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

Infraspinatus-Triceps

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

Diagnostic Mindset

Il loro benessere, il nostro obiettivo
Clinica Veterinaria CASTELLARANO

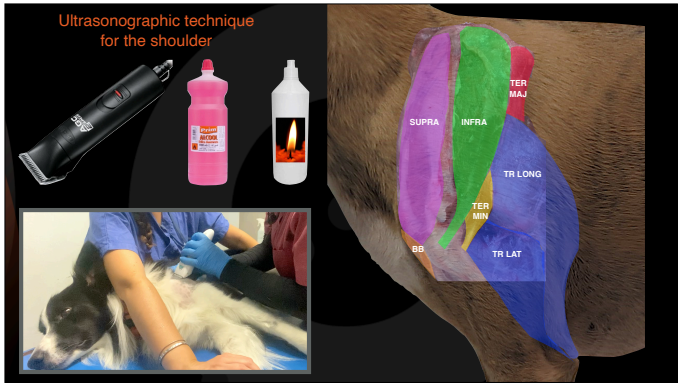
Thank to www.imaios.com

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

Adapted from
"Canine Lameness", 2020

Ultrasonographic technique for the shoulder

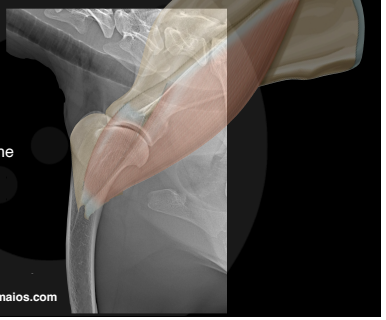


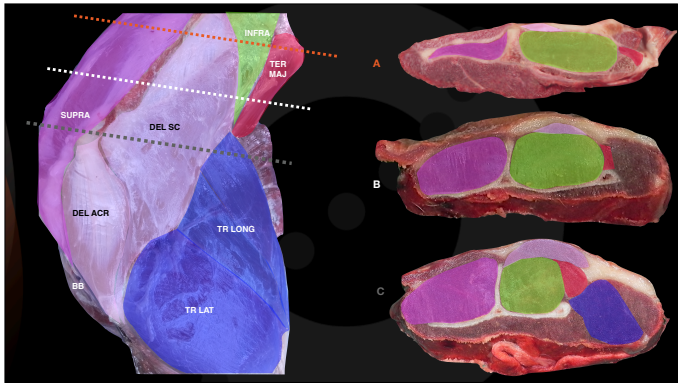
Gross anatomy of the shoulder

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

The deltoid muscle

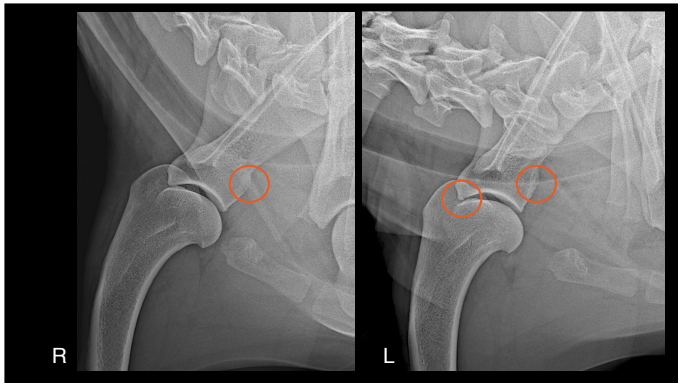
- Anti-gravity muscle
- Stabilises the shoulder when the foot is down (stance phase)



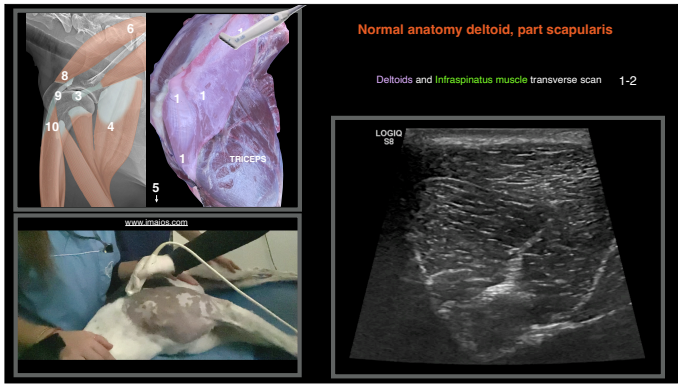


Kim, Golden, FS, 10 years

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




New bone proliferation
New bone proliferation
R
L


Normal anatomy deltoid, part scapularis
Deltoids and Infraspinatus muscle transverse scan 1-2
LOGIQ S8
TRICEPS
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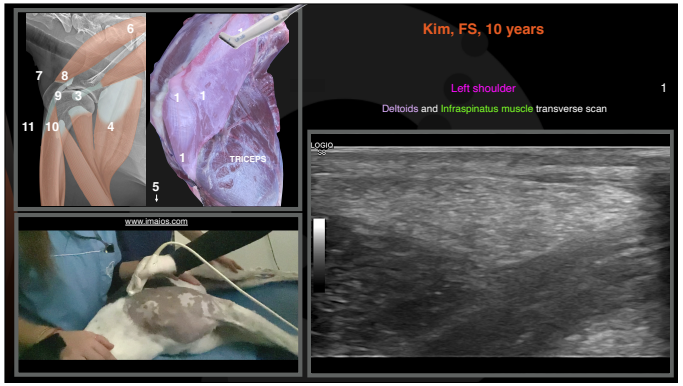
Kim, FS, 10 years
Left shoulder
1
Deltoids and Infraspinatus muscle transverse scan
LOGIQ
TRICEPS
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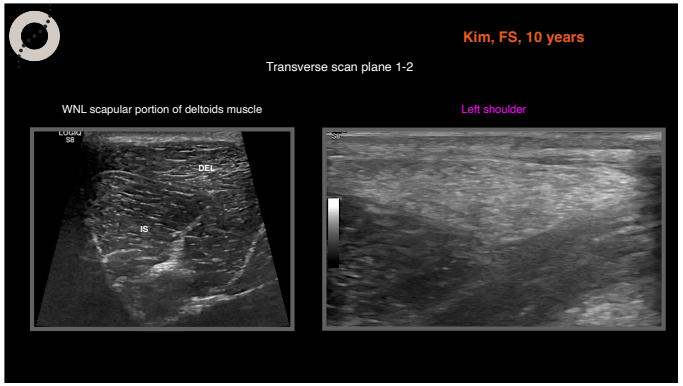
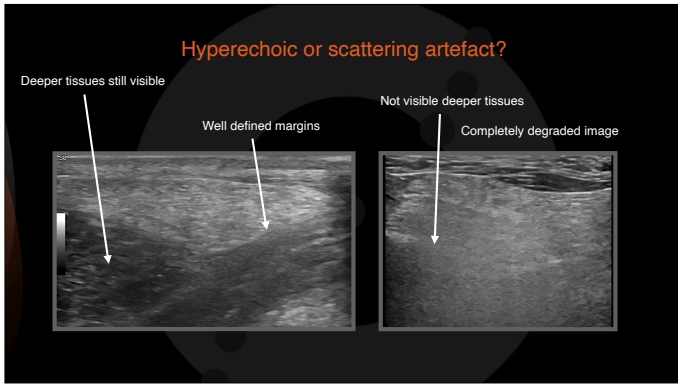
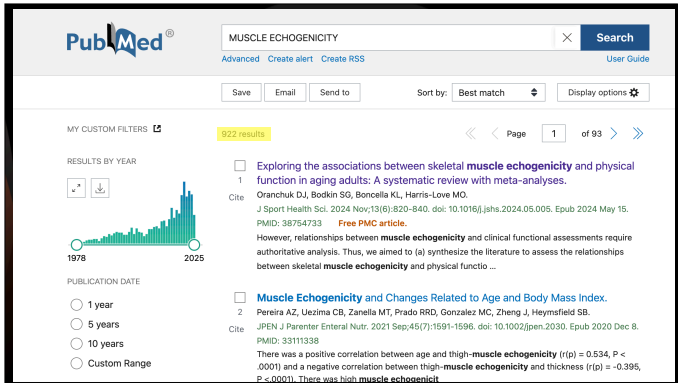

Kim, FS, 10 years
Transverse scan plane 1-2
WNL scapular portion of deltoids muscle
Left shoulder
DEL
IS


Hyperechoic or scattering artefact?
Deeper tissues still visible
Well defined margins
Not visible deeper tissues
Completely degraded image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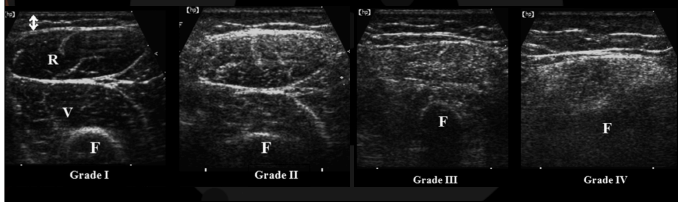
User Guide
Save
Email
Send to
Sort by: Best match
Display options
MY CUSTOM FILTERS
922 results
Page 1 of 93
RESULTS BY YEAR
1978
2025
PUBLICATION DATE
1 year
5 years
10 years
Custom Range
1
Cite
Exploring the associations between skeletal muscle echogenicity and physical function in aging adults: A 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
Cite
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,*]

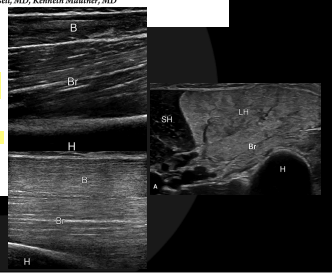


Ultrasound Findings of Delayed-Onset Muscle Soreness

©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*

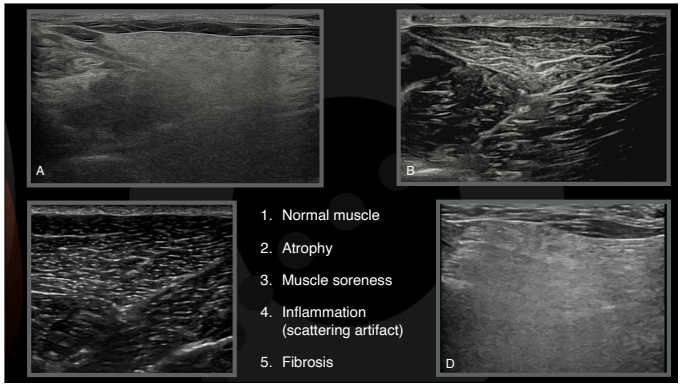
[b] *Department of Physical Therapy and Athletic Training, University of Utah, Salt Lake City, UT 84108, USA*

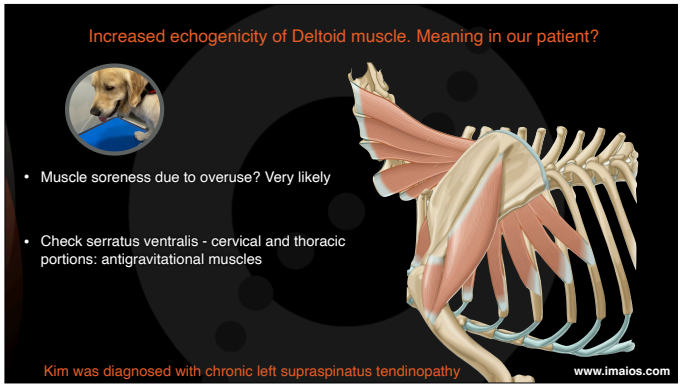
Received 11 January 2024; revised 18 February 2024; accepted 1 April 2024
Available online 15 May 2024

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

tive 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


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


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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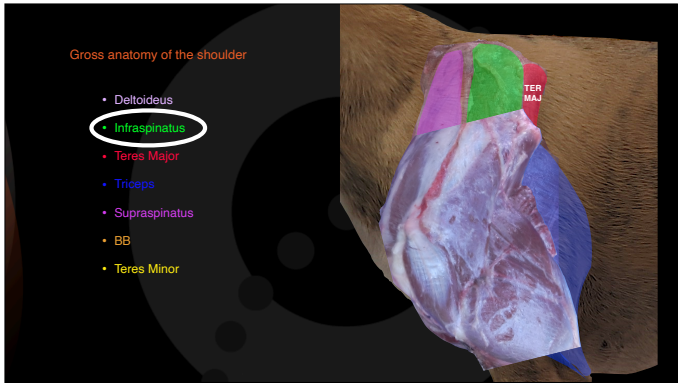
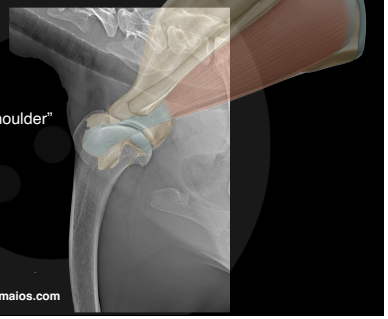

Gross anatomy of the shoulder
• Deltoideus
• Infraspinatus
• Teres Major
• Triceps
• Supraspinatus
• BB
• Teres Minor
TER MAJ

The infraspinatus muscle

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



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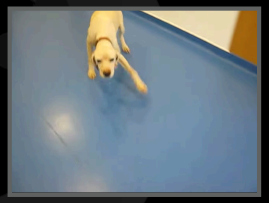
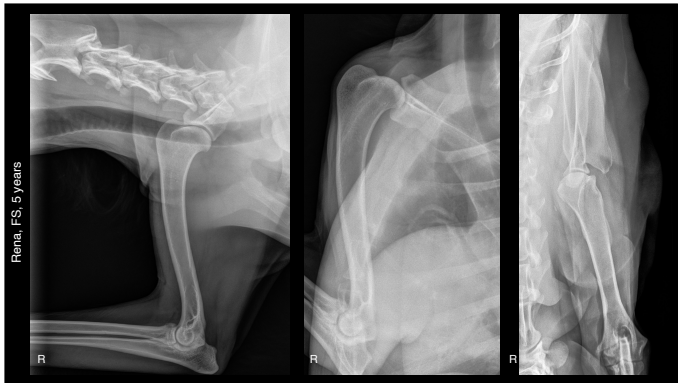
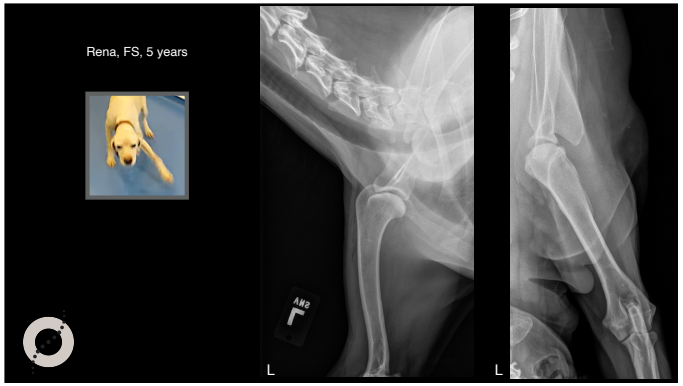
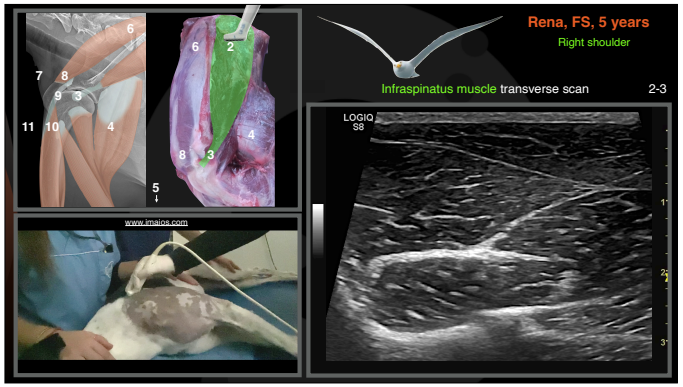
Rena, Mongrel, FS, 5 years

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






Rena, FS, 5 years
L
L


Rena, FS, 5 years
Right shoulder
Infraspinatus muscle transverse scan
2-3
LOGIQ
S8
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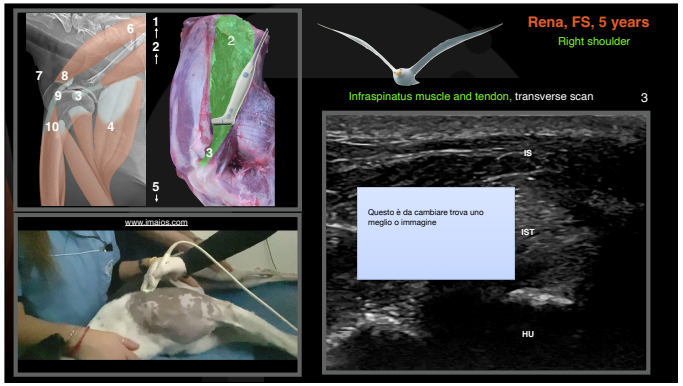
Rena, FS, 5 years
Right shoulder
Infraspinatus muscle and tendon, transverse scan
3
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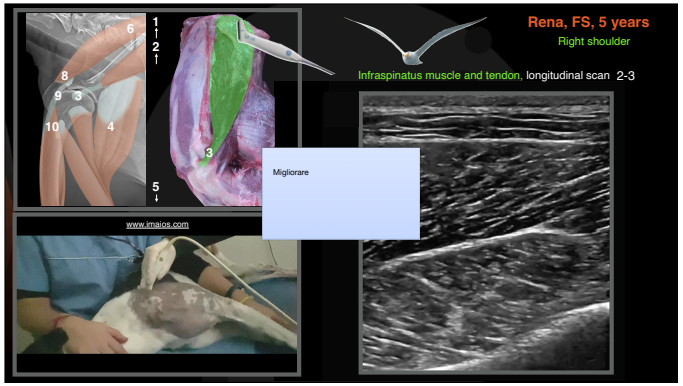
Rena, FS, 5 years
Right shoulder
Infraspinatus muscle and tendon, longitudinal scan 2-3
Migliorare
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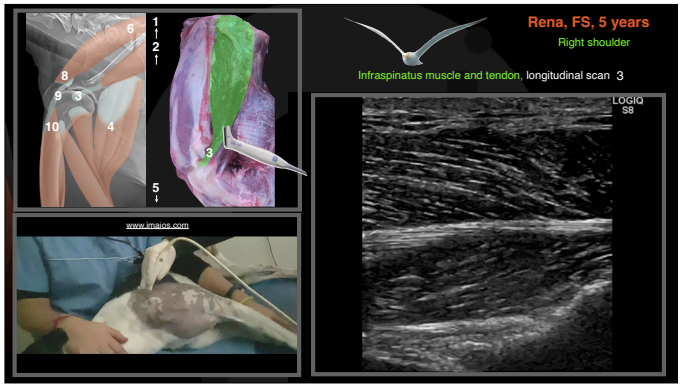
Rena, FS, 5 years
Right shoulder
Infraspinatus muscle and tendon, longitudinal scan 3
LOGIQ
S8
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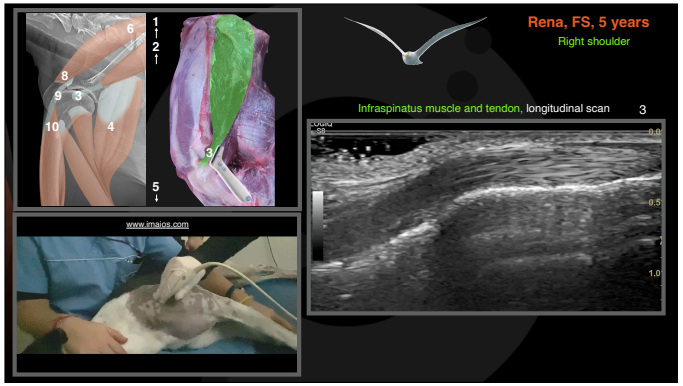
Rena, FS, 5 years
Right shoulder
Infraspinatus muscle and tendon, longitudinal scan 3
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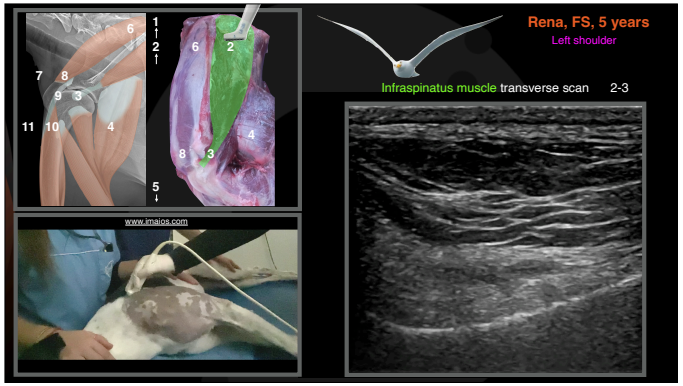
Rena, FS, 5 years
Left shoulder
Infraspinatus muscle transverse scan 2-3
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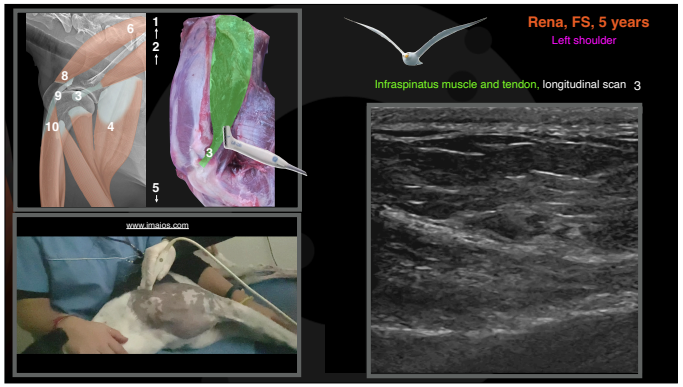
Rena, FS, 5 years
Left shoulder
Infraspinatus muscle and tendon, longitudinal scan 3
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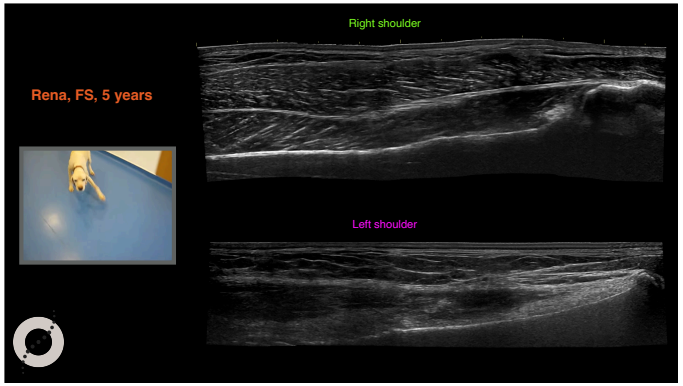
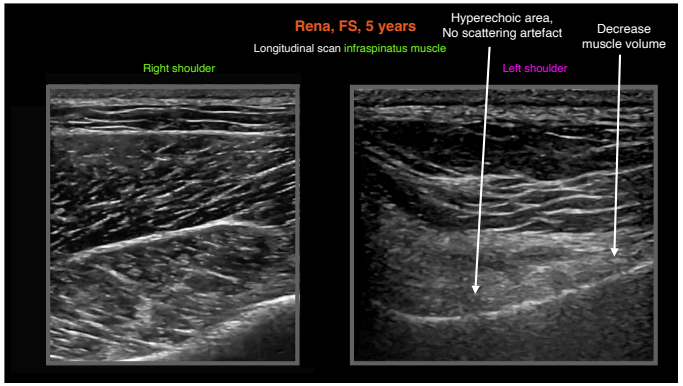
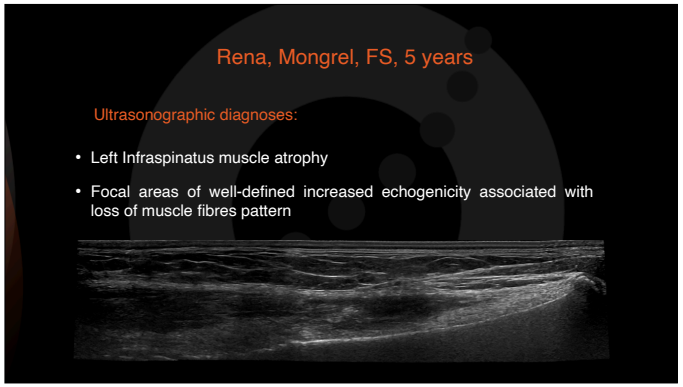
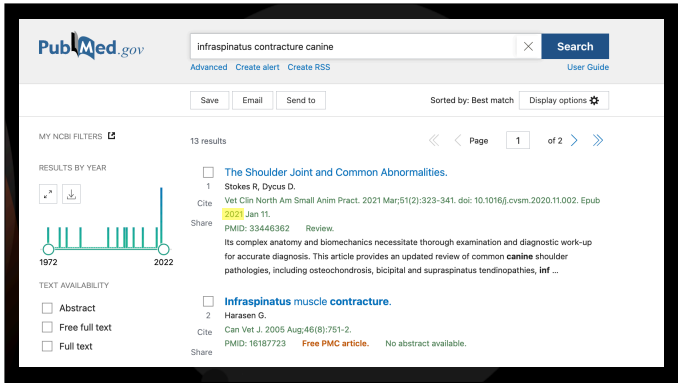

Rena, FS, 5 years
Right shoulder
Left shoulder


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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infraspinatus contracture canine
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RESULTS BY YEAR
1972
2022
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Abstract
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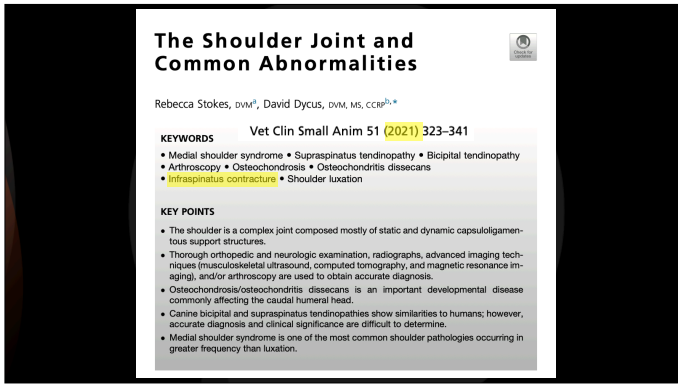
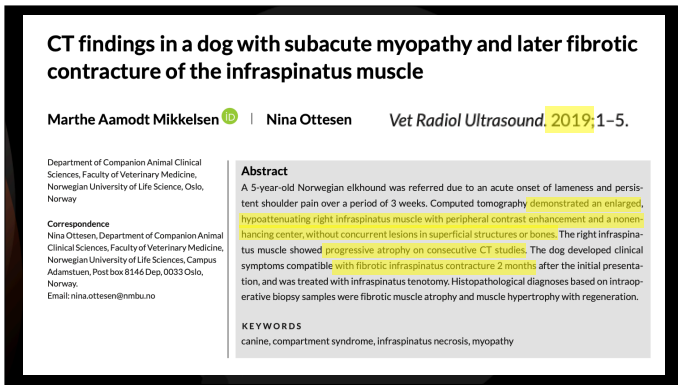
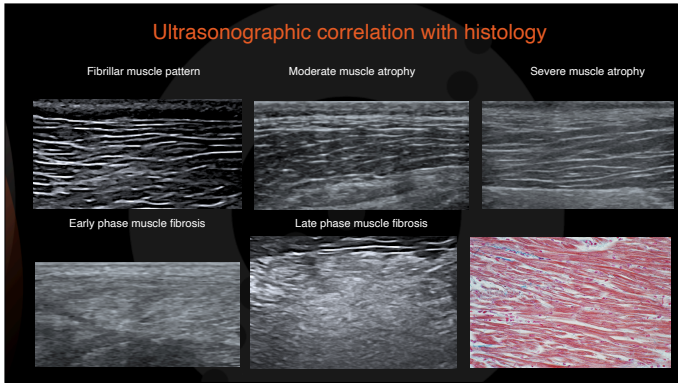
Full text
1 Cite Share
The Shoulder Joint and Common Abnormalities.
Stokes R, Dycus D.
Vet Clin North Am Small Anim Pract. 2021 Mar;51(2):323-341. doi: 10.1016/j.cvsm.2020.11.002. Epub 2021 Jan 11.
PMID: 33446362 Review.
Its complex anatomy and biomechanics necessitate thorough examination and diagnostic work-up for accurate diagnosis. This article provides an updated review of common canine shoulder pathologies, including osteochondrosis, bicipital and supraspinatus tendinopathies, inf ...
2 Cite Share
Infraspinatus muscle contracture.
Harasen G.
Can Vet J. 2005 Aug;46(8):751-2.
PMID: 16187723 Free PMC article. No abstract available.

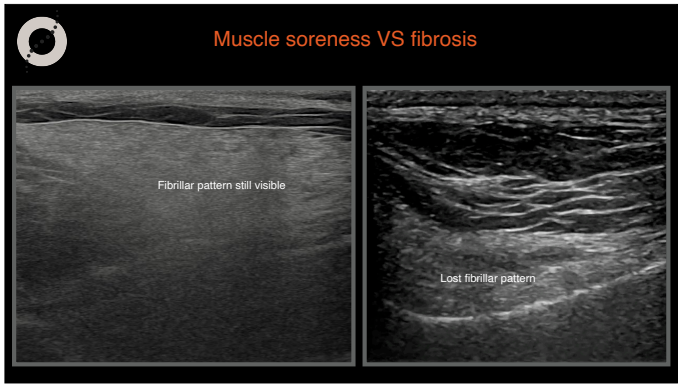

The Shoulder Joint and Common Abnormalities
Rebecca Stokes, DVM, David Dycus, DVM, MS, CCRP
Vet Clin Small Anim 51 (2021) 323–341
KEYWORDS
• Medial shoulder syndrome • Supraspinatus tendinopathy • Bicipital tendinopathy
• Arthroscopy • Osteochondrosis • Osteochondritis dissecans
• Infraspinatus contracture • 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 bicipital 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

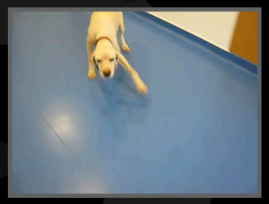


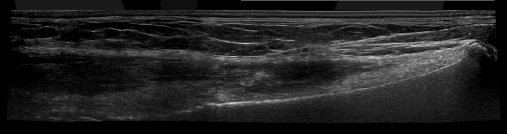
Muscle soreness VS fibrosis



Key points to diagnose infraspinatus contracture

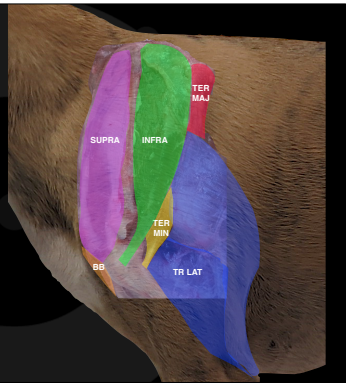
- Typical gait
- Hyperechoic band
- No scattering artefact
- Severe muscle atrophy





Gross anatomy of the shoulder

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



The triceps muscle

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

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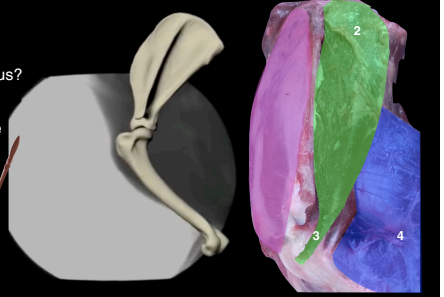
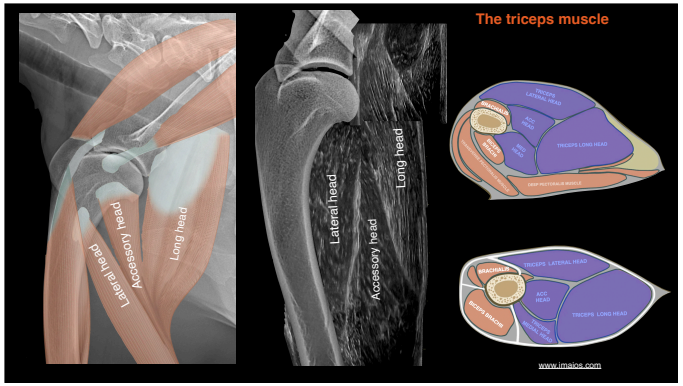
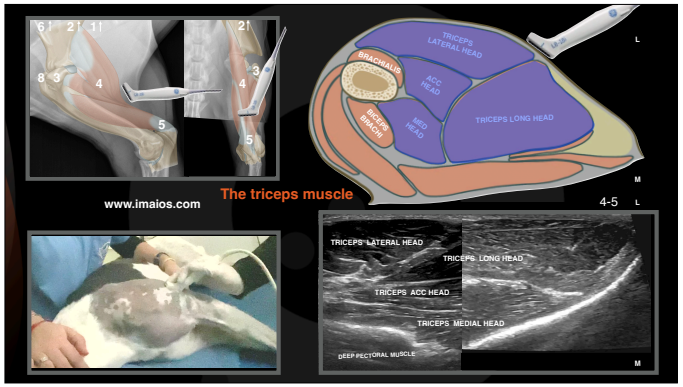
Why we include the triceps in a shoulder ultrasound?

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




The triceps muscle
Lateral head
Accessory head
Long head
Lateral head
Accessory head
Long head
TRICEPS LATERAL HEAD
BRACHIALIS
ACC HEAD
BICEPS BRACHII
MED HEAD
TRICEPS LONG HEAD
DEEP PECTORAL MUSCLE
www.imaios.com


www.imaios.com
The triceps muscle
4-5
TRICEPS LATERAL HEAD
BRACHIALIS
ACC HEAD
BICEPS BRACHII
MED HEAD
TRICEPS LONG HEAD
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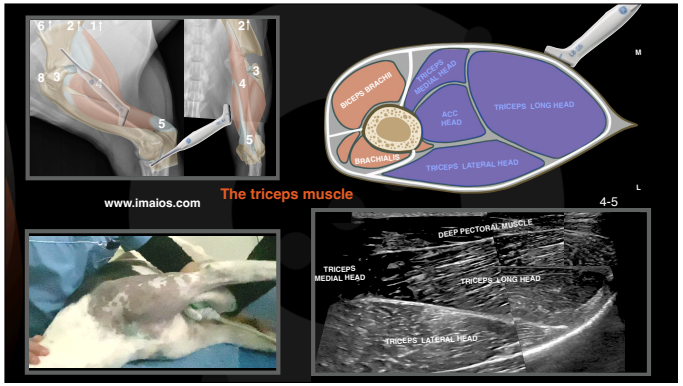
M
TRICEPS LATERAL HEAD
TRICEPS LONG HEAD
TRICEPS ACC HEAD
TRICEPS MEDIAL HEAD
DEEP PECTORAL MUSCLE


www.imaios.com
The triceps muscle
4-5
BICEPS BRACHII
TRICEPS MEDIAL HEAD
ACC HEAD
TRICEPS LONG HEAD
BRACHIALIS
TRICEPS LATERAL HEAD
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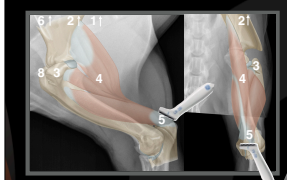
L
DEEP PECTORAL MUSCLE
TRICEPS MEDIAL HEAD
TRICEPS LONG HEAD
TRICEPS LATERAL HEAD

The triceps muscle



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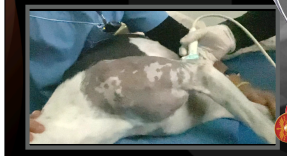


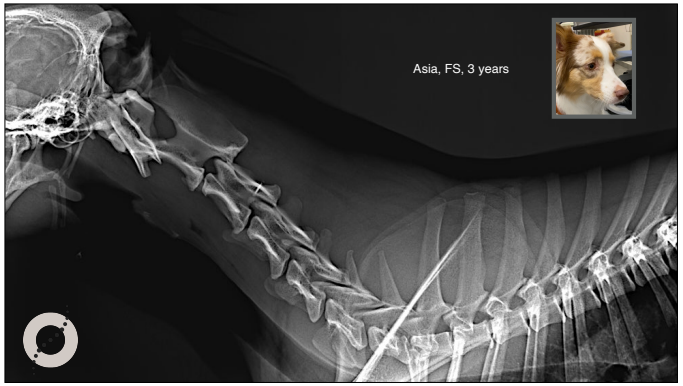
Asia, Australian Shepherd, FS, 3 years

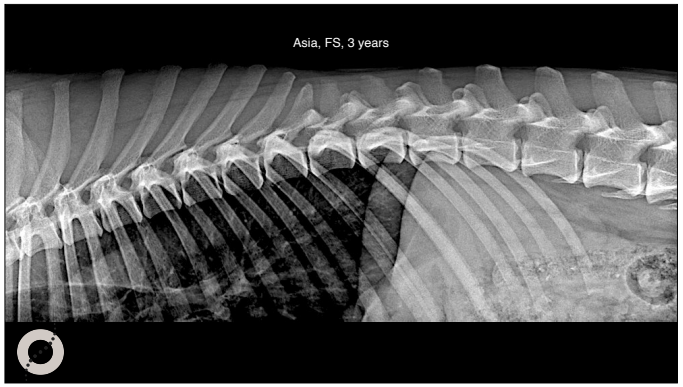
- Felt from a balcony (7 meters high)
- Initial severe abdominal haemorrhage
- Recovered in one week
- Persistent second degree lameness right front limb

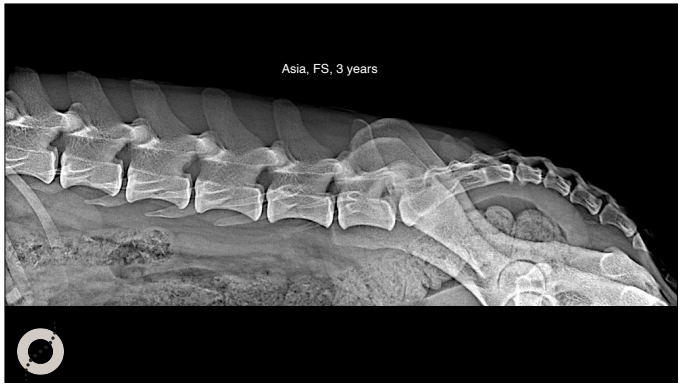
Asia, Australian Shepherd, FS, 3 years

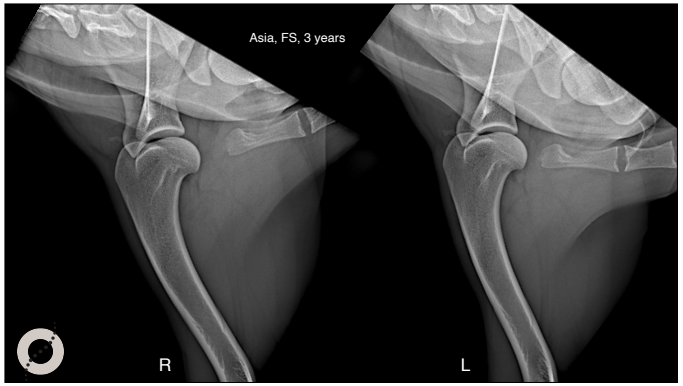
Two weeks later

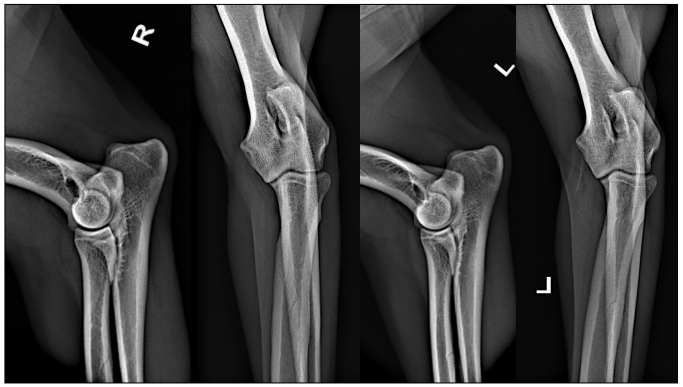
- Minimal reduction of the right hindlimb proprioception
- Second-degree lameness of right front limb persistent ten days after the trauma
- Pain in the area of the right triceps muscle


Asia, FS, 3 years


Asia, FS, 3 years


Asia, FS, 3 years


Asia, FS, 3 years
R
L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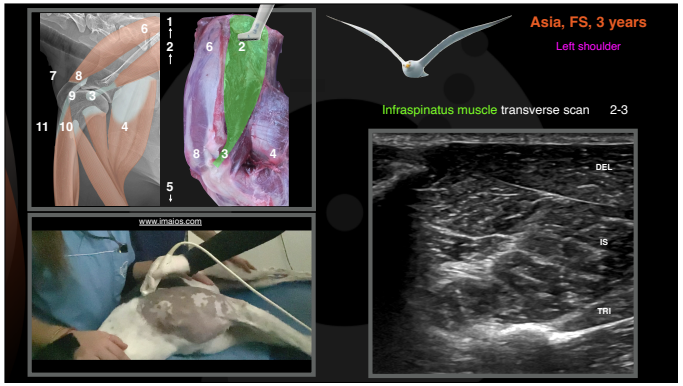
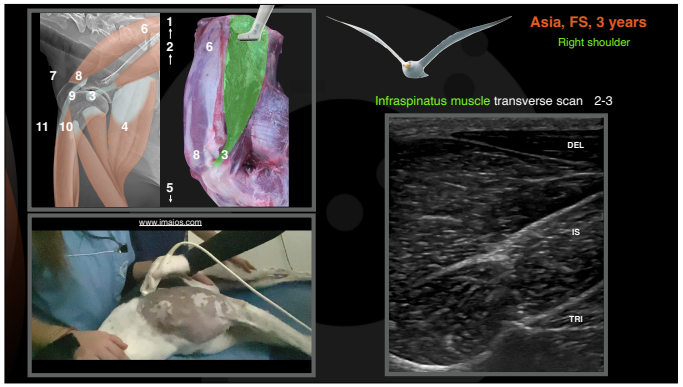
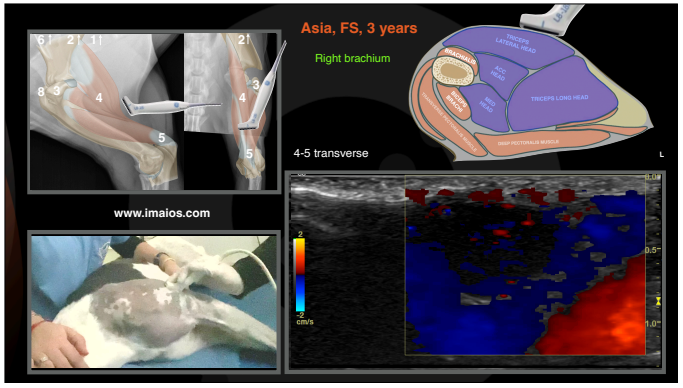
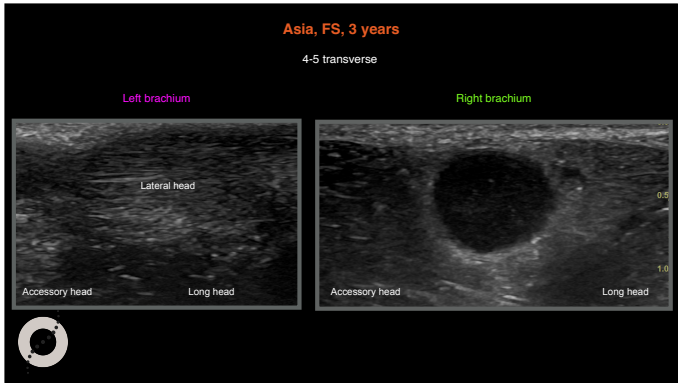

Asia, FS, 3 years
Left shoulder
Infraspinatus muscle transverse scan 2-3
DEL
IS
TRI
www.imaios.com

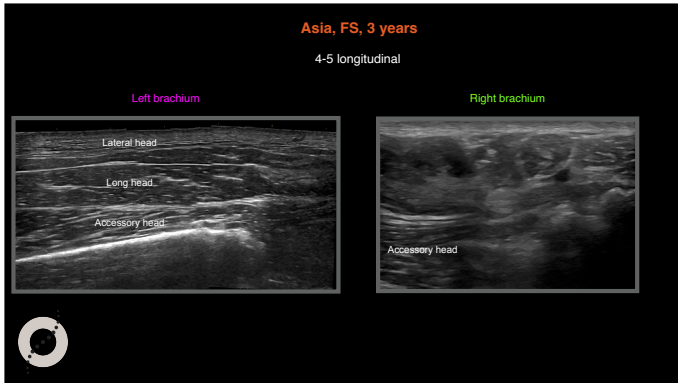

Asia, FS, 3 years
Left brachium
4-5 longitudinal
www.imaios.com


Asia, FS, 3 years
Right shoulder
Infraspinatus muscle transverse scan 2-3
DEL
IS
TRI
www.imaios.com


Asia, FS, 3 years
Right brachium
4-5 transverse
www.imaios.com


Asia, FS, 3 years
4-5 transverse
Left brachium
Right brachium
Lateral head
Accessory head
Long head
Accessory head
Long head

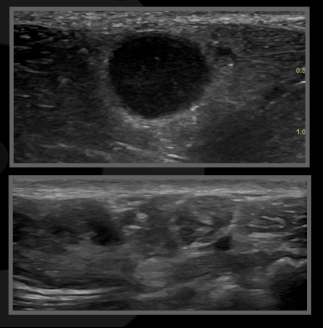

Asia, FS, 3 years
Left brachium
4-5 longitudinal
www.imaios.com


Asia, FS, 3 years
4-5 longitudinal
Left brachium
Right brachium
Lateral head
Long head
Accessory head
Accessory head

Asia, Australian Shepherd, FS, 3 years

Ultrasonographic diagnoses

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



Consensus statement

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 Ueblacker[1]

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)

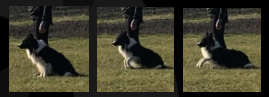
- *Contusion- bruise, hematoma, usually belly muscle affected*
- *Laceration- byte lesion*

Indirect muscle injuries: (intrinsic trauma)

Functional disorders

Over-exertion related (fatigue induced, muscle soreness)

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

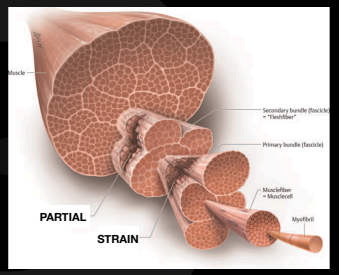


Indirect muscle injuries: (intrinsic trauma)

Structural injuries

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

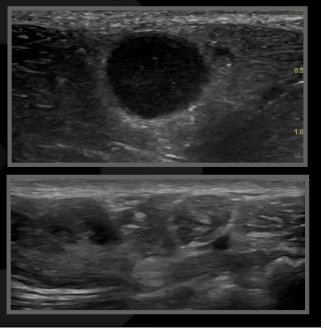
Moderate to total muscle tear (palpable muscle defect)



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

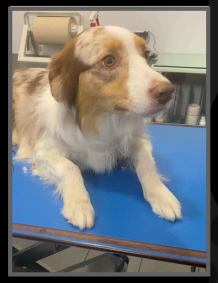
Maria Grazia Entani [1], Alessio Franini [1], Ludovica Dragone [2], Gabriele Barella [3], Fabio De Rensis [4] and Giliola Spattini [5,*]

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

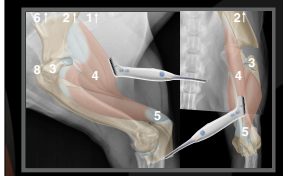
Three months later



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

Asia, FS, 3 years

Right brachium



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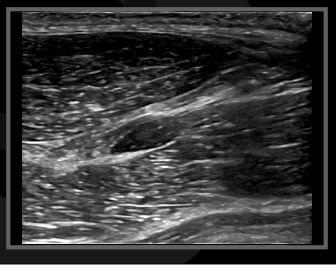
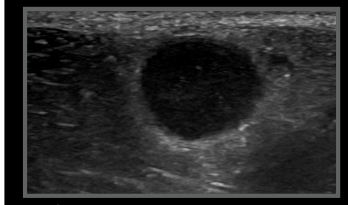
Three months later
4-5 longitudinal



Asia, FS, 3 years

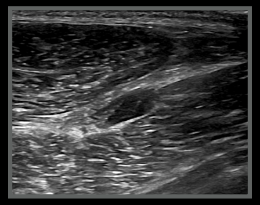
4-5 transverse

Right brachium



Three months later

Right brachium



Asia, Australian Shepherd, FS, 3 years

Six months later

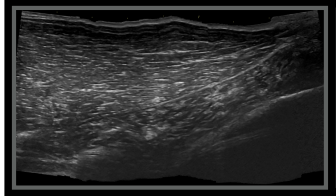
- Rarely shifting weight on the right front limb
- Still minimal deficit-lameness on the right hind limb

Asia, FS, 3 years

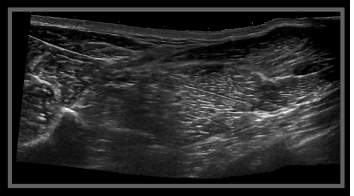
4-5 longitudinal

Six months later

Left brachium



Right brachium



Thank you

Diagnostic Mindset

www.diagnosticmindset.com