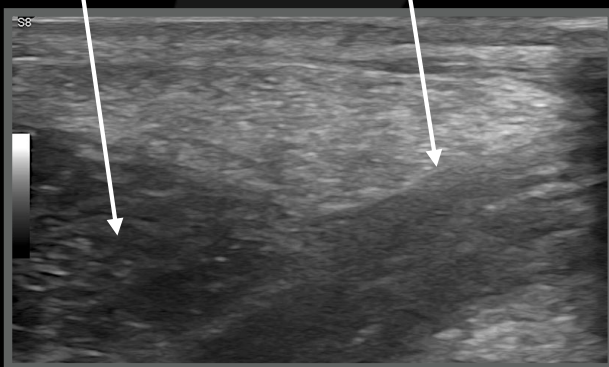
Hyperechoic or scattering artefact?

Deeper tissues still visible

Not visible deeper tissues

Well defined margins

Completely degraded image



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Sort by: Best match

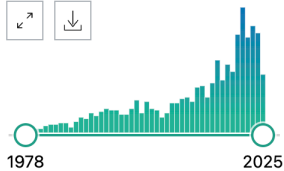
Display options

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922 results

Page 1 of 93

RESULTS BY YEAR



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.**

Cite 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.**

Cite Pereira AZ, Uezima CB, Zanella MT, Prado RRD, Gonzalez MC, Zheng J, Heysmsfield SB. *JPEN J Parenter Enteral Nutr.* 2021 Sep;45(7):1591-1596. doi: 10.1002/jpen.2030. Epub 2020 Dec 8. PMID: 33111338

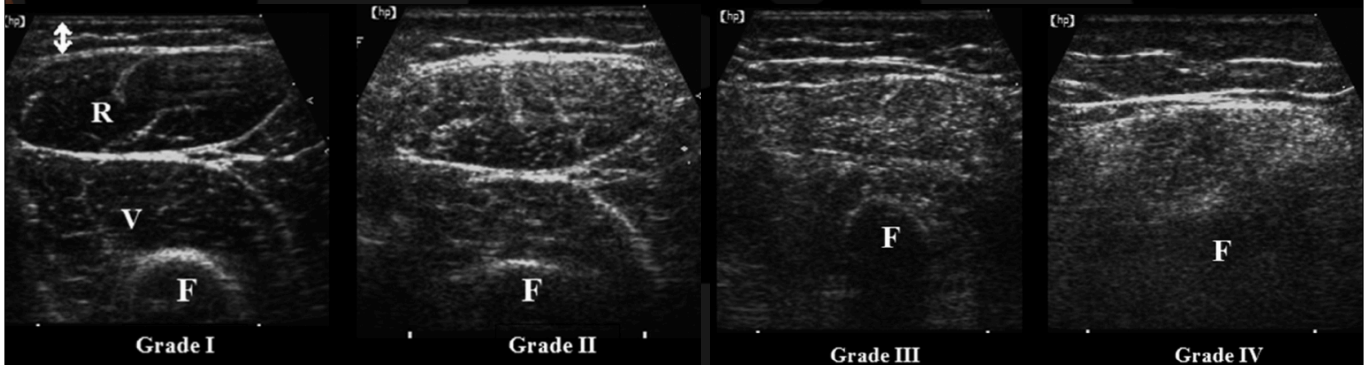
There was a positive correlation between age and thigh-**muscle echogenicity** ($r(p) = 0.534, P < .0001$) and a negative correlation between thigh-**muscle echogenicity** and thickness ($r(p) = -0.395, P < .0001$). There was high **muscle echogenicit**



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,*}

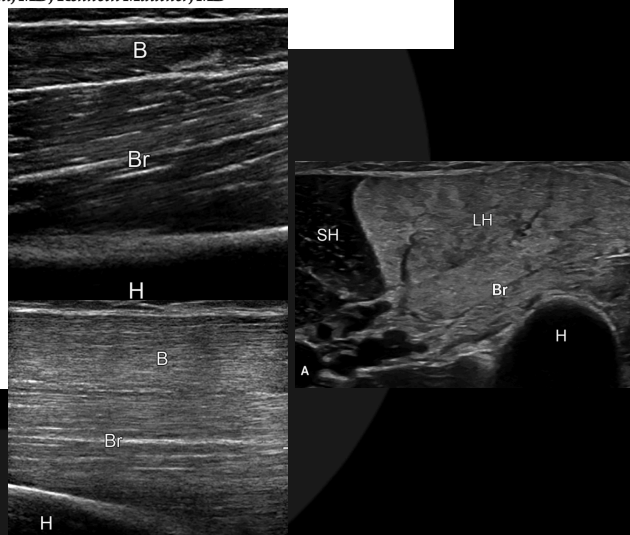


Ultrasound Findings of Delayed-Onset Muscle Soreness

©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.



Review

Journal of Sport and Health Science 13 (2024) 820–840

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

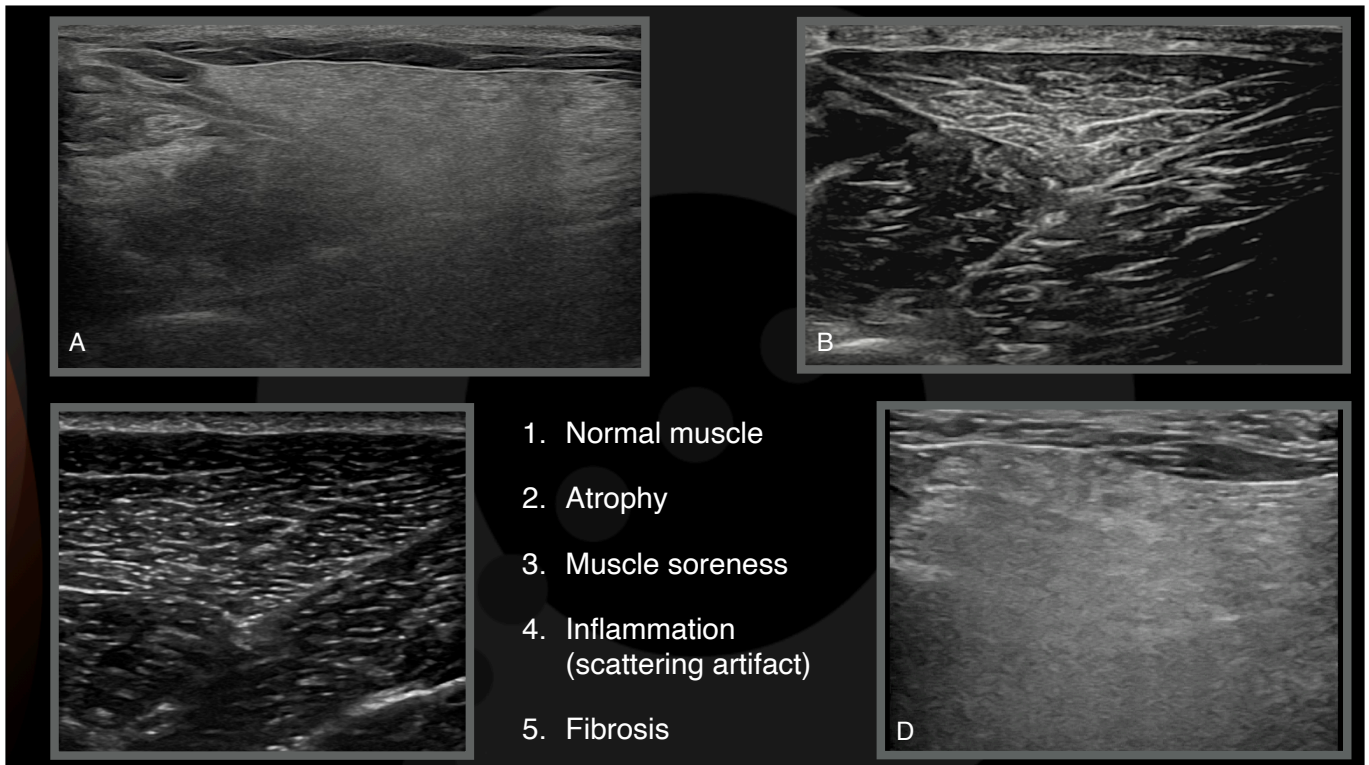
Received 11 January 2024; revised 18 February 2024; accepted 1 April 2024

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 sarcopenic-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

ative 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

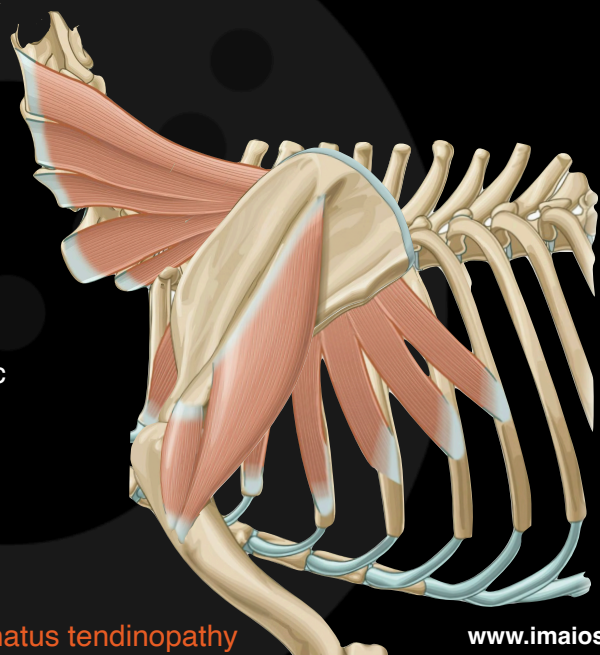


1. Normal muscle
2. Atrophy
3. Muscle soreness
4. Inflammation (scattering artifact)
5. Fibrosis

Increased echogenicity of Deltoid muscle. Meaning in our patient?



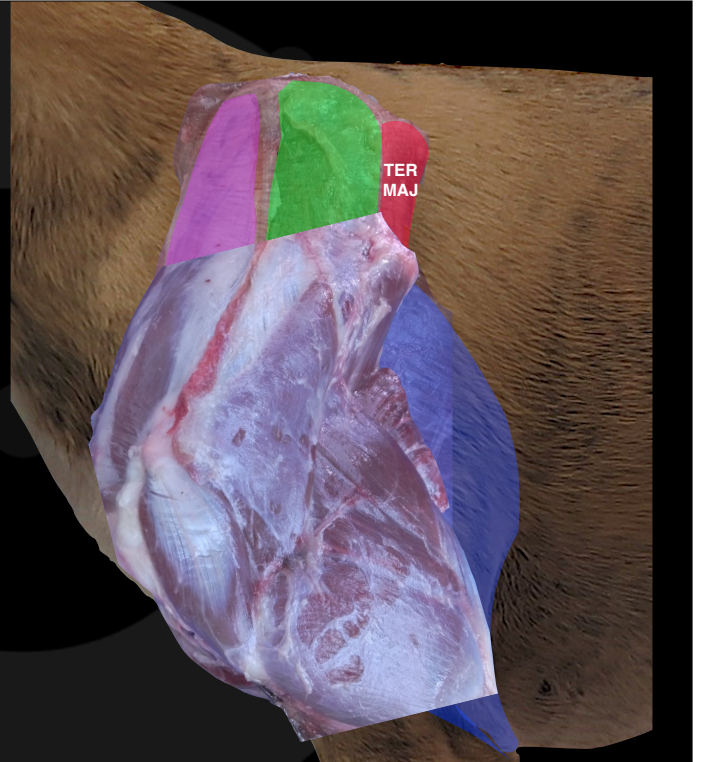
- Muscle soreness due to overuse? Very likely
- Check serratus ventralis - cervical and thoracic portions: antigravitational muscles



Kim was diagnosed with chronic left supraspinatus tendinopathy

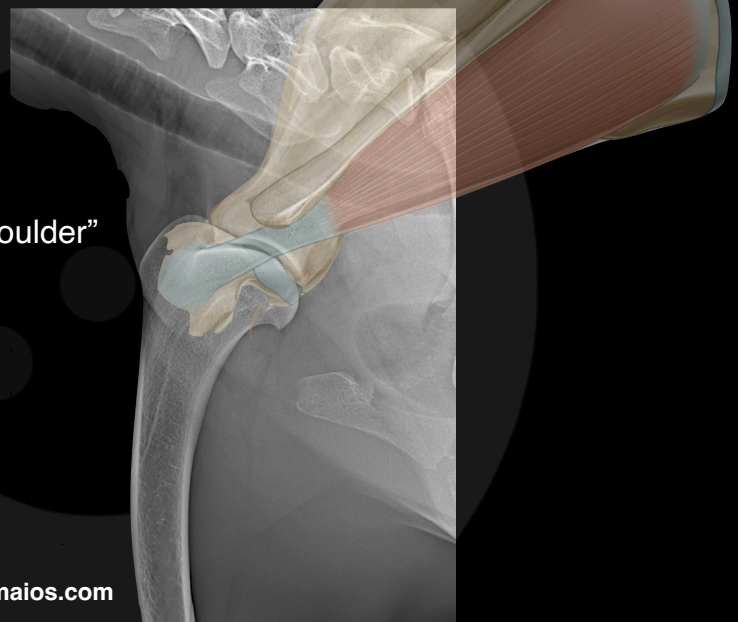
Gross anatomy of the shoulder

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



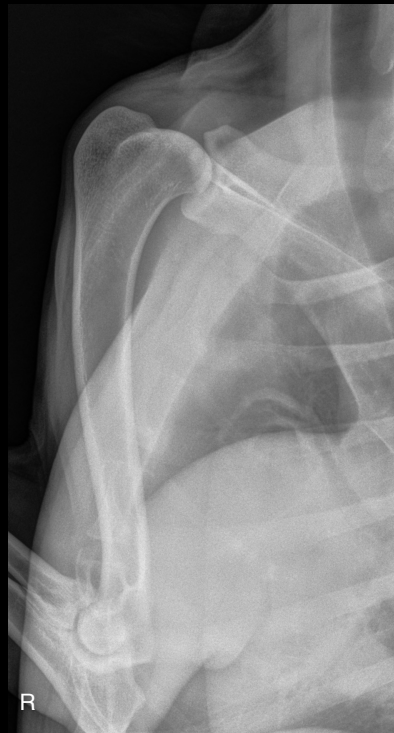
The infraspinatus muscle

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



Rena, Mongrel, FS, 5 years

- Progressive left front lameness from the last three months
- Abnormal gait, worsening
- Not responding to NSAID



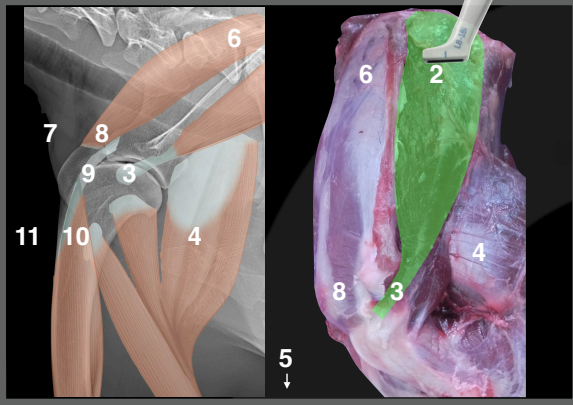
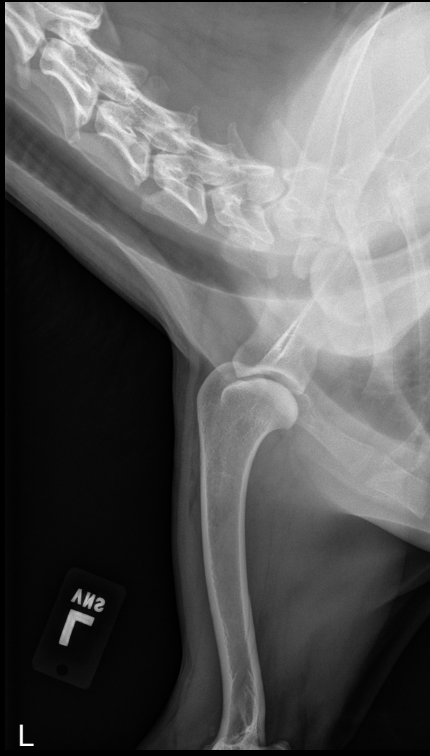
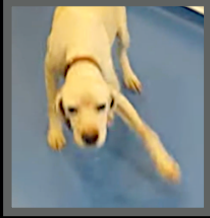
Rena, FS, 5 years

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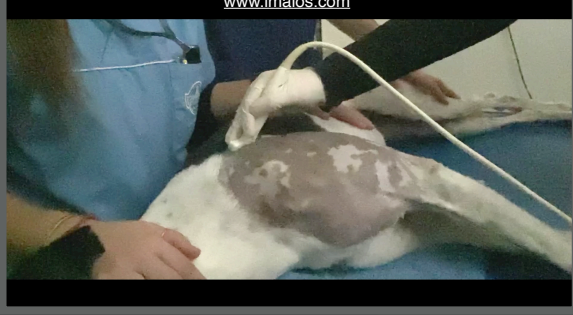
R

R

Rena, FS, 5 years



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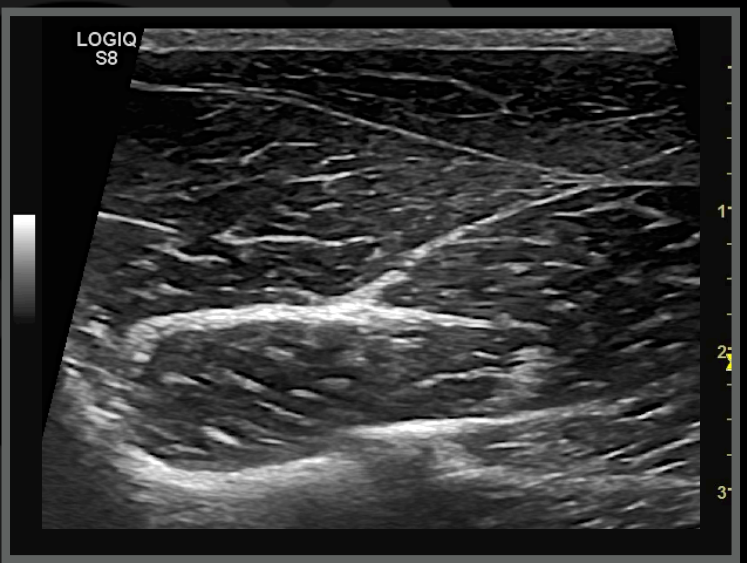


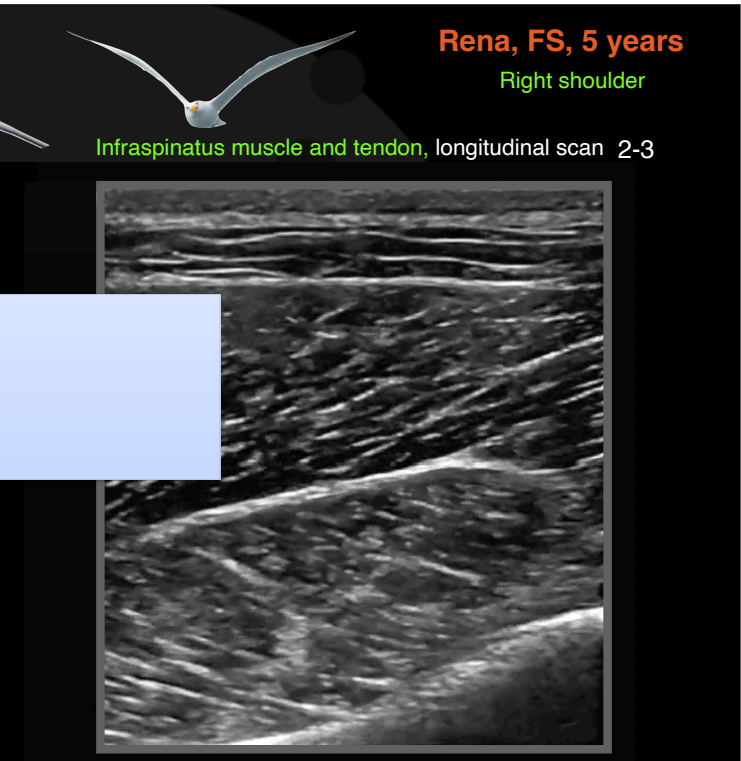
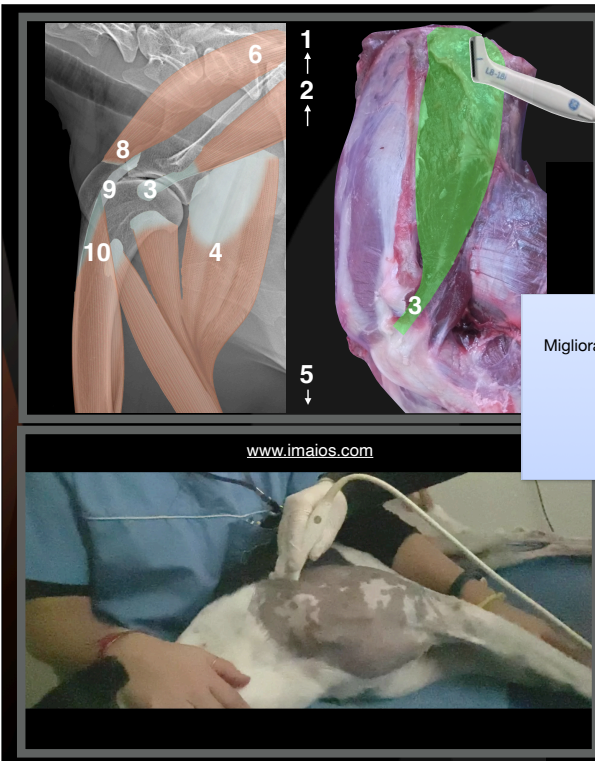
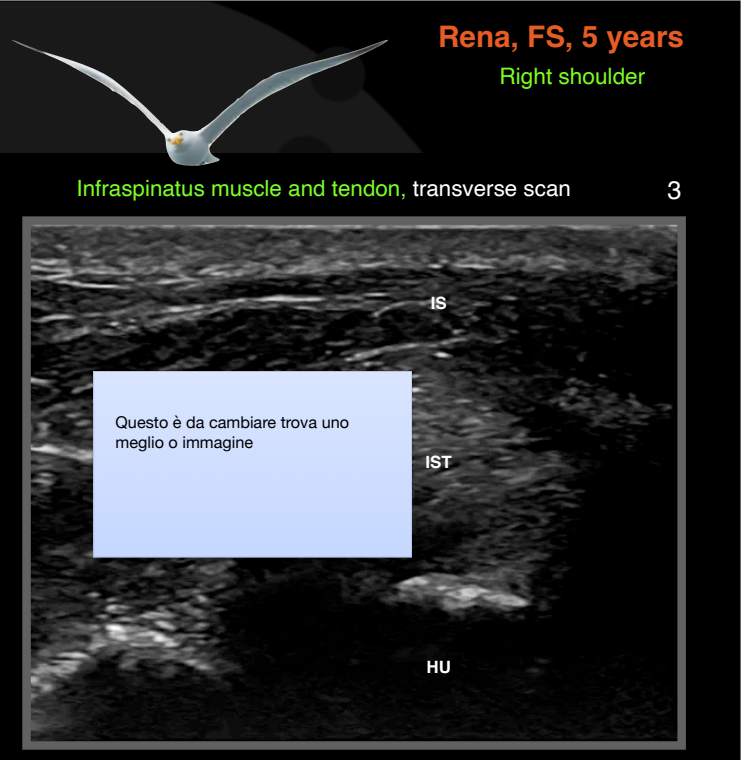
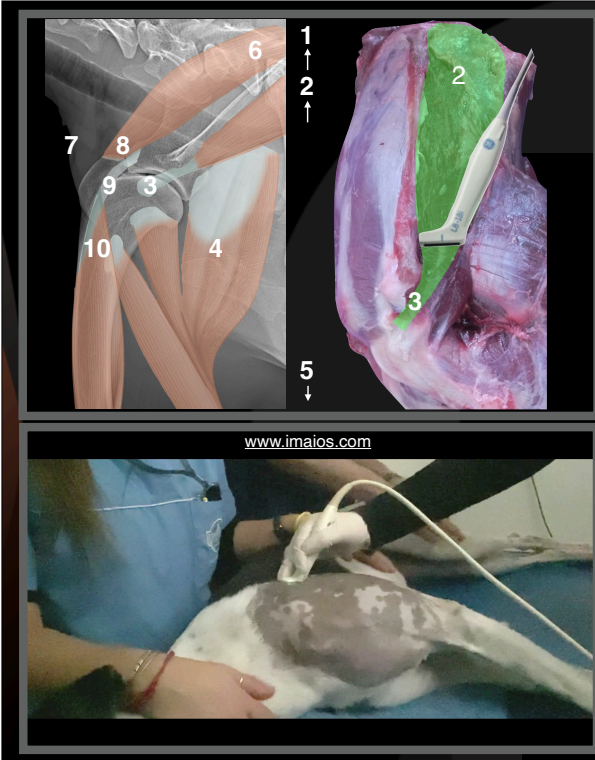
Rena, FS, 5 years

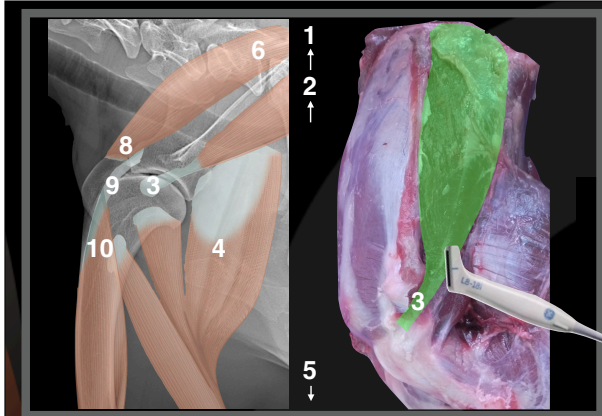
Right shoulder

Infraspinatus muscle transverse scan

2-3







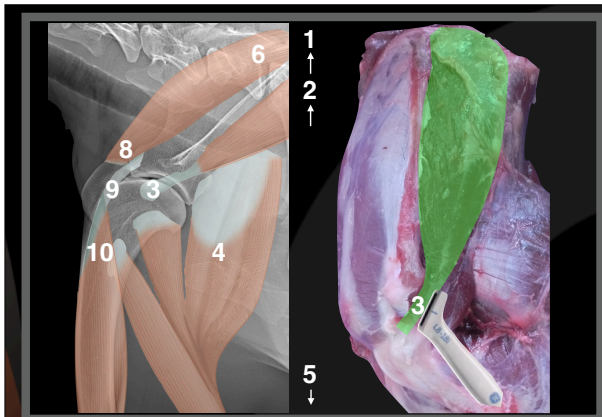
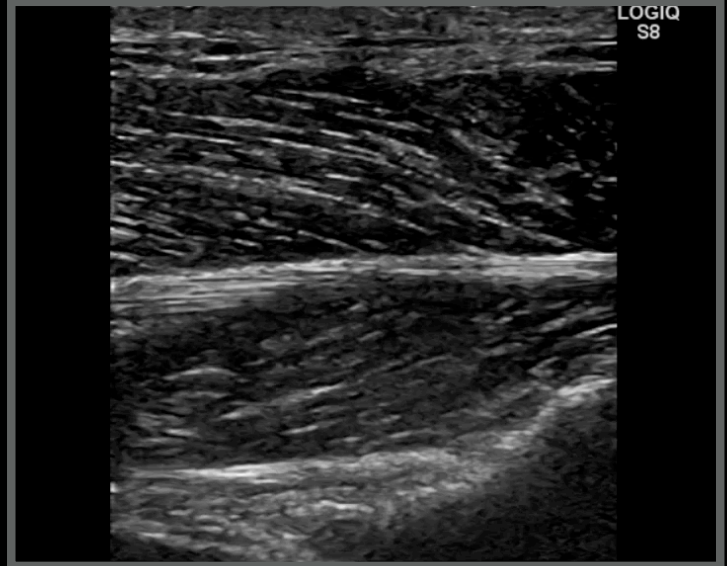
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Rena, FS, 5 years

Right shoulder

Infraspinatus muscle and tendon, longitudinal scan 3



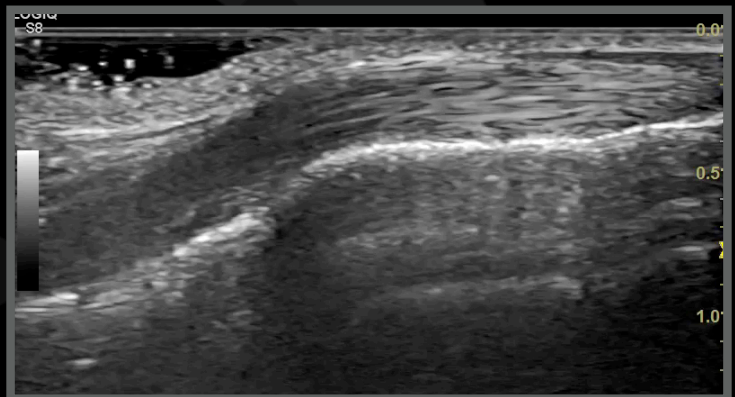
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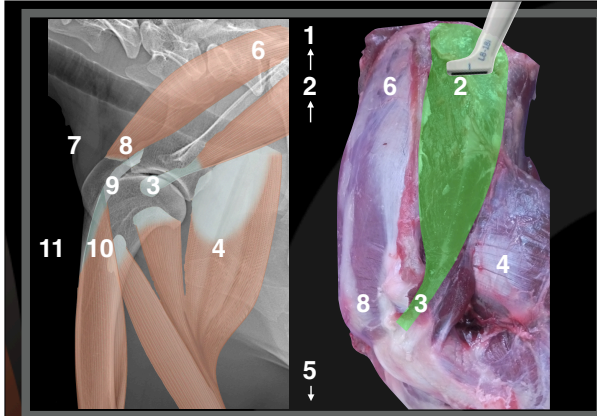


Rena, FS, 5 years

Right shoulder

Infraspinatus muscle and tendon, longitudinal scan 3



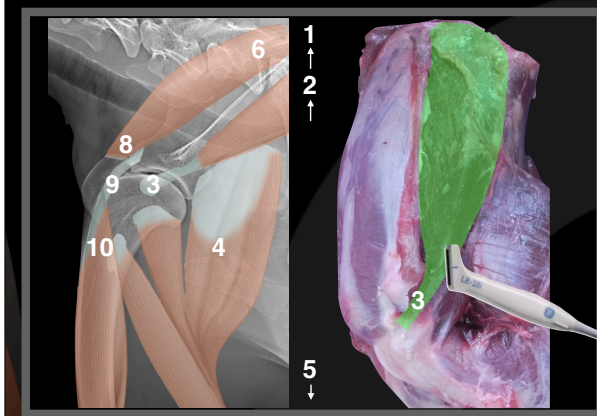
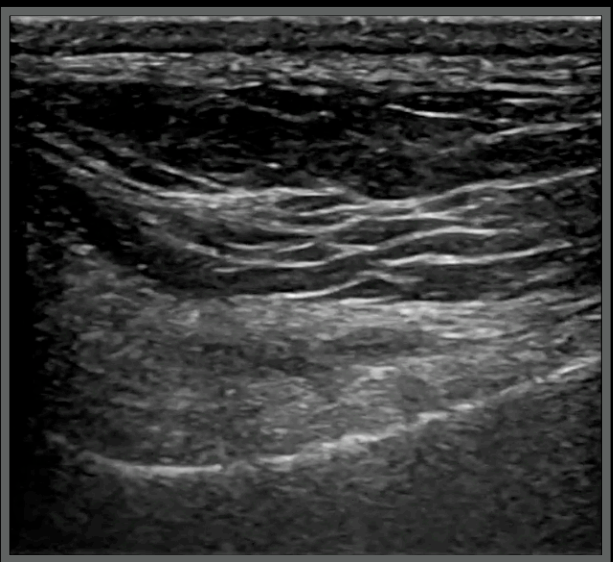


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Rena, FS, 5 years
Left shoulder

Infraspinatus muscle transverse scan 2-3



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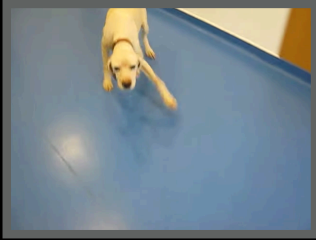


Rena, FS, 5 years
Left shoulder

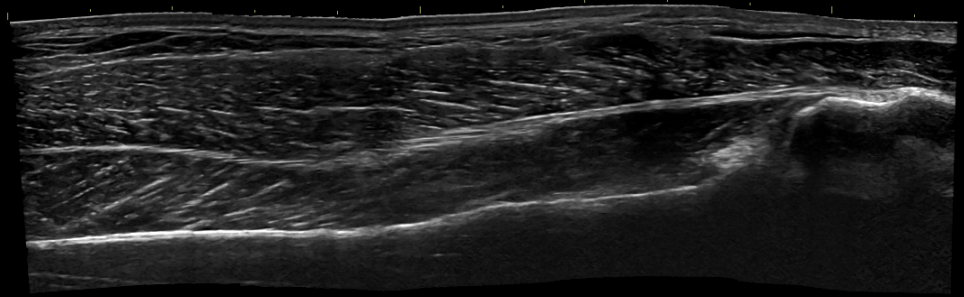
Infraspinatus muscle and tendon, longitudinal scan 3



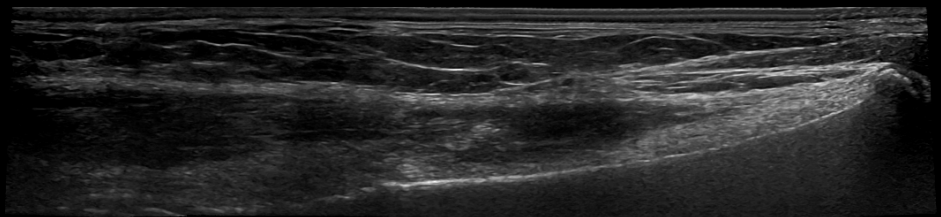
Rena, FS, 5 years



Right shoulder



Left shoulder



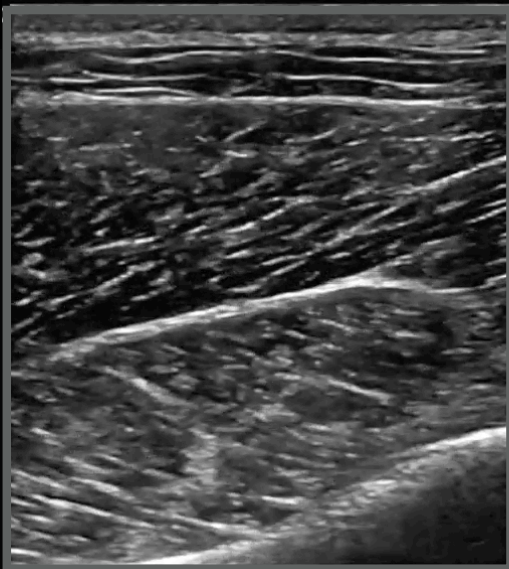
Rena, FS, 5 years

Longitudinal scan **infraspinatus muscle**

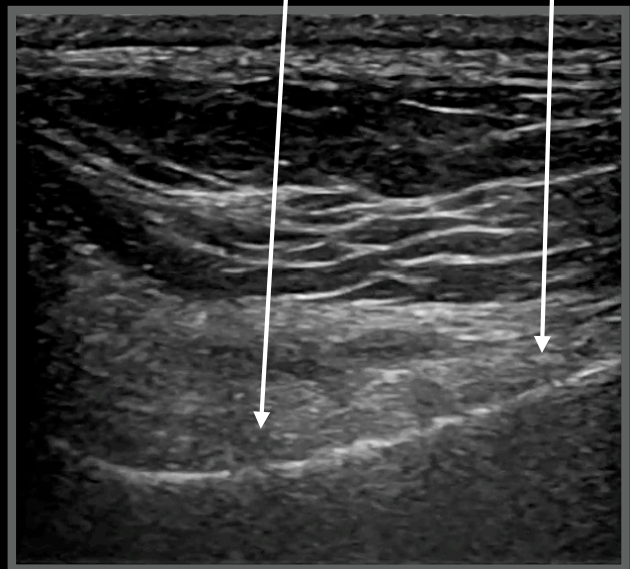
Hyperechoic area,
No scattering artefact

Decrease
muscle volume

Right shoulder



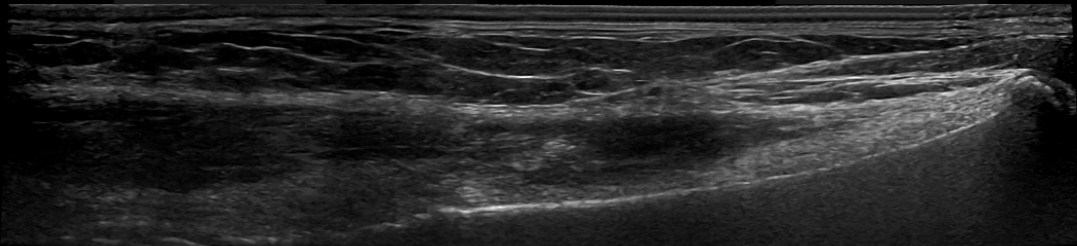
Left shoulder



Rena, Mongrel, FS, 5 years

Ultrasonographic diagnoses:

- Left Infraspinatus muscle atrophy
- Focal areas of well-defined increased echogenicity associated with loss of muscle fibres pattern



How to arrive to Conclusions:

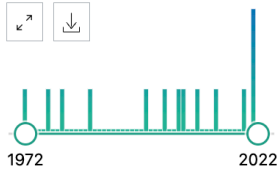
- PE examination
- Blood works
- Ultrasonographic findings
- Literature



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13 results

RESULTS BY YEAR



TEXT AVAILABILITY

- Abstract
- Free full text
- Full text

The Shoulder Joint and Common Abnormalities.

1 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.

Share PMID: 33446362 Review.

Its complex anatomy and biomechanics necessitate thorough examination and diagnostic work-up for accurate diagnosis. This article provides an updated review of common **canine** shoulder pathologies, including osteochondrosis, bicapital and supraspinatus tendinopathies, **inf ...**

Infraspinatus muscle contracture.

2 Harasen G.

Cite Can Vet J. 2005 Aug;46(8):751-2.

Share PMID: 16187723 **Free PMC article.** No abstract available.

The Shoulder Joint and Common Abnormalities



Rebecca Stokes, DVM^a, David Dycus, DVM, MS, CCRP^{b,*}

Vet Clin Small Anim 51 (2021) 323–341

KEYWORDS

- Medial shoulder syndrome • Supraspinatus tendinopathy • Bicapital tendinopathy
- Arthroscopy • Osteochondrosis • Osteochondritis dissecans
- **Infraspinatus contracture** • Shoulder luxation

KEY POINTS

- The shoulder is a complex joint composed mostly of static and dynamic capsuloligamentous support structures.
- Thorough orthopedic and neurologic examination, radiographs, advanced imaging techniques (musculoskeletal ultrasound, computed tomography, and magnetic resonance imaging), and/or arthroscopy are used to obtain accurate diagnosis.
- Osteochondrosis/osteochondritis dissecans is an important developmental disease commonly affecting the caudal humeral head.
- Canine bicapital and supraspinatus tendinopathies show similarities to humans; however, accurate diagnosis and clinical significance are difficult to determine.
- Medial shoulder syndrome is one of the most common shoulder pathologies occurring in greater frequency than luxation.

CT findings in a dog with subacute myopathy and later fibrotic contracture of the infraspinatus muscle

Marthe Aamodt Mikkelsen 

| Nina Ottesen

Vet Radiol Ultrasound 2019;1-5.

Department of Companion Animal Clinical Sciences, Faculty of Veterinary Medicine, Norwegian University of Life Science, Oslo, Norway

Correspondence

Nina Ottesen, Department of Companion Animal Clinical Sciences, Faculty of Veterinary Medicine, Norwegian University of Life Sciences, Campus Adamstuen, Post box 8146 Dep, 0033 Oslo, Norway.
Email: nina.ottesen@nmbu.no

Abstract

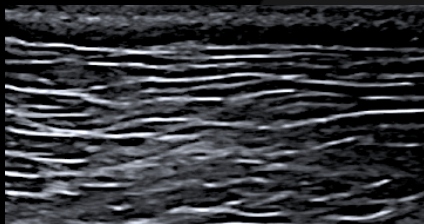
A 5-year-old Norwegian elkhound was referred due to an acute onset of lameness and persistent shoulder pain over a period of 3 weeks. Computed tomography demonstrated an enlarged, hypoattenuating right infraspinatus muscle with peripheral contrast enhancement and a nonenhancing center, without concurrent lesions in superficial structures or bones. The right infraspinatus muscle showed progressive atrophy on consecutive CT studies. The dog developed clinical symptoms compatible with fibrotic infraspinatus contracture 2 months after the initial presentation, and was treated with infraspinatus tenotomy. Histopathological diagnoses based on intraoperative biopsy samples were fibrotic muscle atrophy and muscle hypertrophy with regeneration.

KEYWORDS

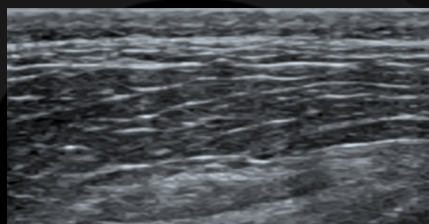
canine, compartment syndrome, infraspinatus necrosis, myopathy

Ultrasonographic correlation with histology

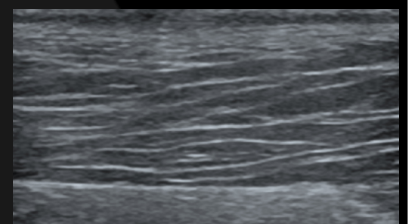
Fibrillar muscle pattern



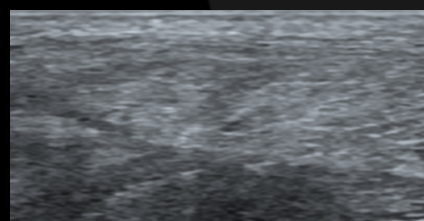
Moderate muscle atrophy



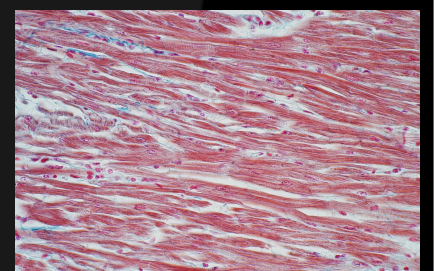
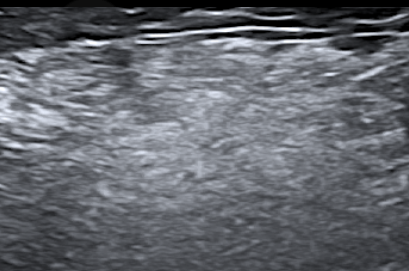
Severe muscle atrophy



Early phase muscle fibrosis

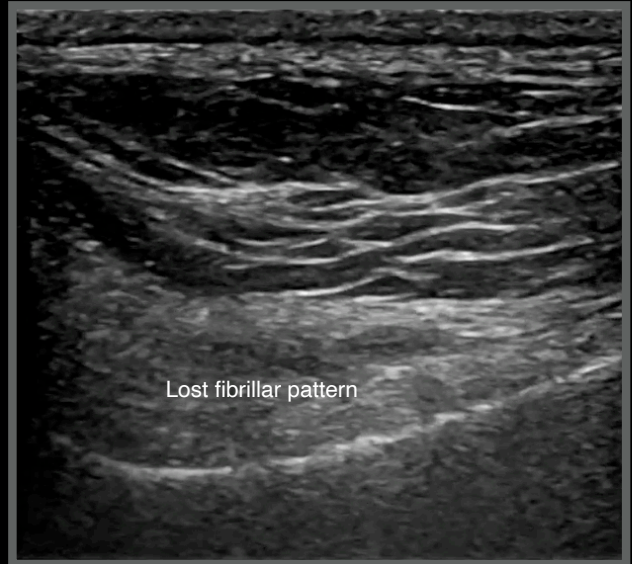


Late phase muscle fibrosis



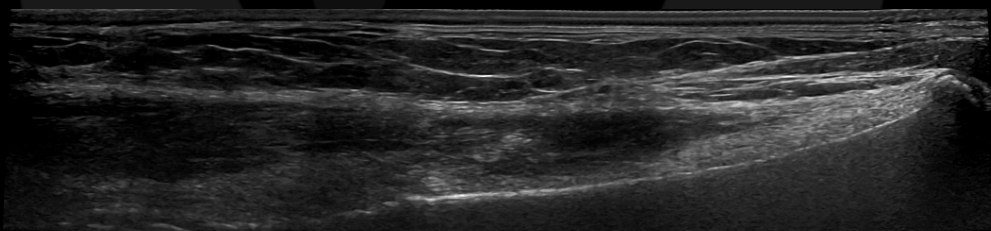


Muscle soreness VS fibrosis



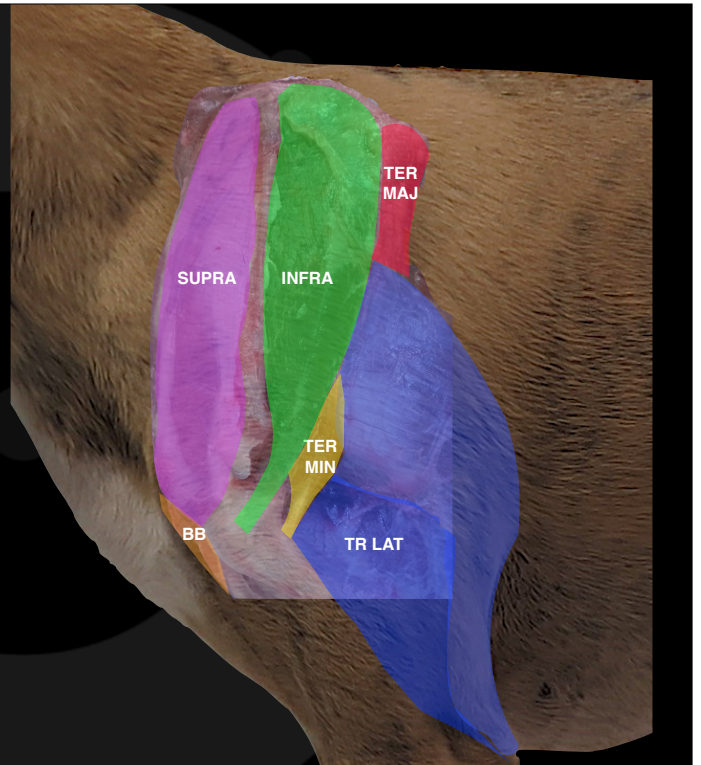
Key points to diagnose infraspinatus contracture

- Typical gait
- Hyperechoic band
- No scattering artefact
- Severe muscle atrophy



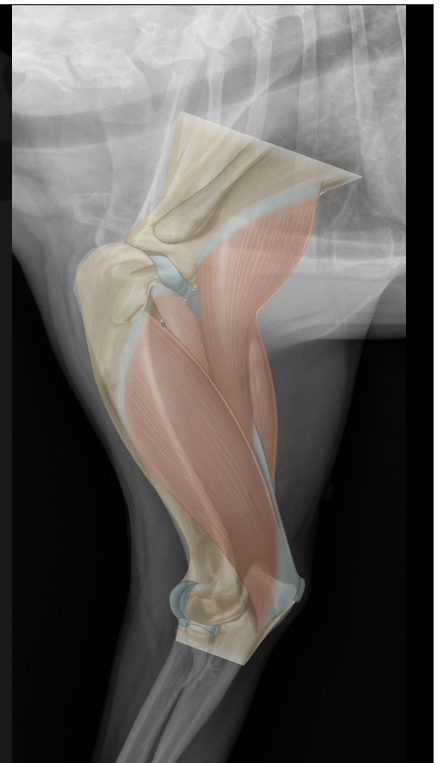
Gross anatomy of the shoulder

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



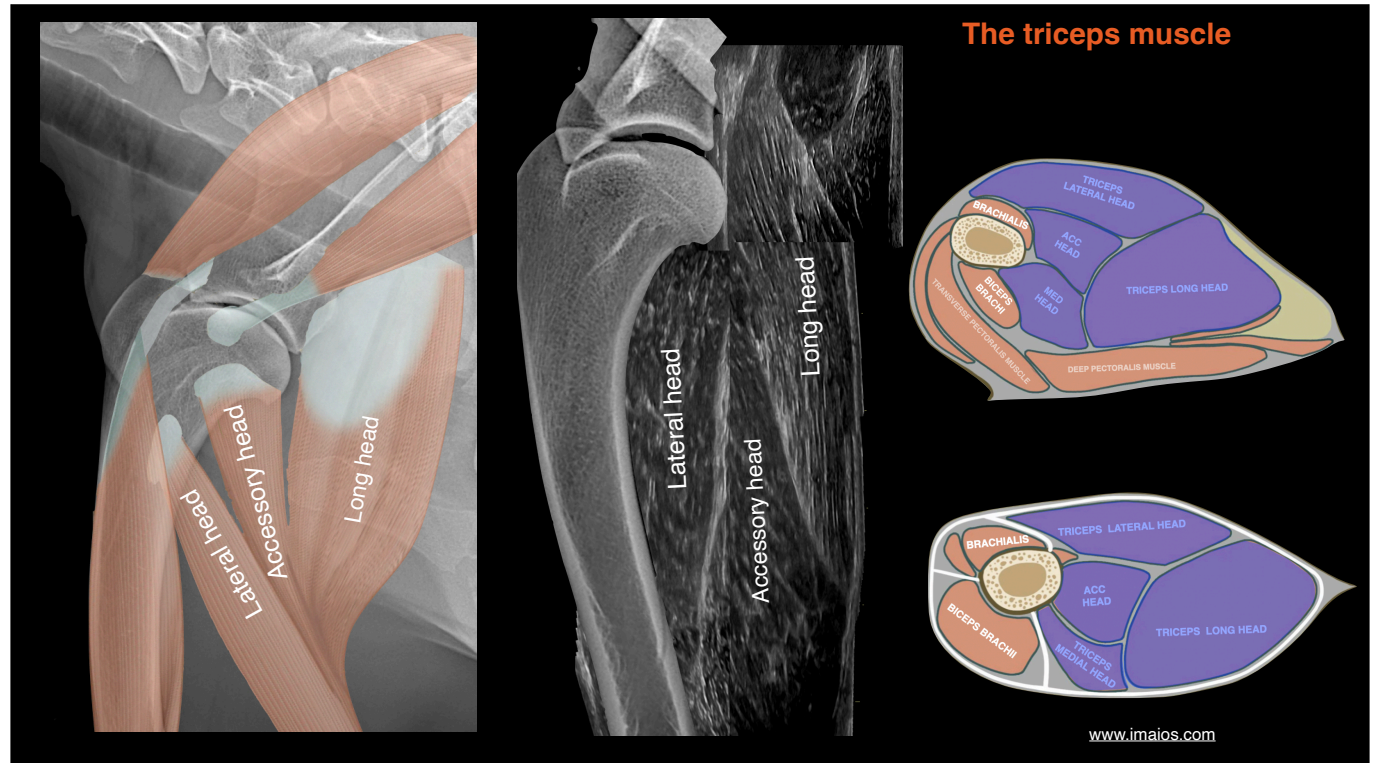
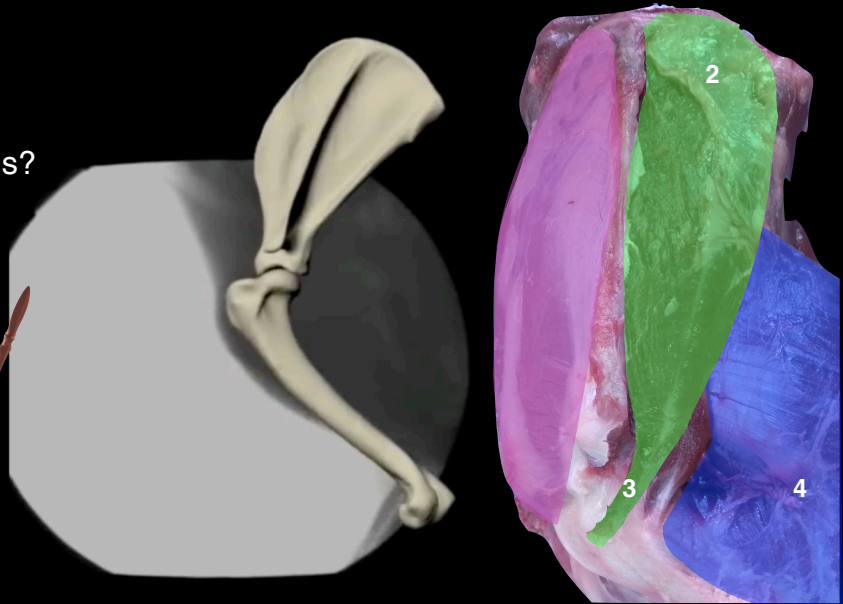
The triceps muscle

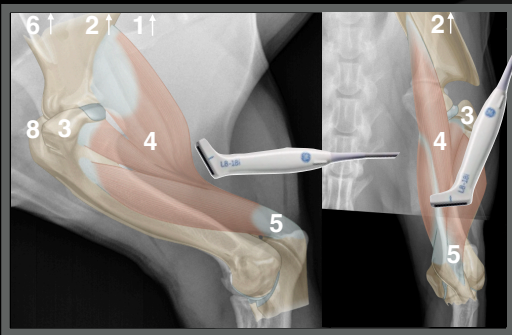
- The great stabiliser of the shoulder
- Anti-rotational
- Antagonist of the supraspinatus



Why we include the triceps in a shoulder ultrasound?

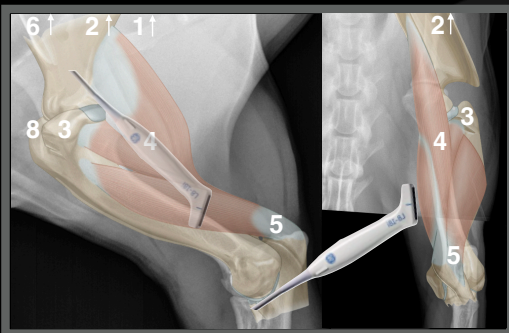
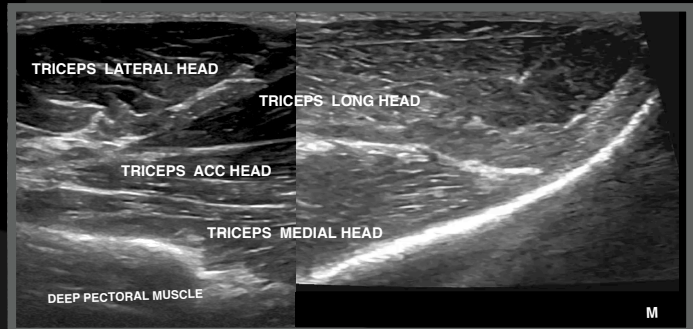
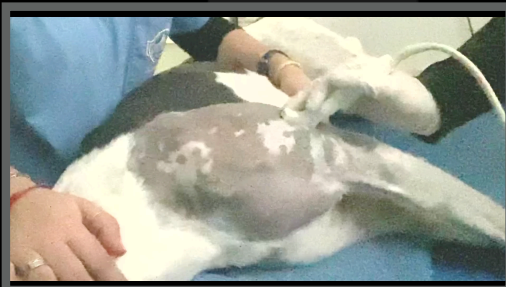
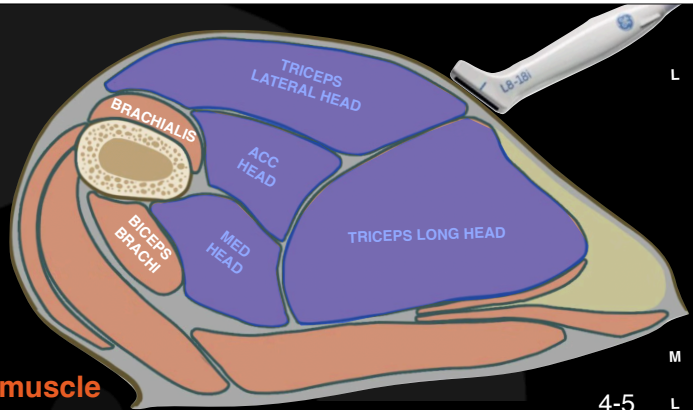
- How can we decrease the pressure on the supraspinatus?
- Improving the triceps muscle volume and function





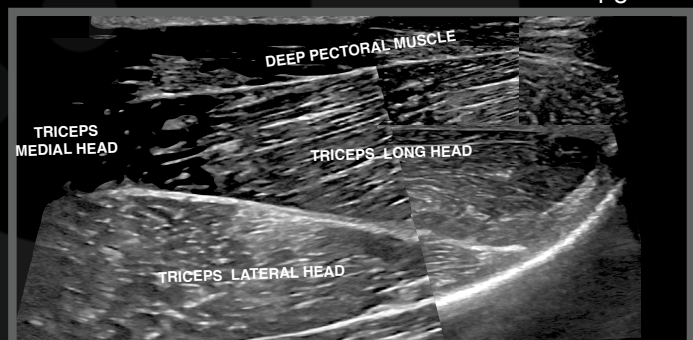
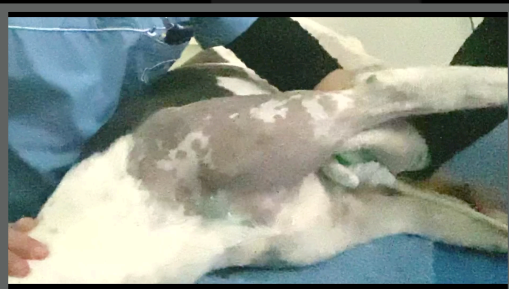
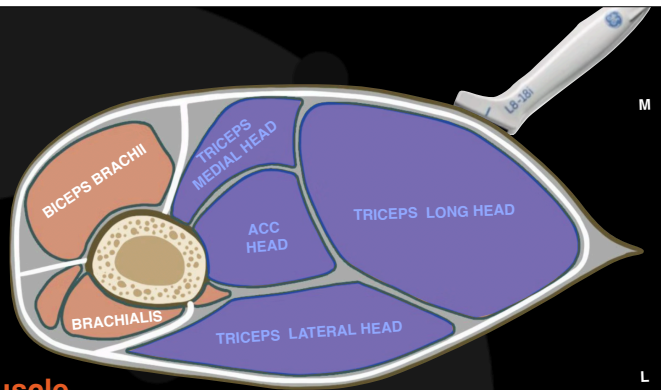
www.imaios.com

The triceps muscle

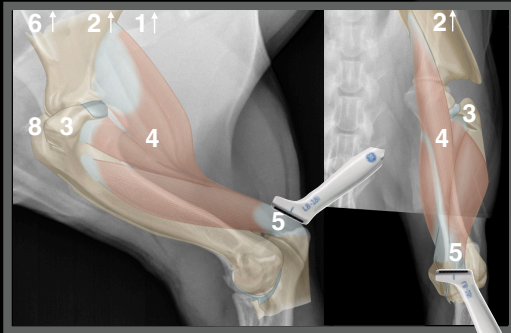


www.imaios.com

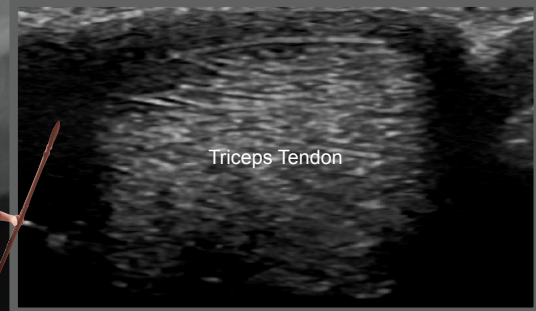
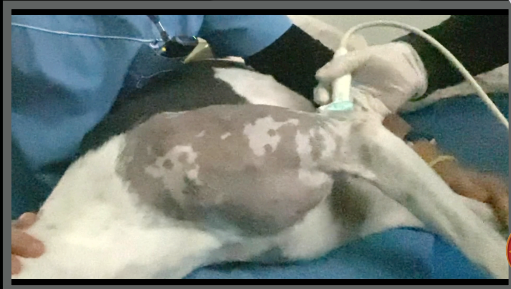
The triceps muscle



The triceps muscle



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Asia, Australian Shepherd, FS, 3 years

- Felt from a balcony (7 meters high)
- Initial severe abdominal haemorrhage
- Recovered in one week
- Persistent second degree lameness right front limb



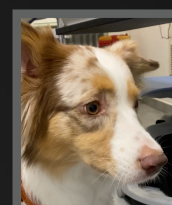
Asia, Australian Shepherd, FS, 3 years

Two weeks later

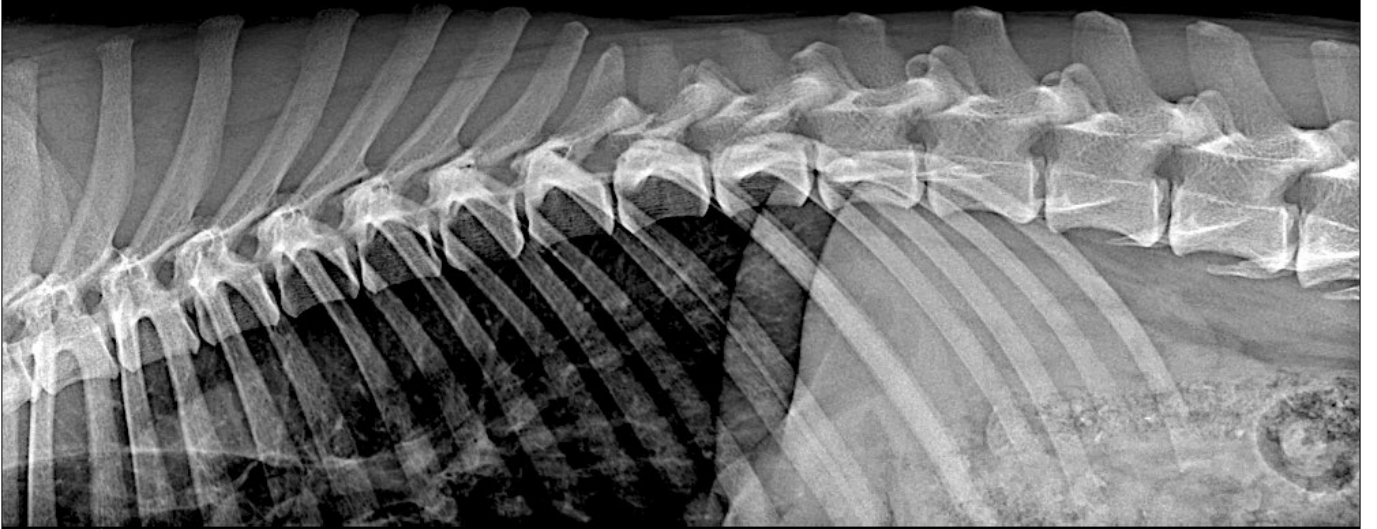
- Minimal reduction of the right hindlimb proprioception
- Second-degree lameness of right front limb persistent ten days after the trauma
- Pain in the area of the right triceps muscle



Asia, FS, 3 years

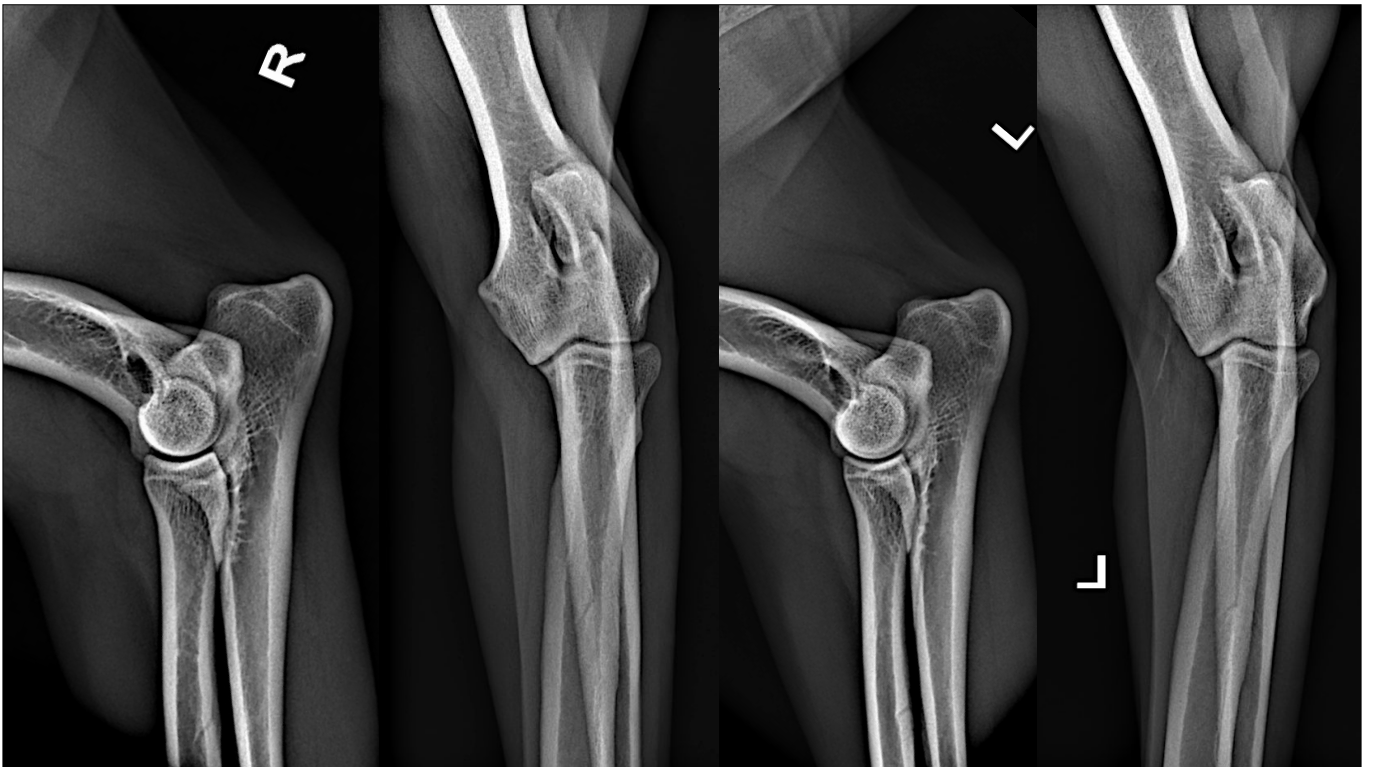


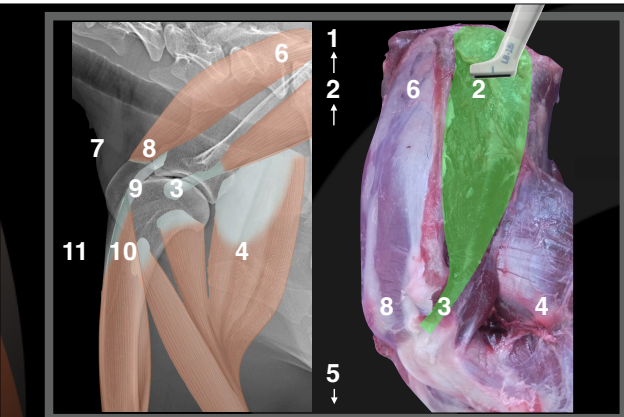
Asia, FS, 3 years



Asia, FS, 3 years



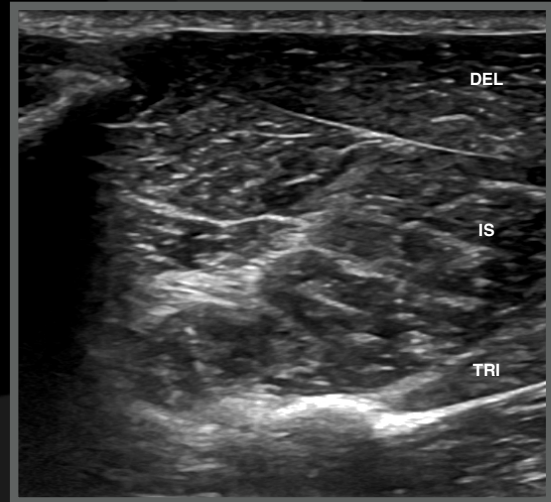




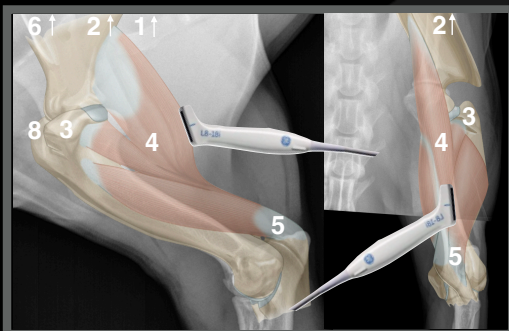
Asia, FS, 3 years

Left shoulder

Infraspinatus muscle transverse scan 2-3



Asia, FS, 3 years

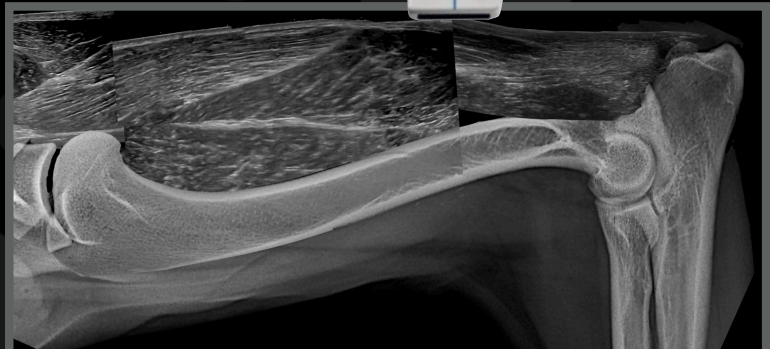
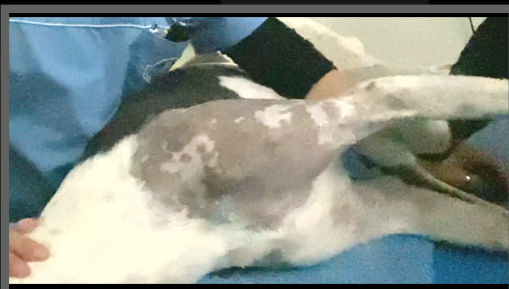


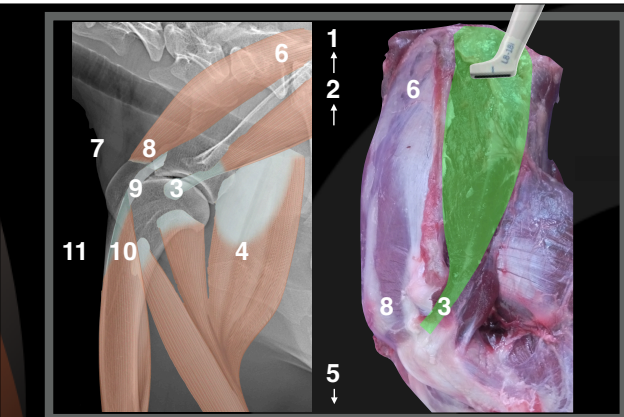
www.imaios.com



Left brachium

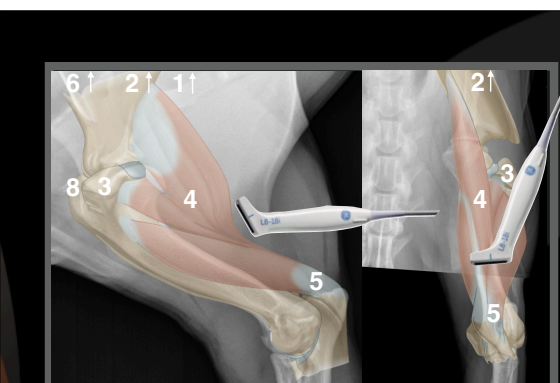
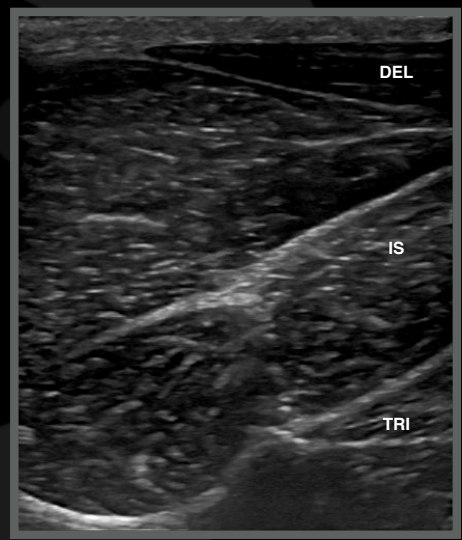
4-5 longitudinal





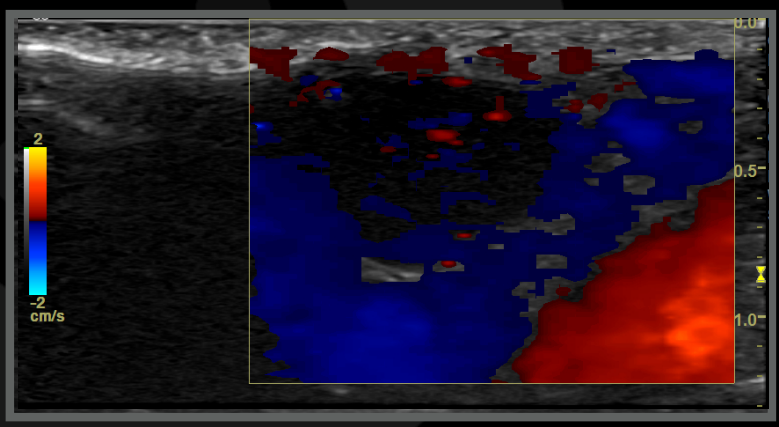
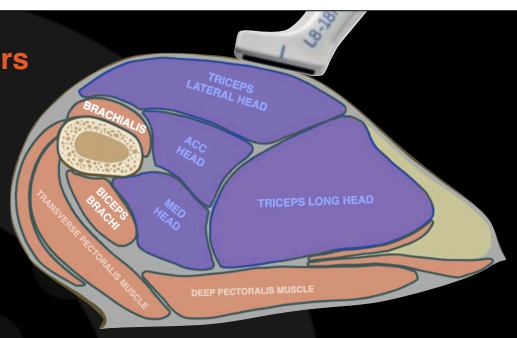
Asia, FS, 3 years
Right shoulder

Infraspinatus muscle transverse scan 2-3



Asia, FS, 3 years
Right brachium

4-5 transverse

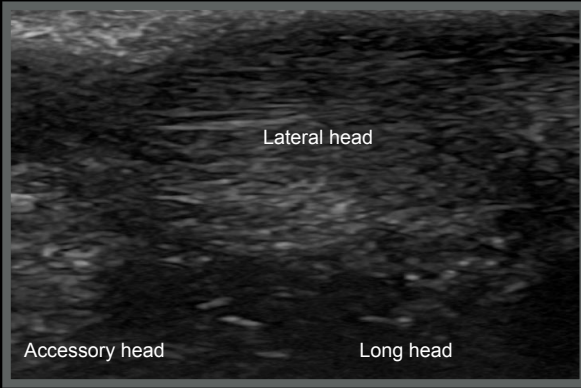


Asia, FS, 3 years

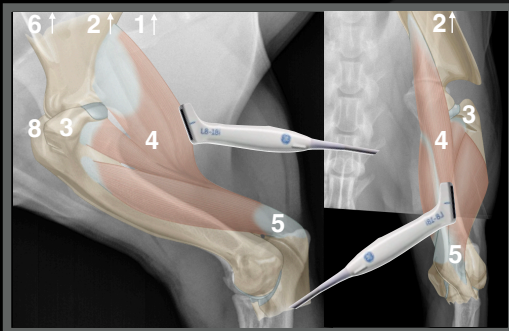
4-5 transverse

Left brachium

Right brachium



Asia, FS, 3 years



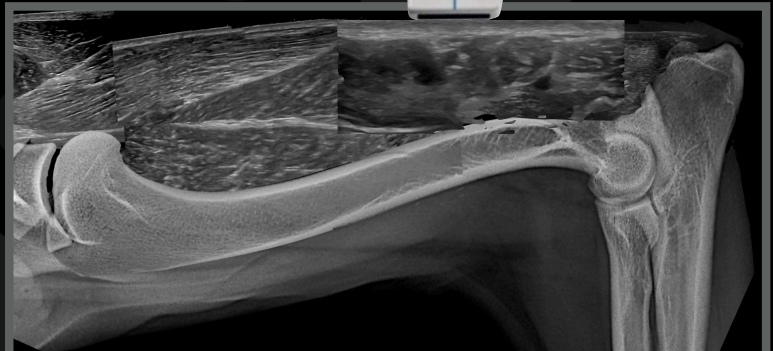
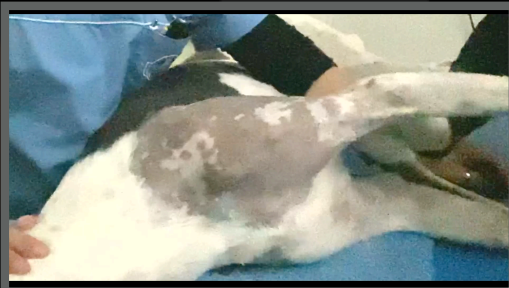
www.imaios.com



Left brachium



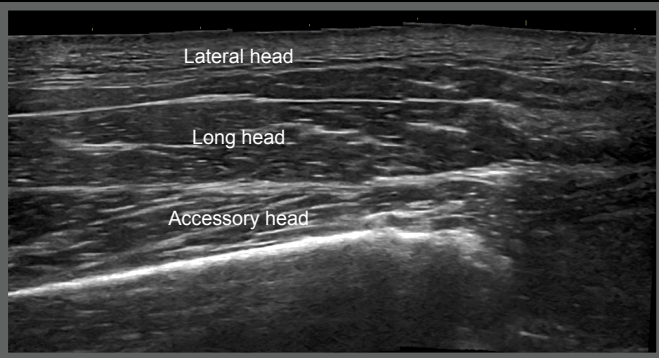
4-5 longitudinal



Asia, FS, 3 years

4-5 longitudinal

Left brachium



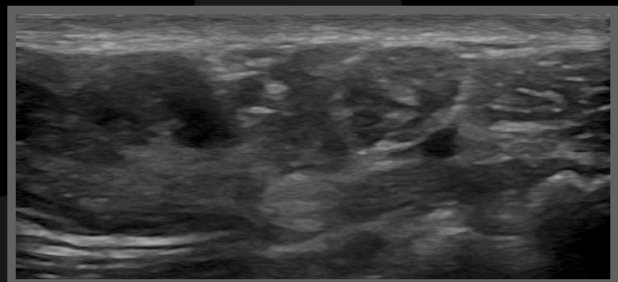
Right brachium



Asia, Australian Shepherd, FS, 3 years

Ultrasonographic diagnoses

- Focal rupture-hematoma of the lateral head of the right triceps





OPEN ACCESS

Terminology and classification of muscle injuries in sport: The Munich consensus statement

Hans-Wilhelm Mueller-Wohlfahrt,¹ Lutz Haensel,¹ Kai Mithoefer,² Jan Ekstrand,³ Bryan English,⁴ Steven McNally,⁵ John Orchard,^{6,7} C Niek van Dijk,⁸ Gino M Kerkhoffs,⁹ Patrick Schamasch,¹⁰ Dieter Blottner,¹¹ Leif Swaerd,¹² Edwin Goedhart,¹³ Peter Uebli¹

Mueller-Wohlfahrt H-W, et al. *Br J Sports Med* 2013;**47**:342–350. doi:10.1136/bjsports-2012-091448

Direct muscle injuries: (extrinsic trauma)

- **Contusion**- bruise, hematoma, usually belly muscle affected
- **Laceration**- bite lesion

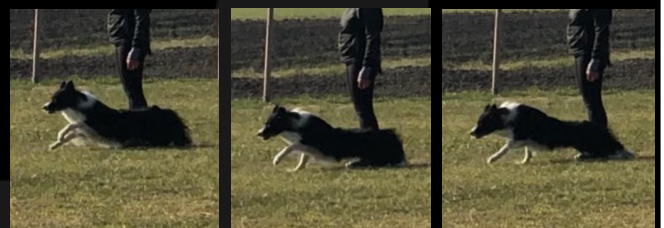
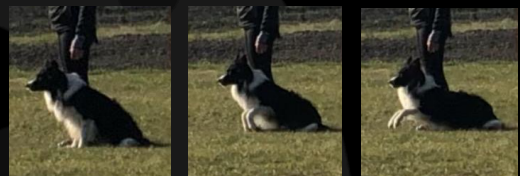


Indirect muscle injuries: (intrinsic trauma)

Functional disorders

Over-exertion related (fatigue induced, muscle soreness)

Neuromuscular muscle disorders (eg. nerve compression, myositis...)

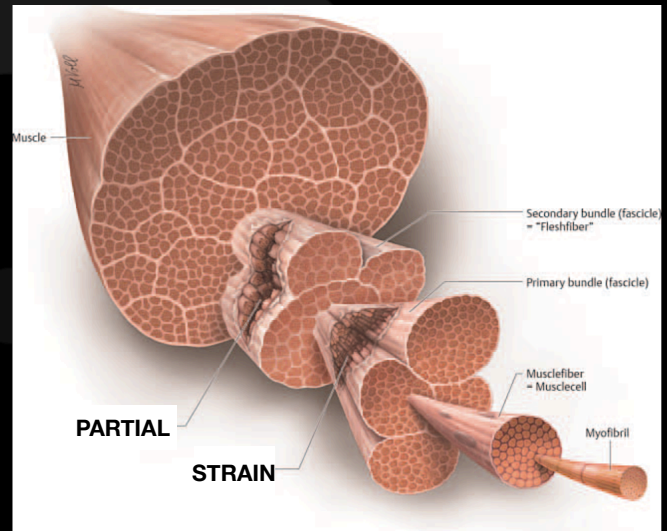


Indirect muscle injuries: (intrinsic trauma)

Structural injuries

Partial muscle/tendon/ligament tear (strain/sprain. Not palpable lesion)

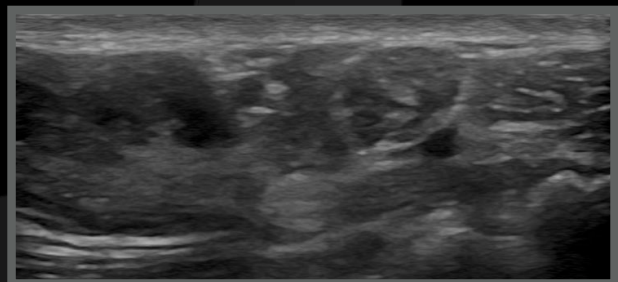
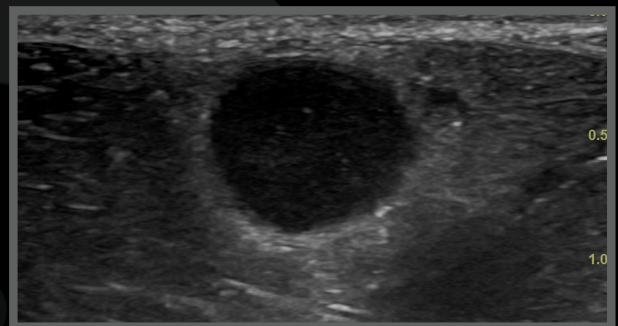
Moderate to total muscle tear (palpable muscle defect)



Asia, Australian Shepherd, FS, 3 years

Ultrasonographic diagnoses

- Lateral head of the right triceps focal hematoma-rupture



Article

Efficacy of Serial Ultrasonographic Examinations in Predicting Return to Play in Agility Dogs with Shoulder Lameness

Maria Grazia Entani ¹, Alessio Franini ¹ , Ludovica Dragone ², Gabriele Barella ³, Fabio De Rensis ⁴ and Giliola Spattini ^{5,*}

Healing phase	Tendon	Muscle
Inflammatory phase	24 h	5 days
Proliferative phase	2 days- 6 weeks	4 weeks
Remodeling phase	Consolidation 6-10 weeks Maturation 10-52 weeks	Consolidation 5-12 weeks Maturation 12-52 weeks

Animals **2022**, *12*, 78. <https://doi.org/10.3390/ani12010078>

Asia Australian Shepherd, FS, 3 years

Three months later



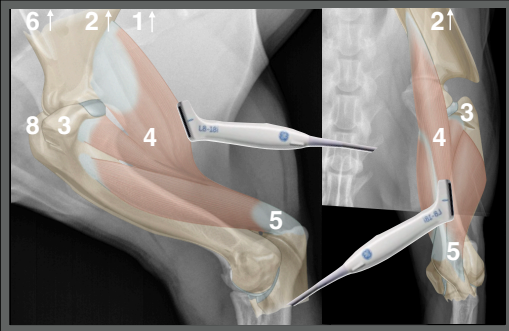
- She is doing fine, but when She runs, the right front limb is less cranially extended

Asia, FS, 3 years

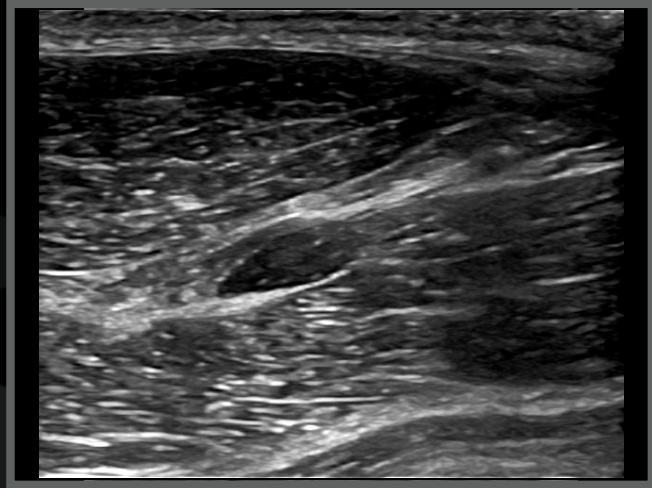
Right brachium



Three months later
4-5 longitudinal



www.imaios.com



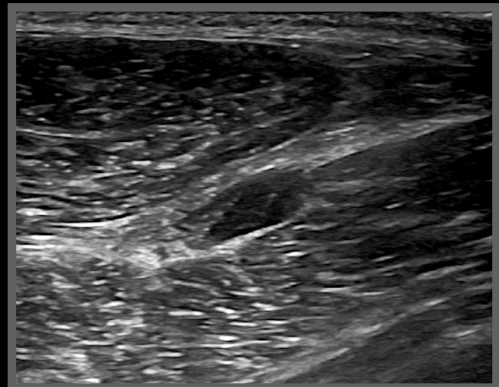
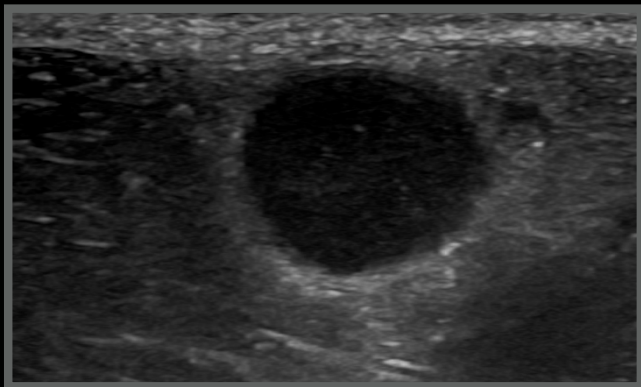
Asia, FS, 3 years

4-5 transverse

Right brachium

Three months later

Right brachium



Asia, Australian Shepherd, FS, 3 years

Six months later

- Rarely shifting weight on the right front limb
- Still minimal deficit-lameness on the right hind limb



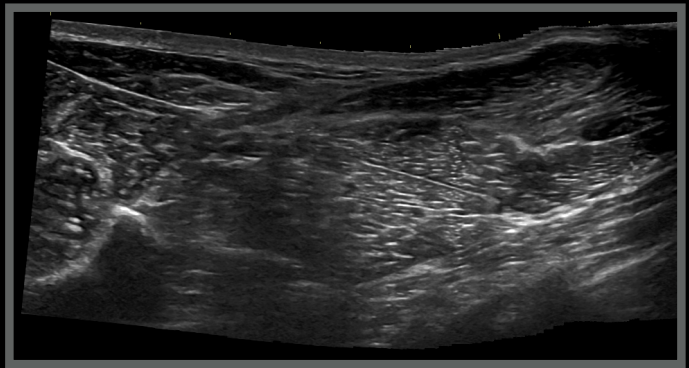
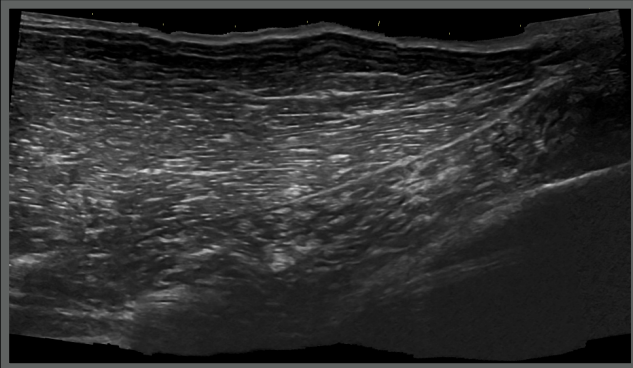
Asia, FS, 3 years

4-5 longitudinal

Six months later

Left brachium

Right brachium



Thank you



Diagnostic Mindset

www.diagnosticmindset.com