Imaging of Primary Soft Tissue Infections in the Pediatric Patient

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Introduction

- Prior to the advent and widespread availability of magnetic resonance imaging (MRI), diagnosis of soft tissue inflammation was frequently clinical and often delayed

- MRI enables prompt and accurate diagnosis of soft tissue infections and decreases morbidity and mortality

Introduction

- Soft tissue inflammation is often seen in the setting of osteomyelitis
- This presentation addresses soft tissue infection that occurs in the absence of osteomyelitis
- Soft tissue infections occurring in a setting of prior surgery, presence of prosthesis and immune depressive states are also excluded

Purpose

- Demonstrate various patterns of primary soft tissue inflammation occurring in otherwise healthy pediatric patients

- Review the MRI findings, discuss the differential diagnosis and pathogenesis

Signs and Symptoms

- Patients usually have systemic signs and symptoms including fever, night sweats, and leukocytosis

- Patients also present with focal symptoms such as swelling, erythema, pain and tenderness

Soft Tissue Inflammation

- Cellulitis
- Fasciitis
- Myositis

Cellulitis

- Cellulitis is acute inflammation of the skin and superficial subcutaneous tissue
- Diagnosis is often clinical
- MRI aids in detection of extension into the underlying fascia (fasciitis) and muscle (myositis), and presence of concurrent abscesses

Fasciitis

- Fasciitis is non-specific inflammation of the deeper subcutaneous tissues and muscle sheath
- Commonly associated with cellulitis or myositis
- Necrotizing form due to “flesh-eating” or gas-forming bacterial infection

Myositis

- Normal muscle is inherently resistant to infection
- Myositis is acute inflammation of the muscles, commonly seen in the setting of osteomyelitis, immune depression, or trauma
- Primary pyomyositis is uncommon in an otherwise healthy patient

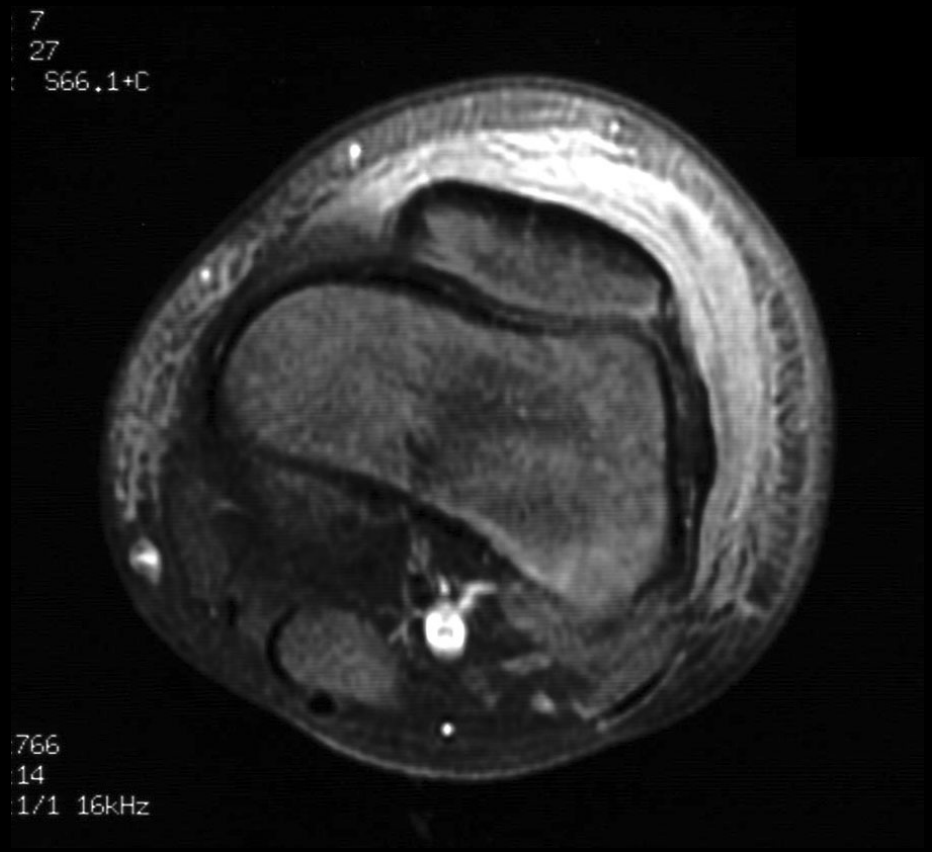
MR Imaging Protocol

- T2-weighted (long TR and TE) images in both axial and longitudinal planes
  - Fast Spin Echo (FSE) sequences with fat saturation are used at our institution
  - Inversion Recovery (IR) sequences may also be used
- T1-weighted (short TR and TE) images in longitudinal plane
- Intravenous contrast is often helpful
  - Pre and post contrast fat saturated T1-weighted images in axial plane

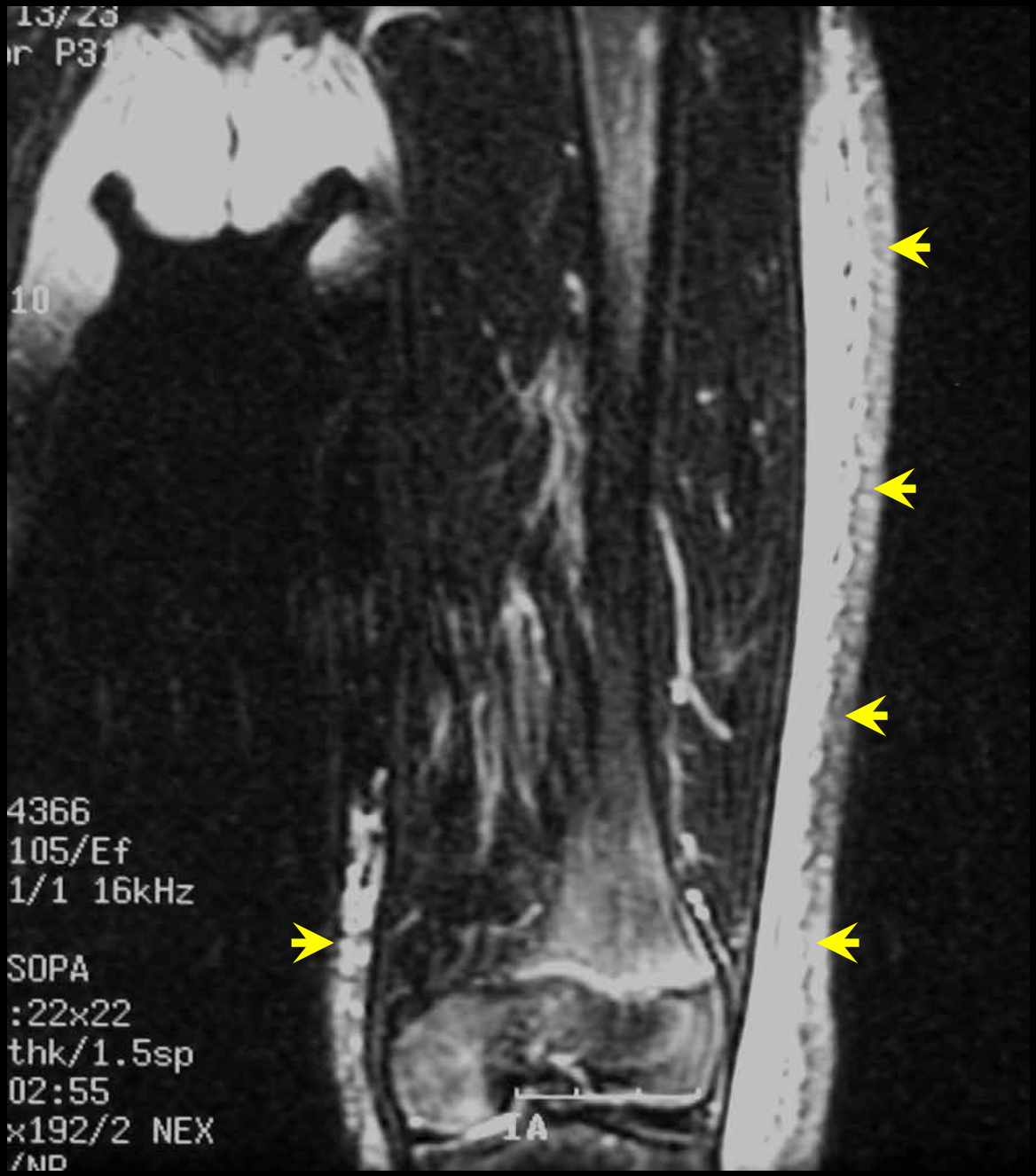
Case 1

2 year old with left leg swelling and erythema

Fat-Suppressed T2-Weighted Image (**T2W**)

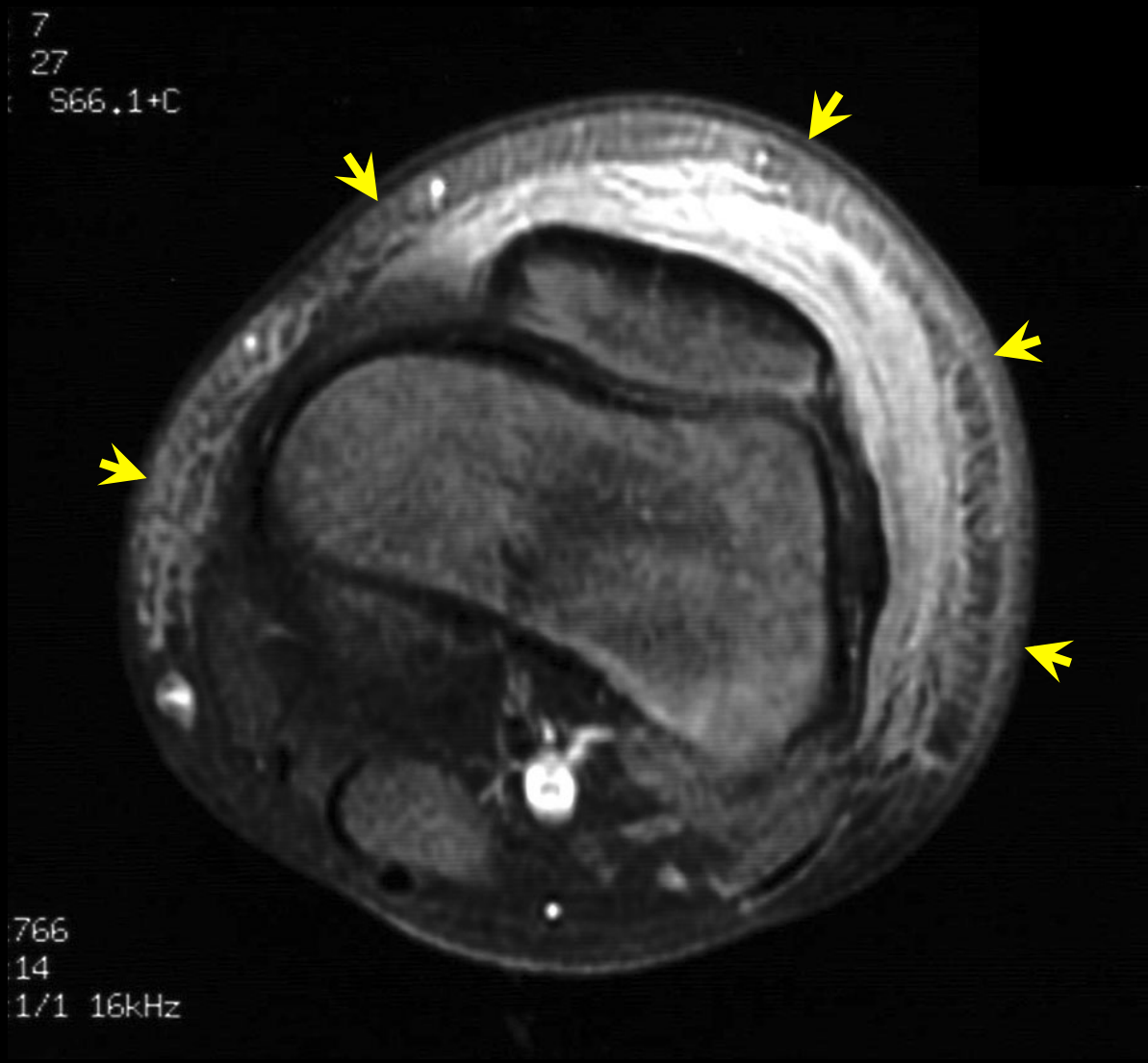


Fat-Suppressed T1-Weighted Image Post-Gadolinium (**Post-contrast T1W**)



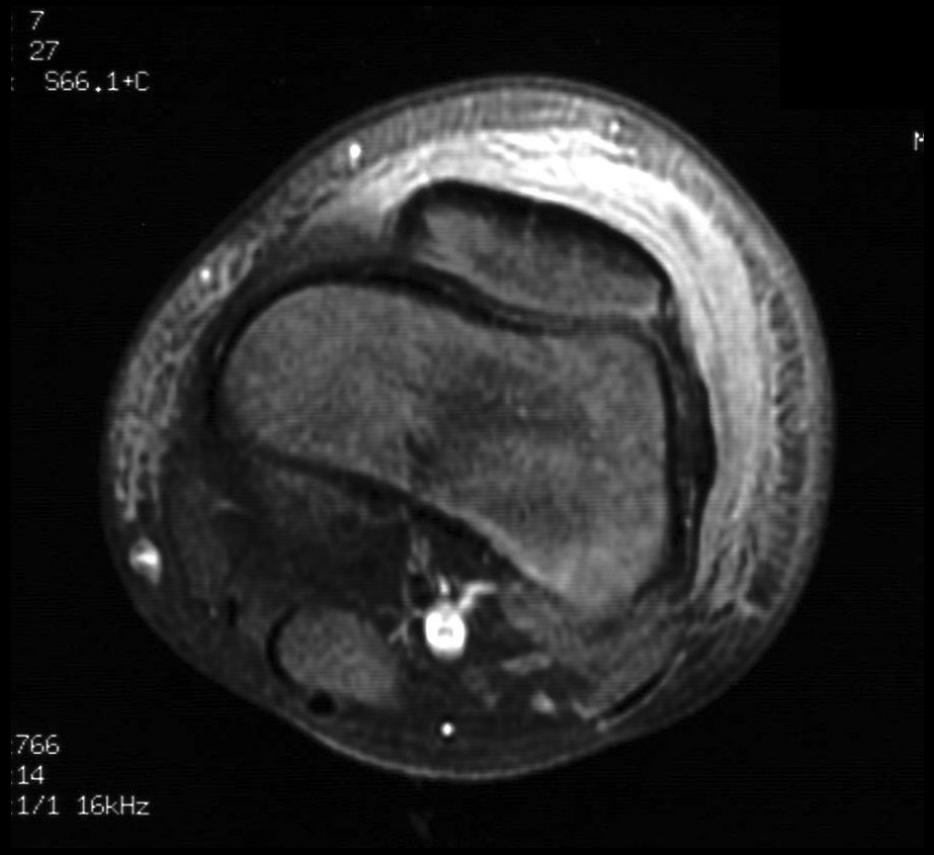
- Diffuse high signal intensity of the skin and superficial subcutaneous tissue on T2-weighted imaging

- Diffuse enhancement of the same tissues on post-contrast images



Cellulitis

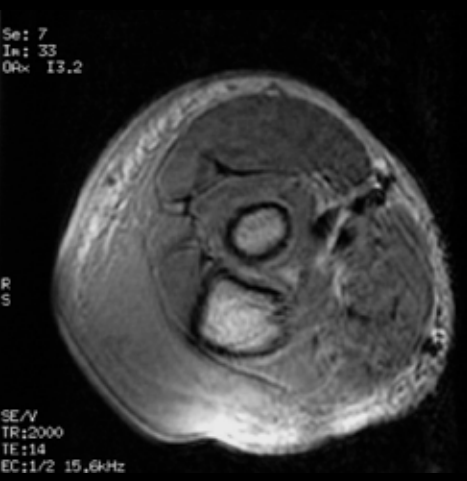
Coronal T2W



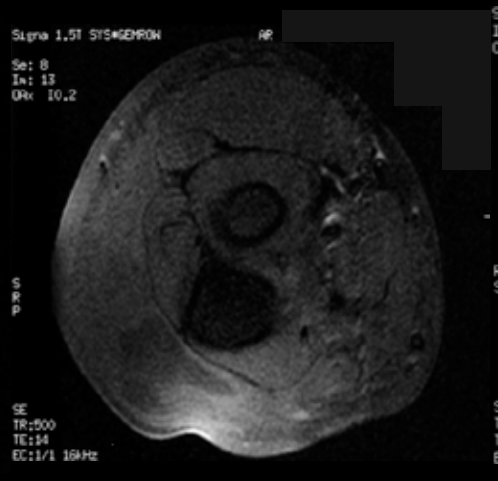
Axial Post-contrast T1W

Case 2

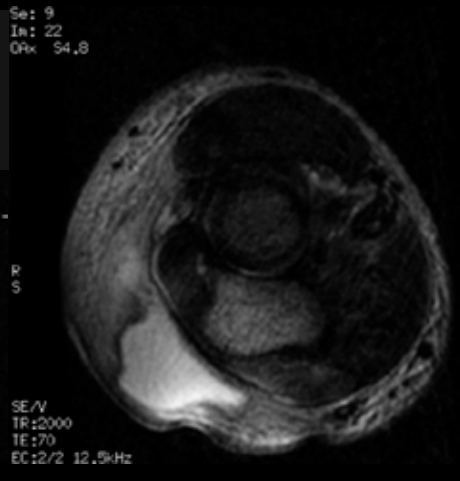
6 year old with right elbow swelling and erythema



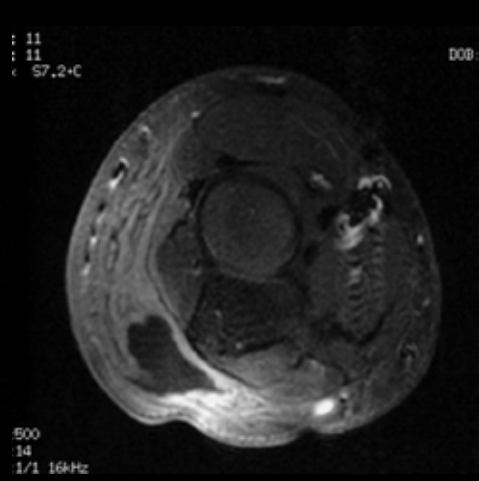
Proton density



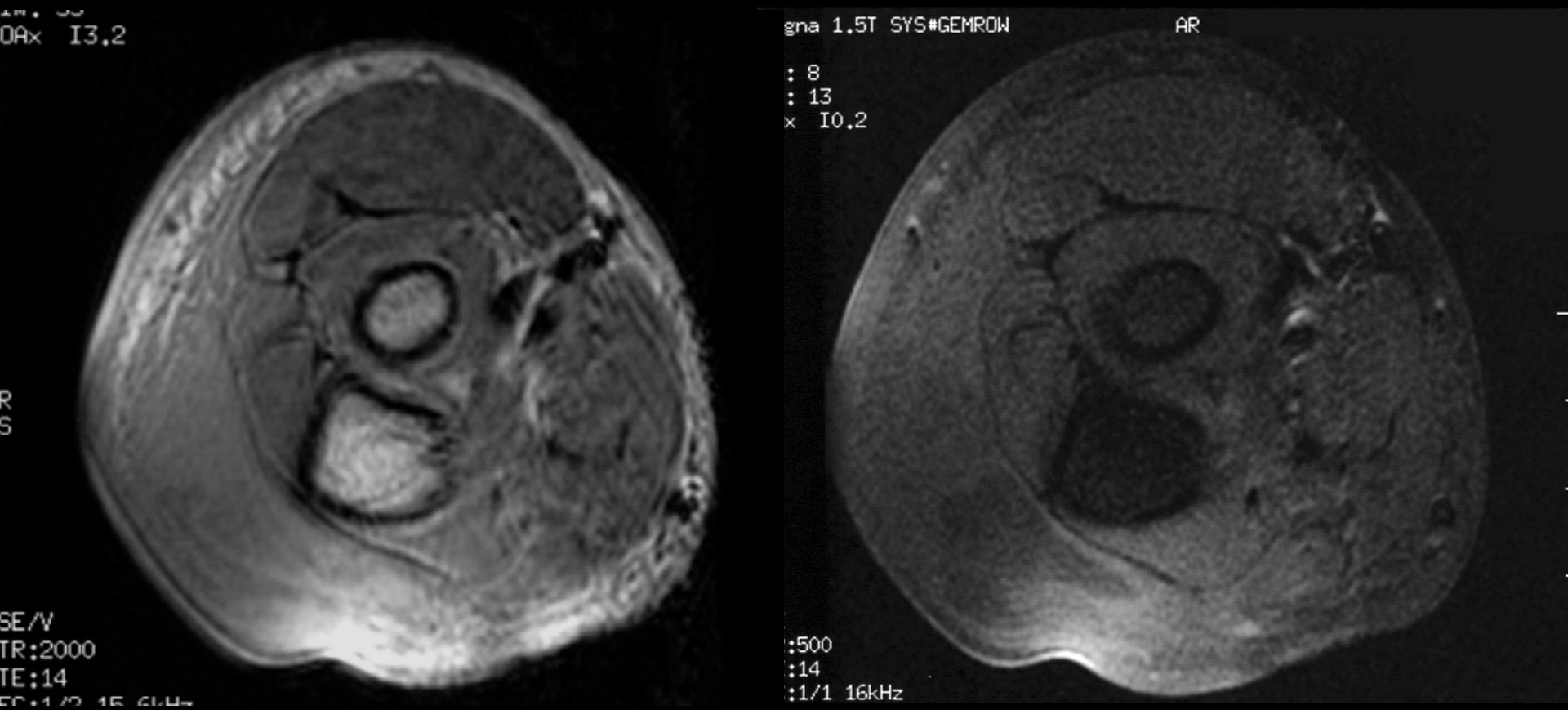
T1W



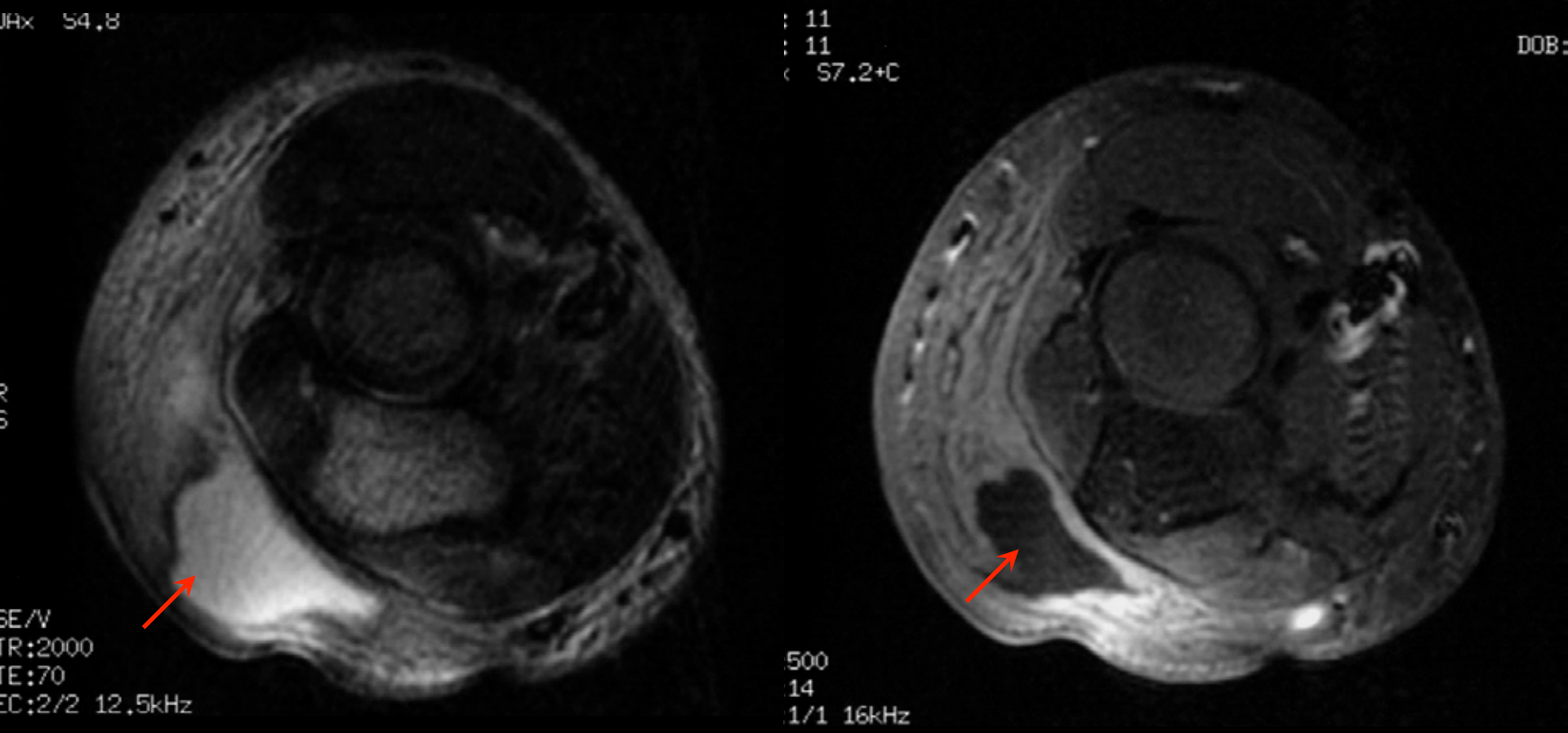
T2W



Post-contrast T1W

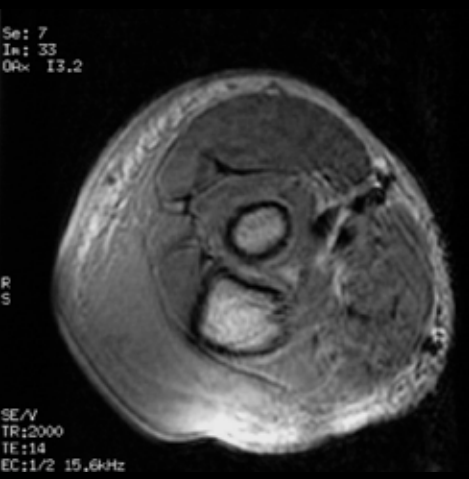


- Proton density image (left) and T1-weighted image (right) demonstrate low signal collection within the thickened subcutaneous tissue posterior to the olecranon



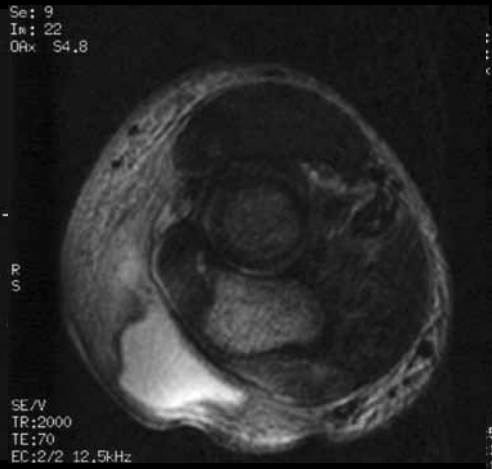
- T2-weighted image (left) and post-contrast image (right) demonstrate abscess (arrows) with peripheral enhancement within inflamed subcutaneous tissue

Cellulitis with Abscess

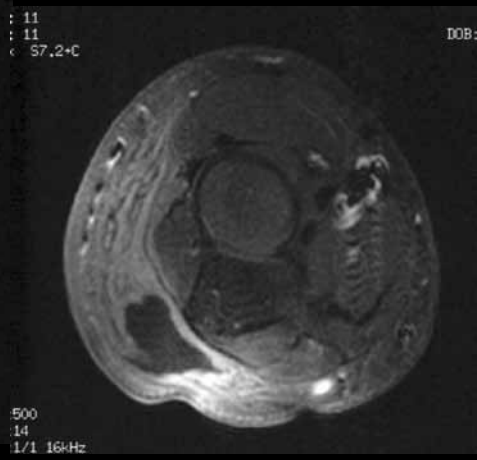


Proton density

T1W



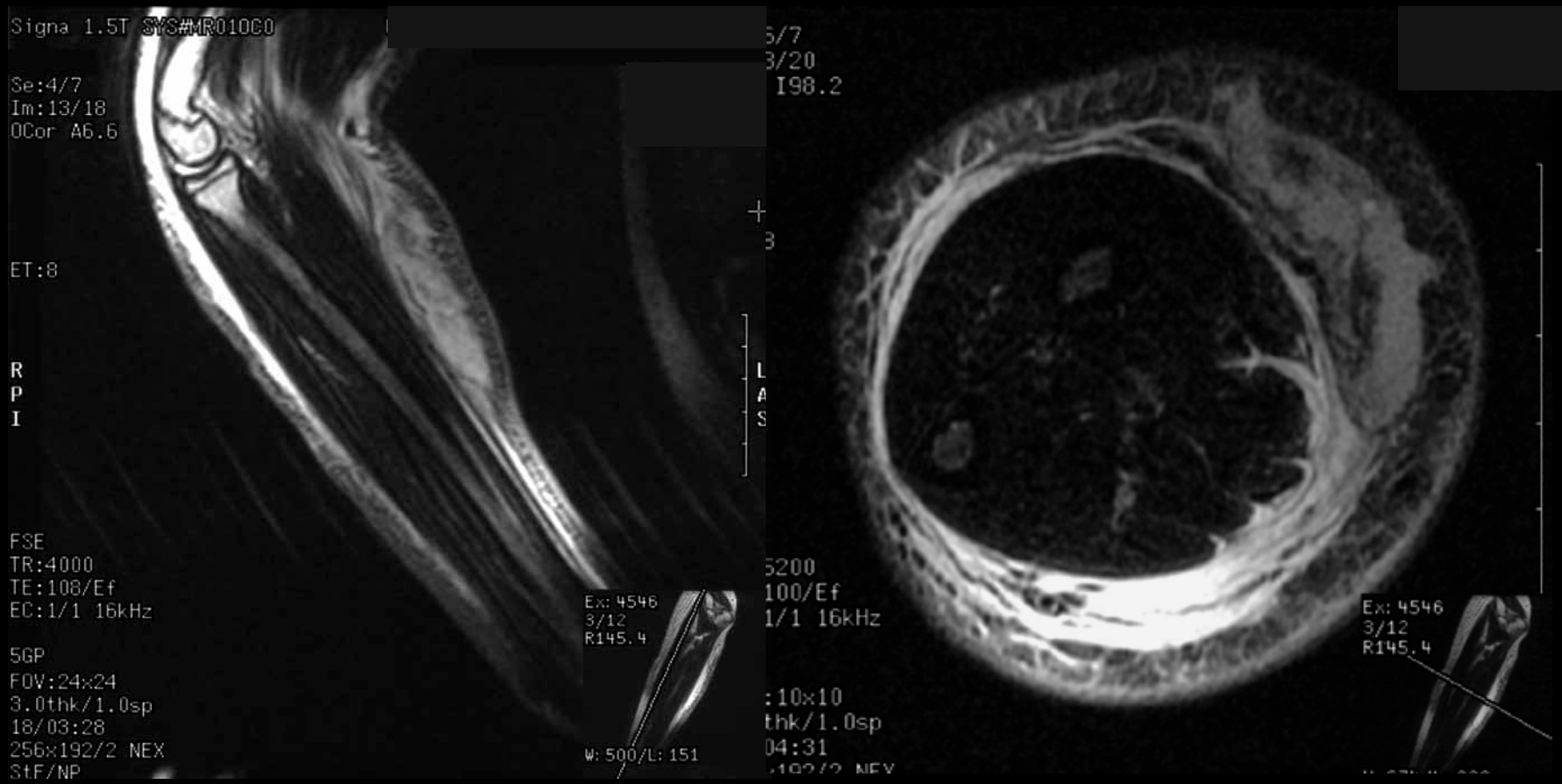
T2W



Post-contrast T1W

Case 3

11 year old with right forearm pain and swelling

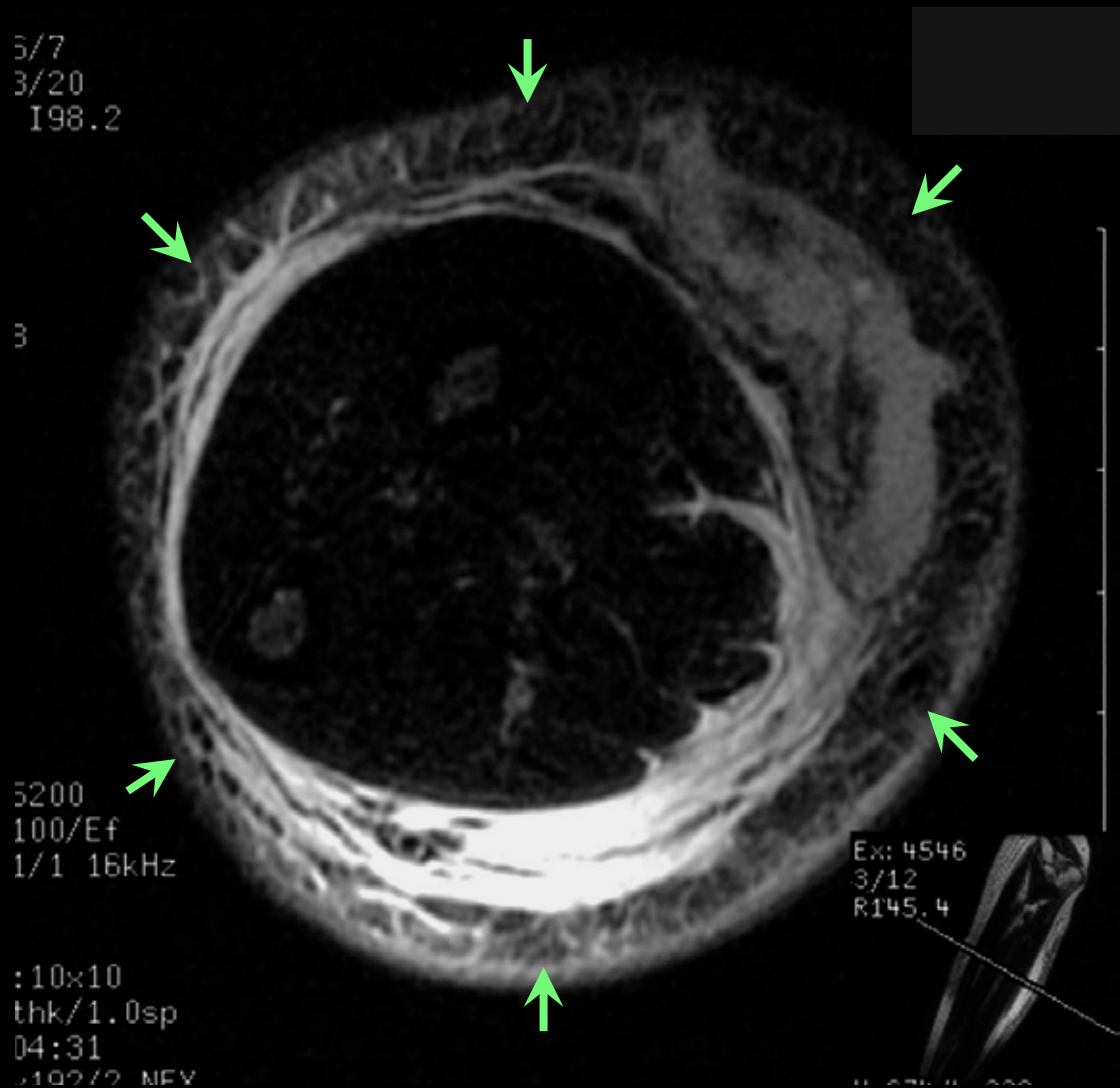


Sagittal and axial T2W

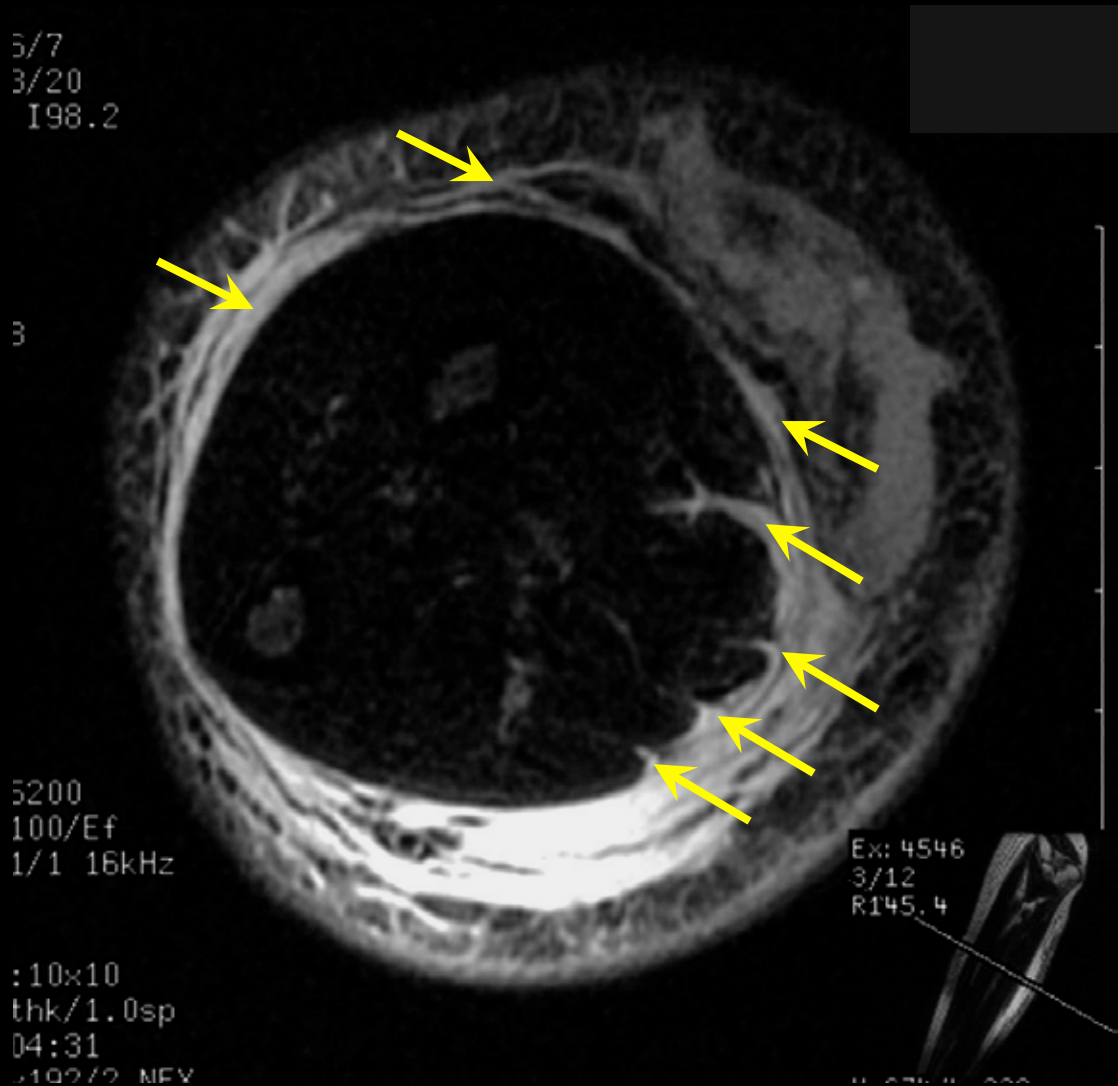
- Diffuse inflammation of the skin and subcutaneous tissues (arrows) as well as within the fascial planes

- Diffuse inflammation of the skin and subcutaneous tissues as well as within the fascial planes
- Focal irregular collection in the volar aspect of the forearm (arrow)

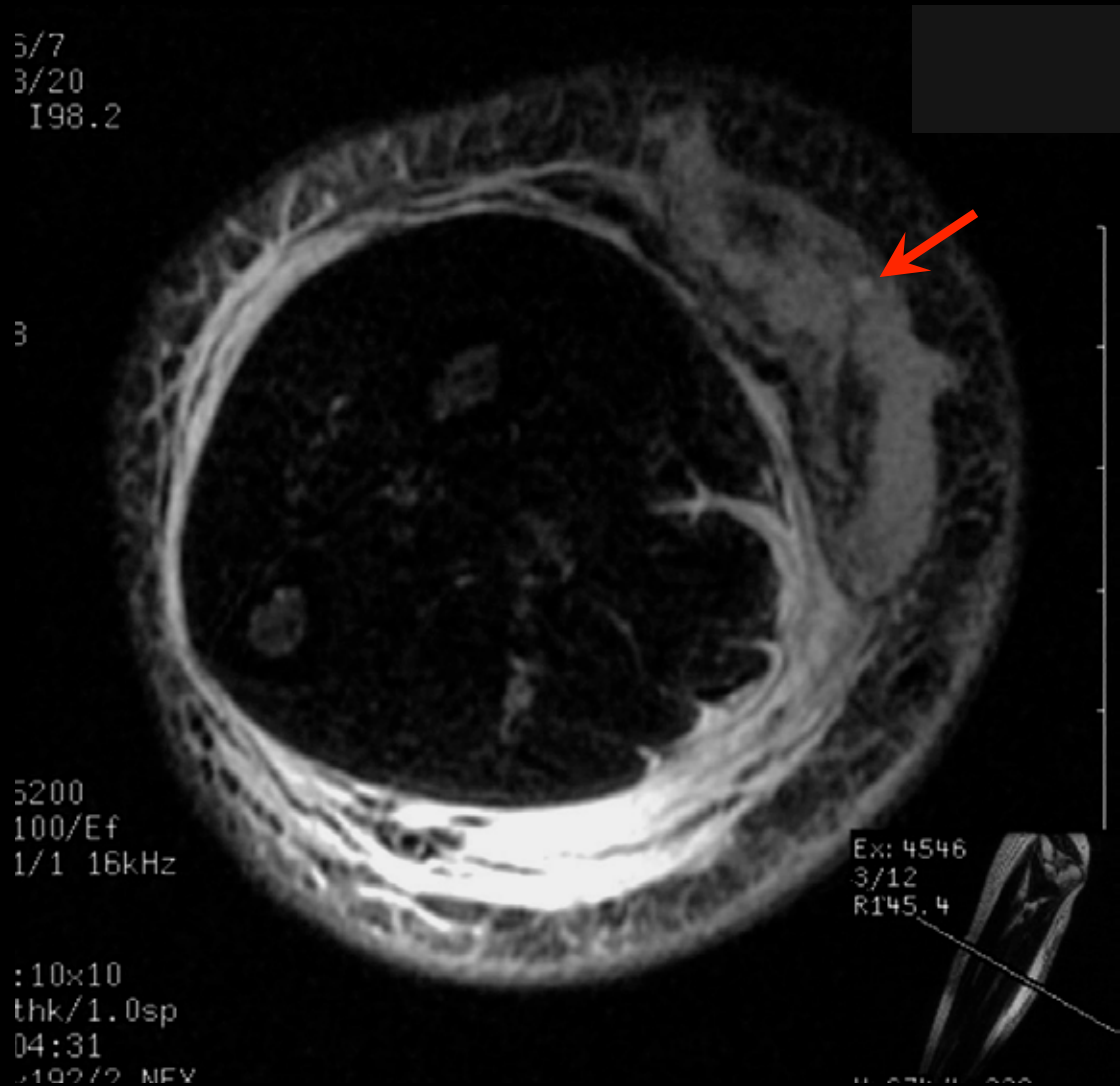
- Diffuse inflammation of the skin and subcutaneous tissues (arrows)



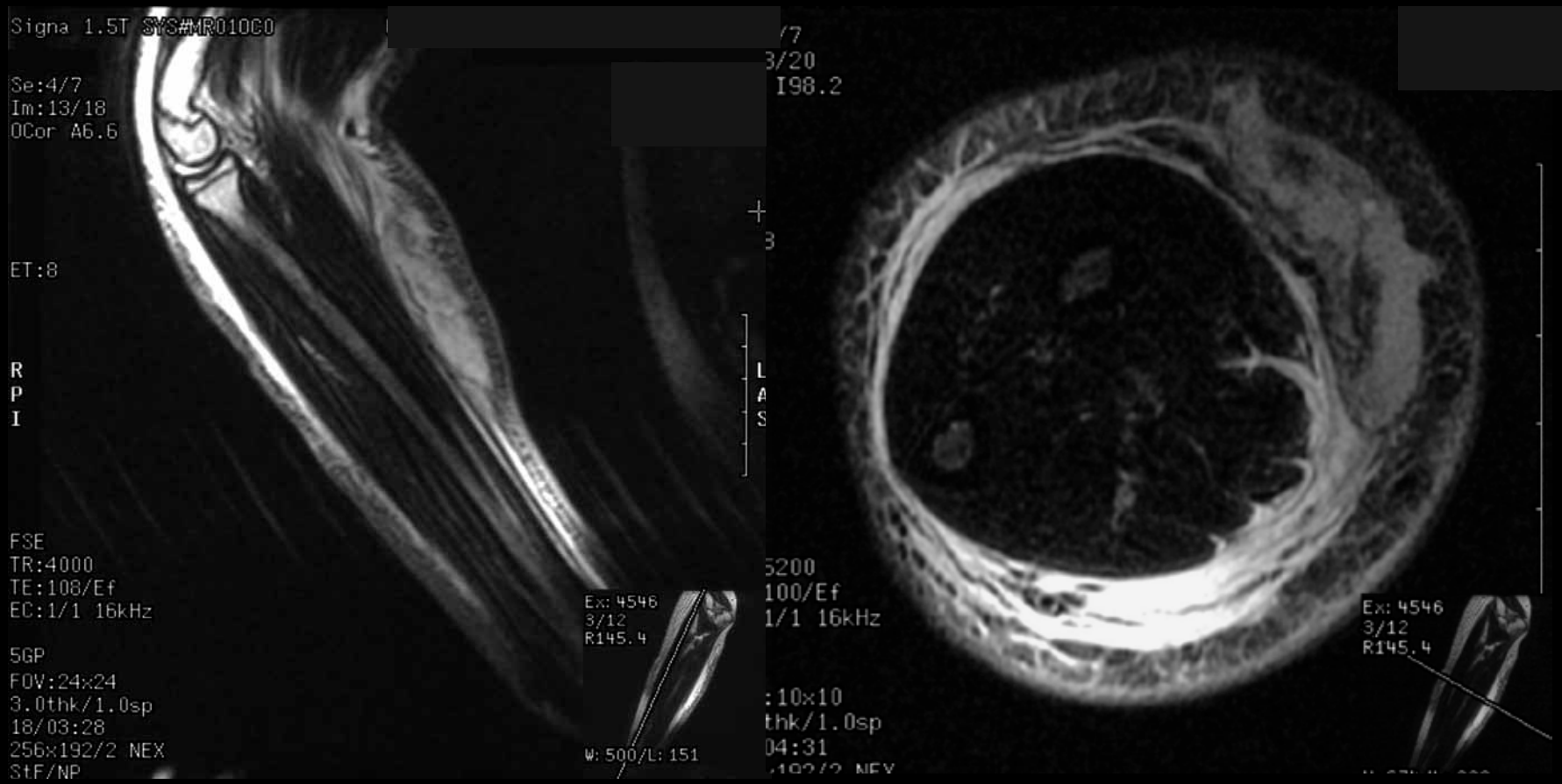
- Diffuse inflammation of the skin and subcutaneous tissues as well as within the fascial planes (arrows)



- Diffuse inflammation of the skin and subcutaneous tissues as well as within the fascial planes
- Focal abscess in the volar aspect of the forearm (arrow)



Fasciitis with Abscess



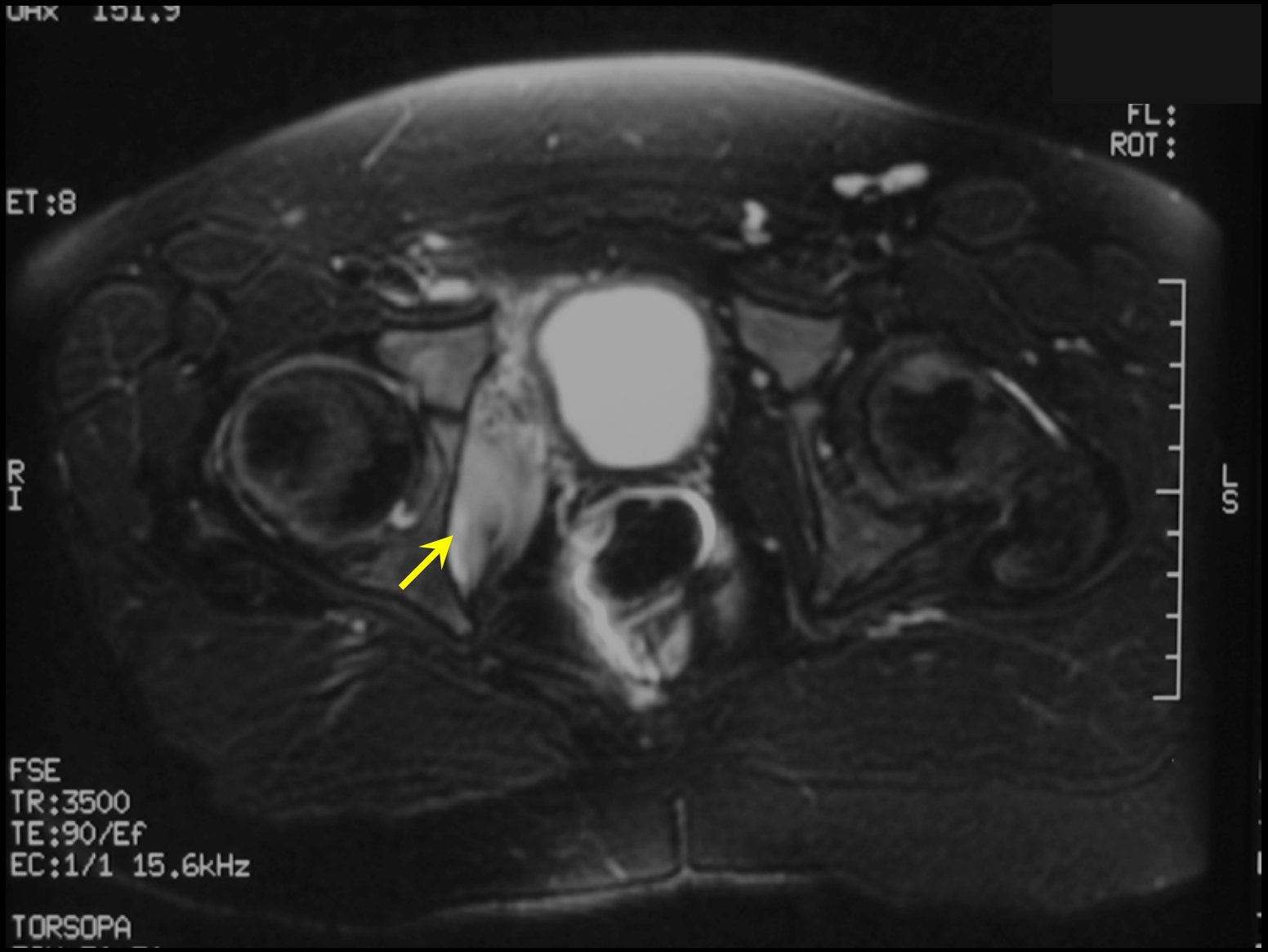
T2W

Case 4

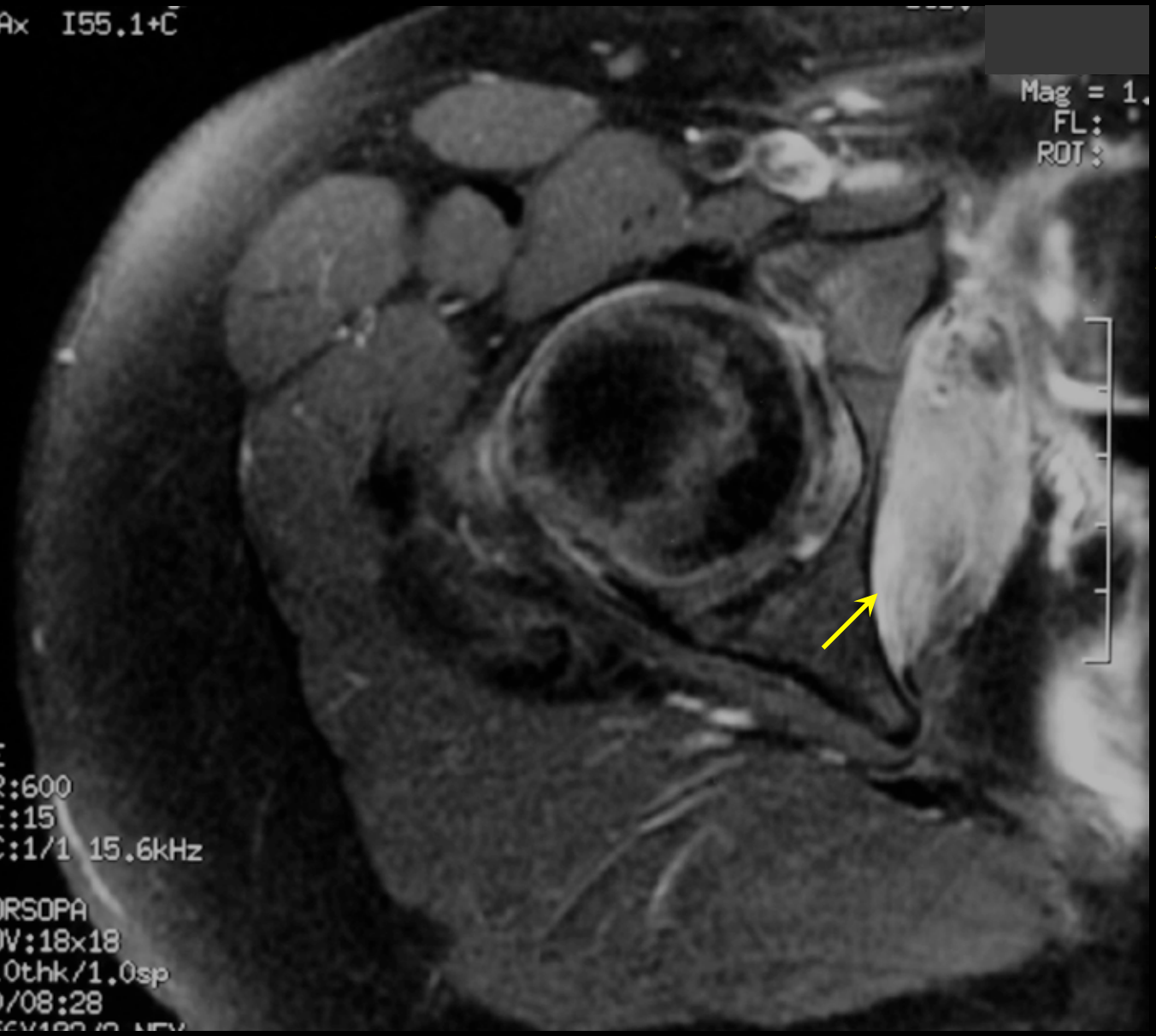
11 year old with right hip pain

T2W

Post-contrast T1W

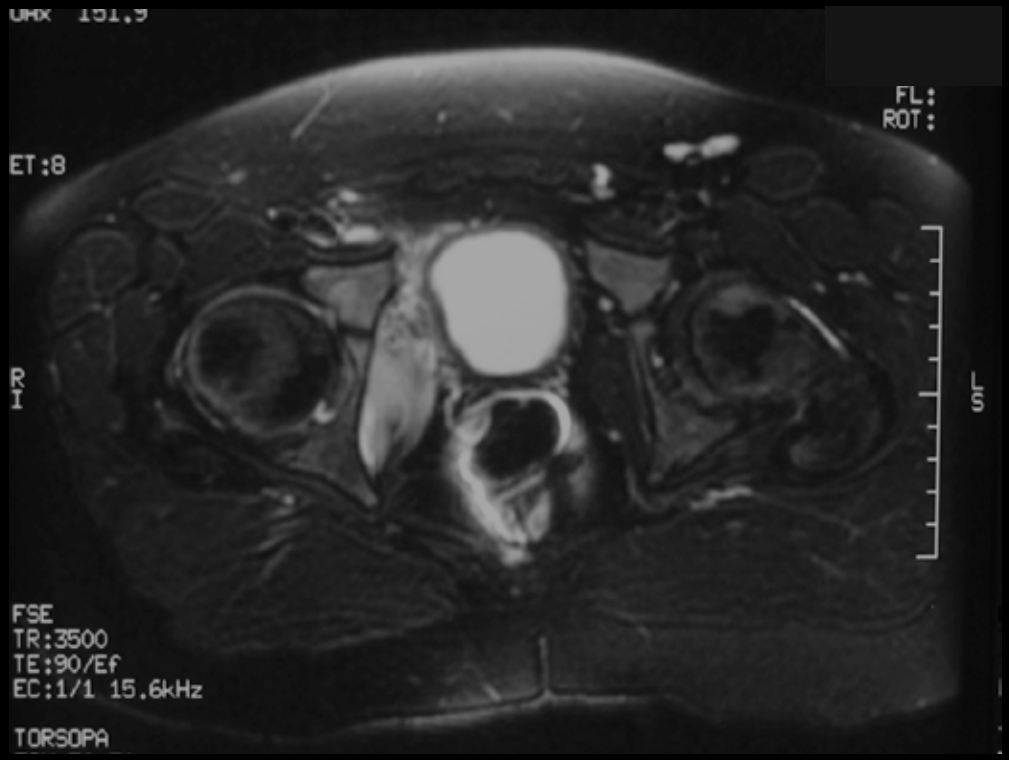


- High T2-weighted signal involving an inflamed right obturator internus muscle (arrow)



- Post-contrast enhancement of the right obturator internus muscle (arrow)

Focal Pyomyositis

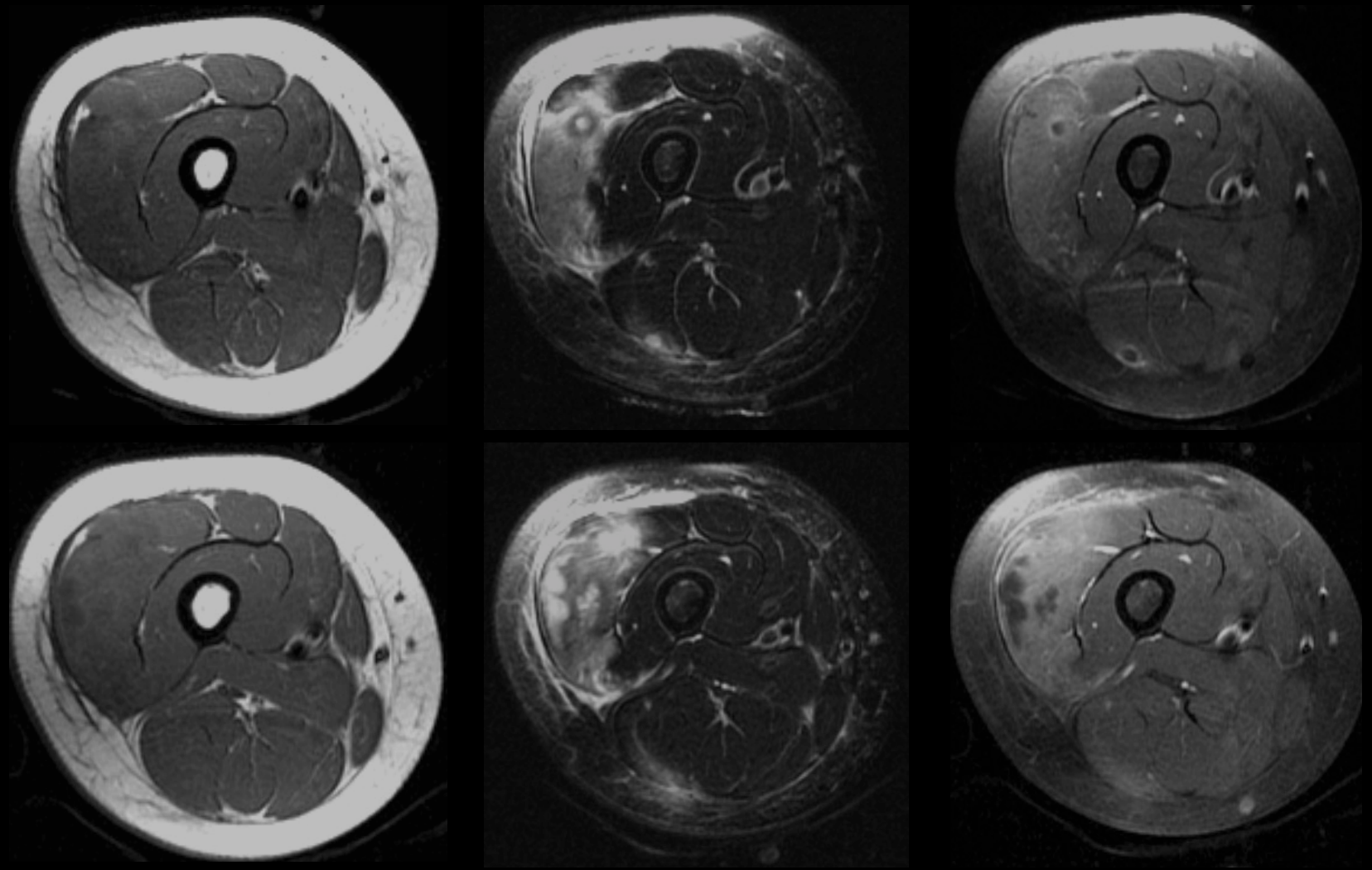


T2W

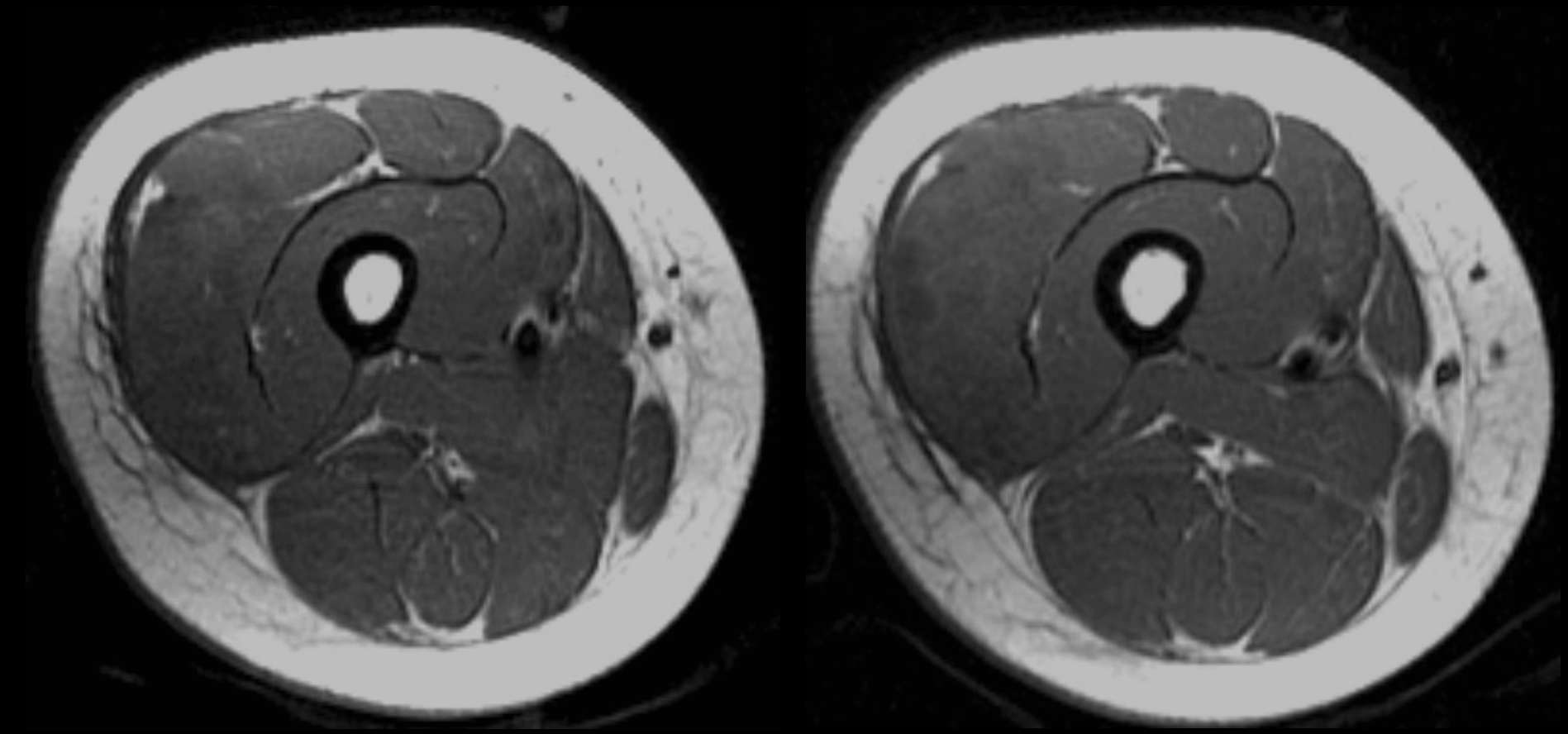
Post-contrast T1W

Case 5

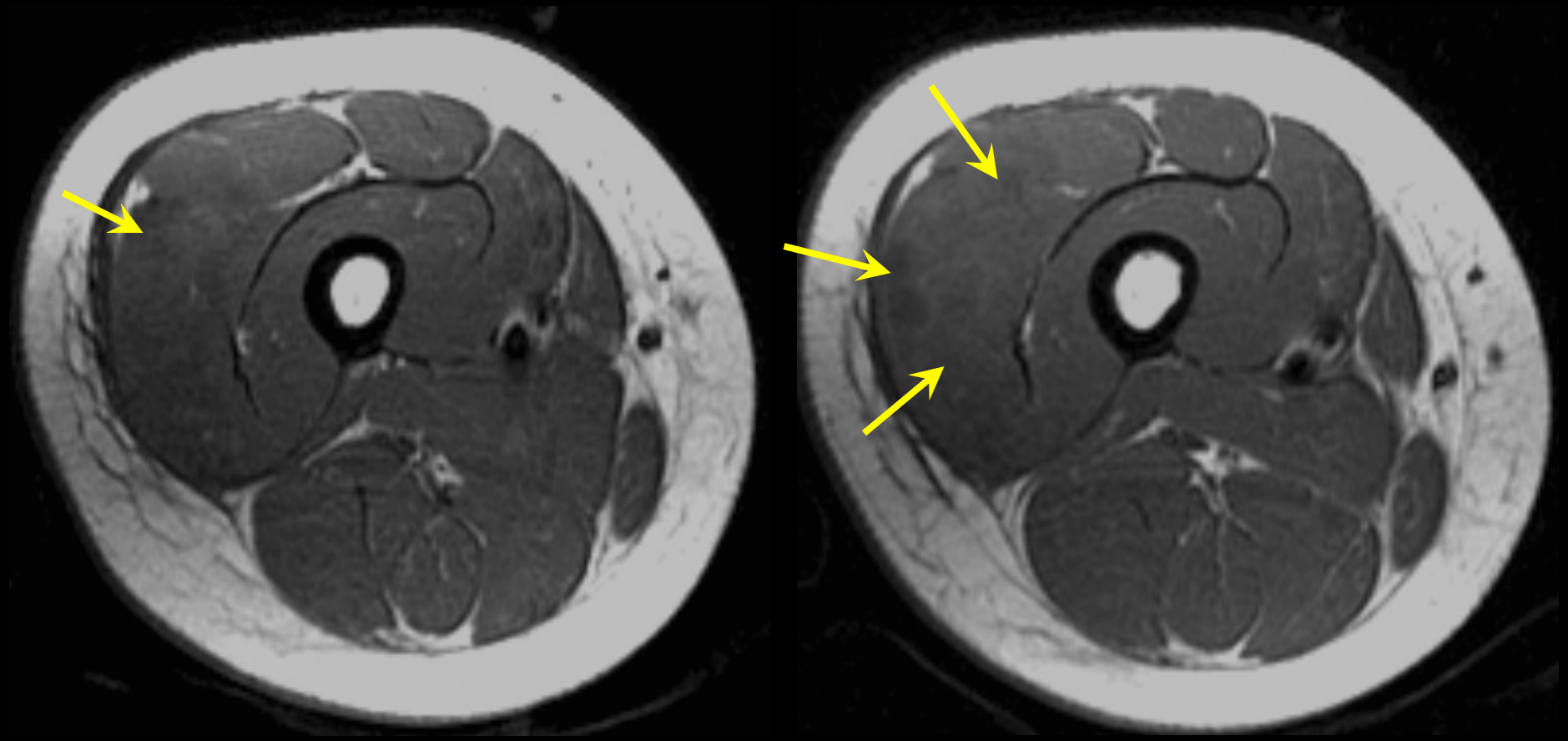
5 year old with right hip pain



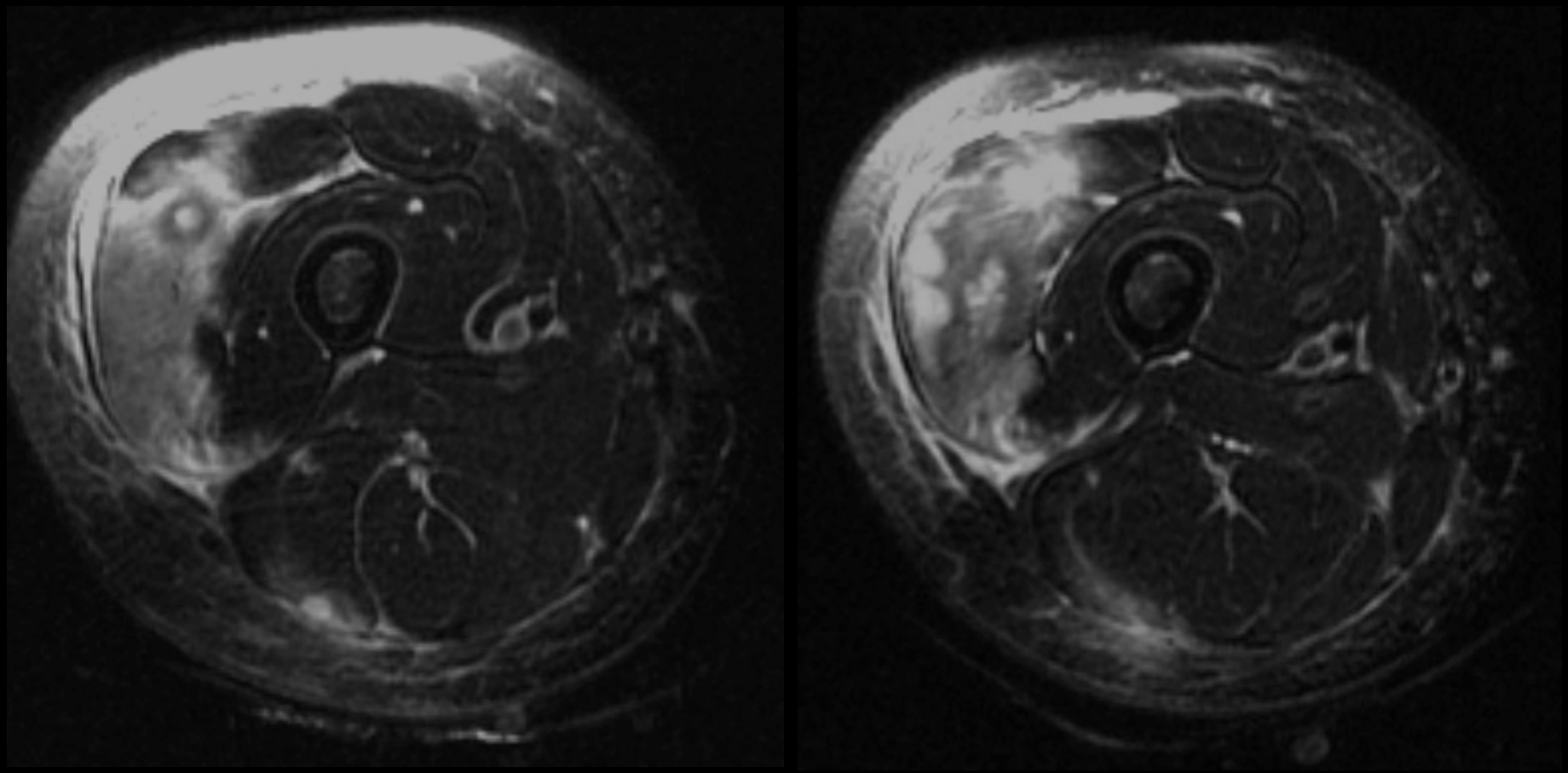
T1W **T2W** **Post-contrast T1W**



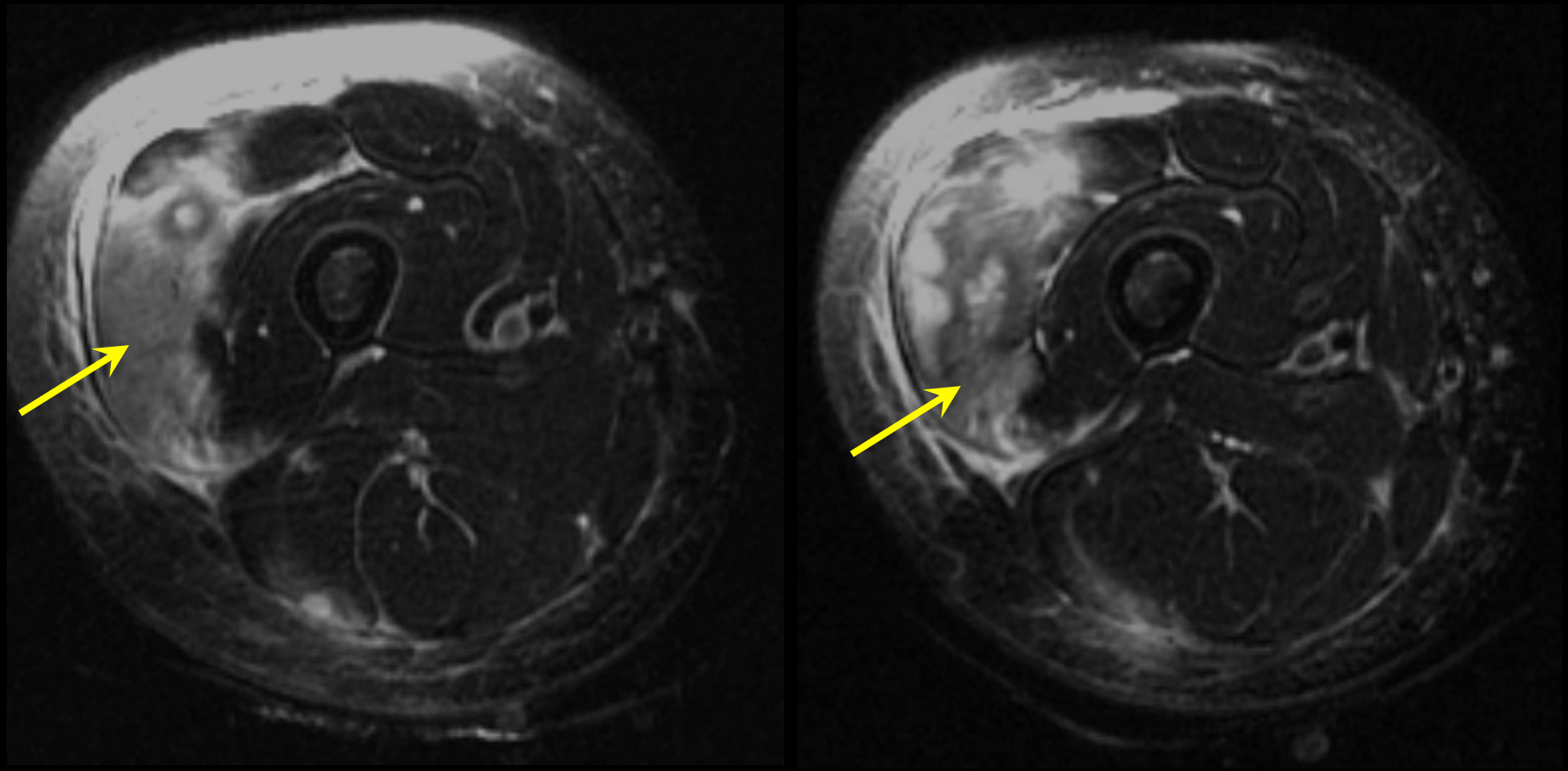
- Diffusely enlarged vastus lateralis muscle with multiple subtle hypointense foci



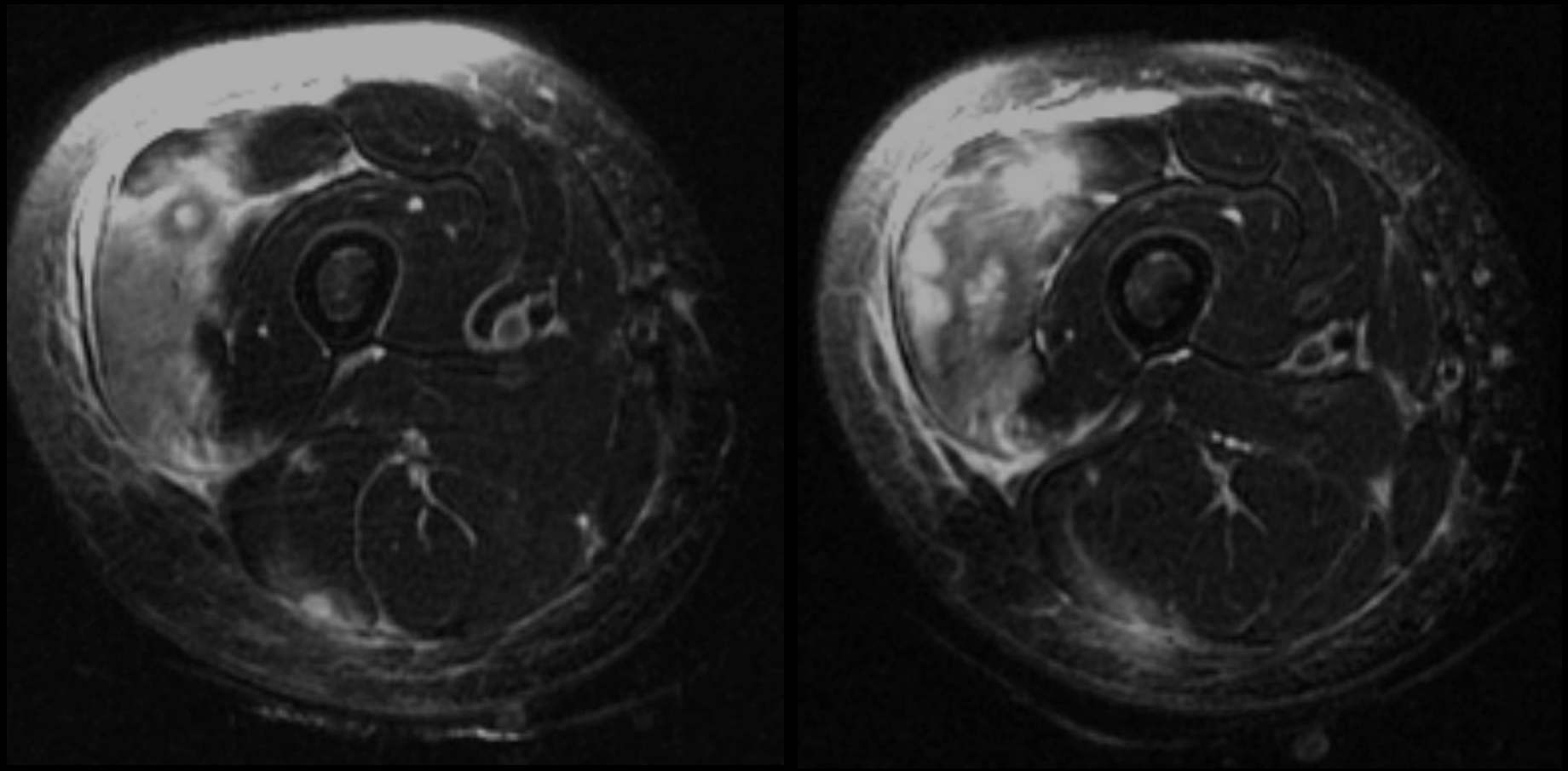
- T1W images show diffusely enlarged vastus lateralis muscle with multiple subtle hypointense foci (arrows)



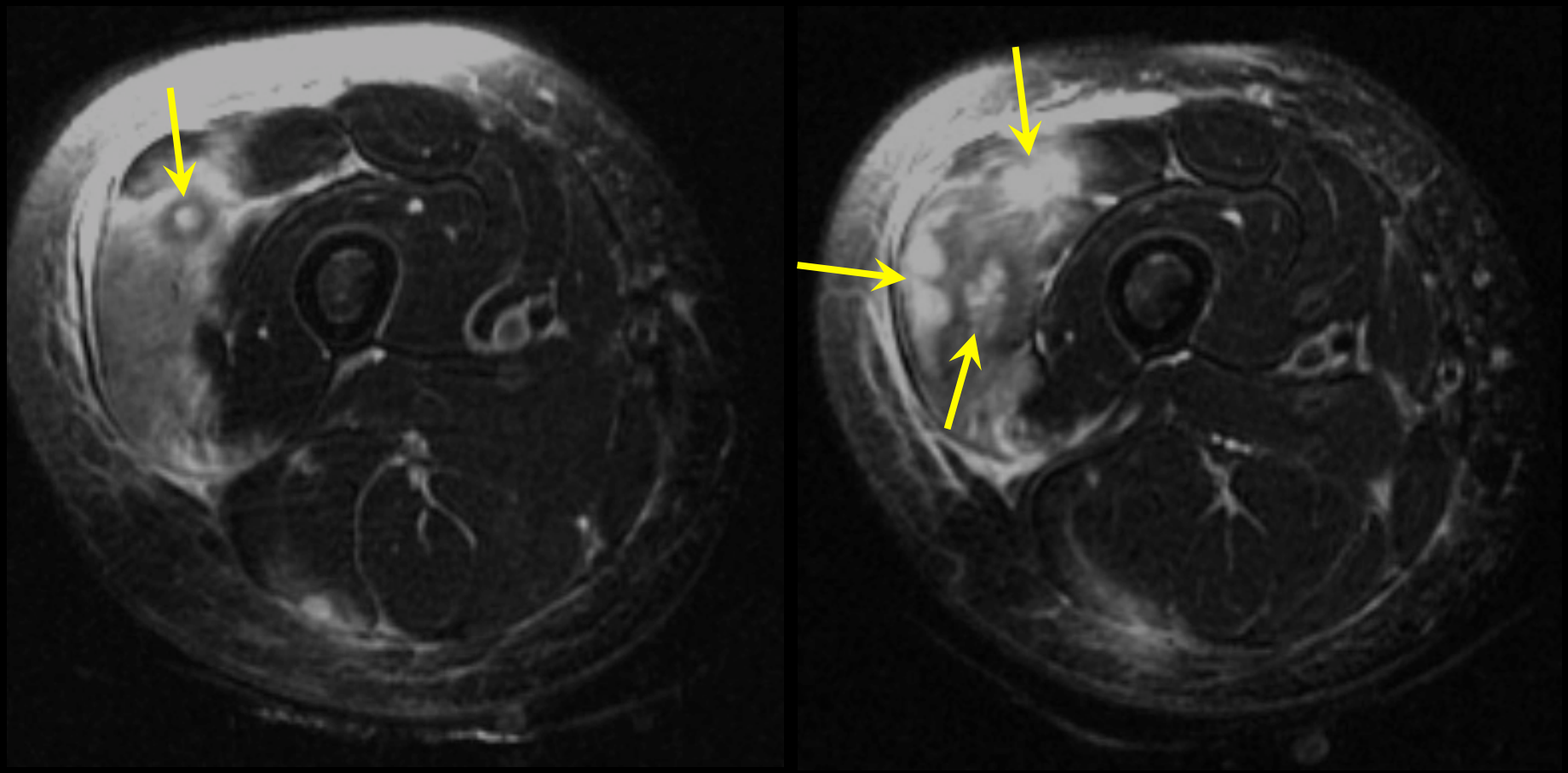
- T2W images show diffuse heterogeneous high signal within swollen vastus lateralis muscle



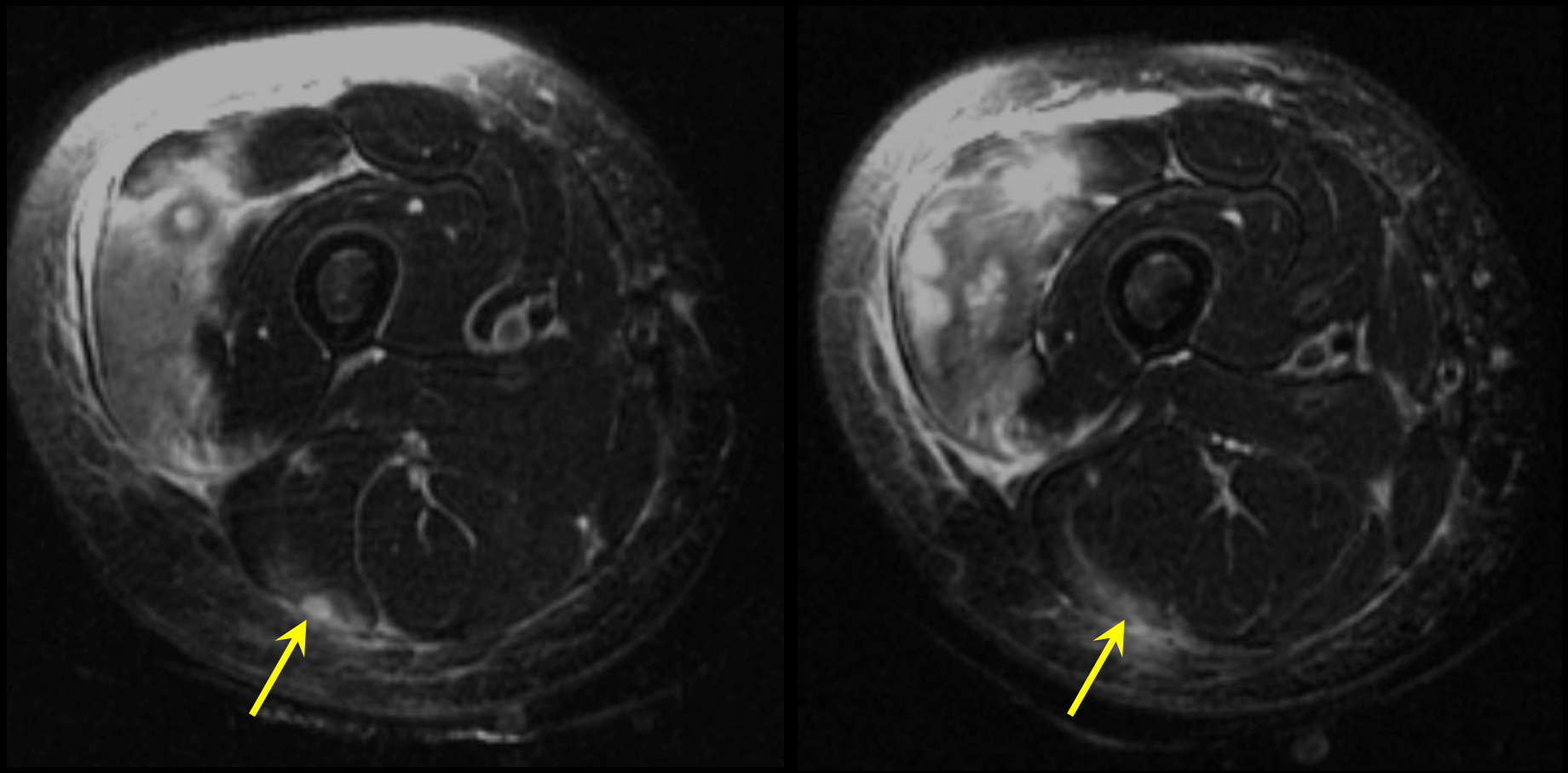
- T2W images show diffuse heterogeneous high signal within swollen vastus lateralis muscle (arrows)



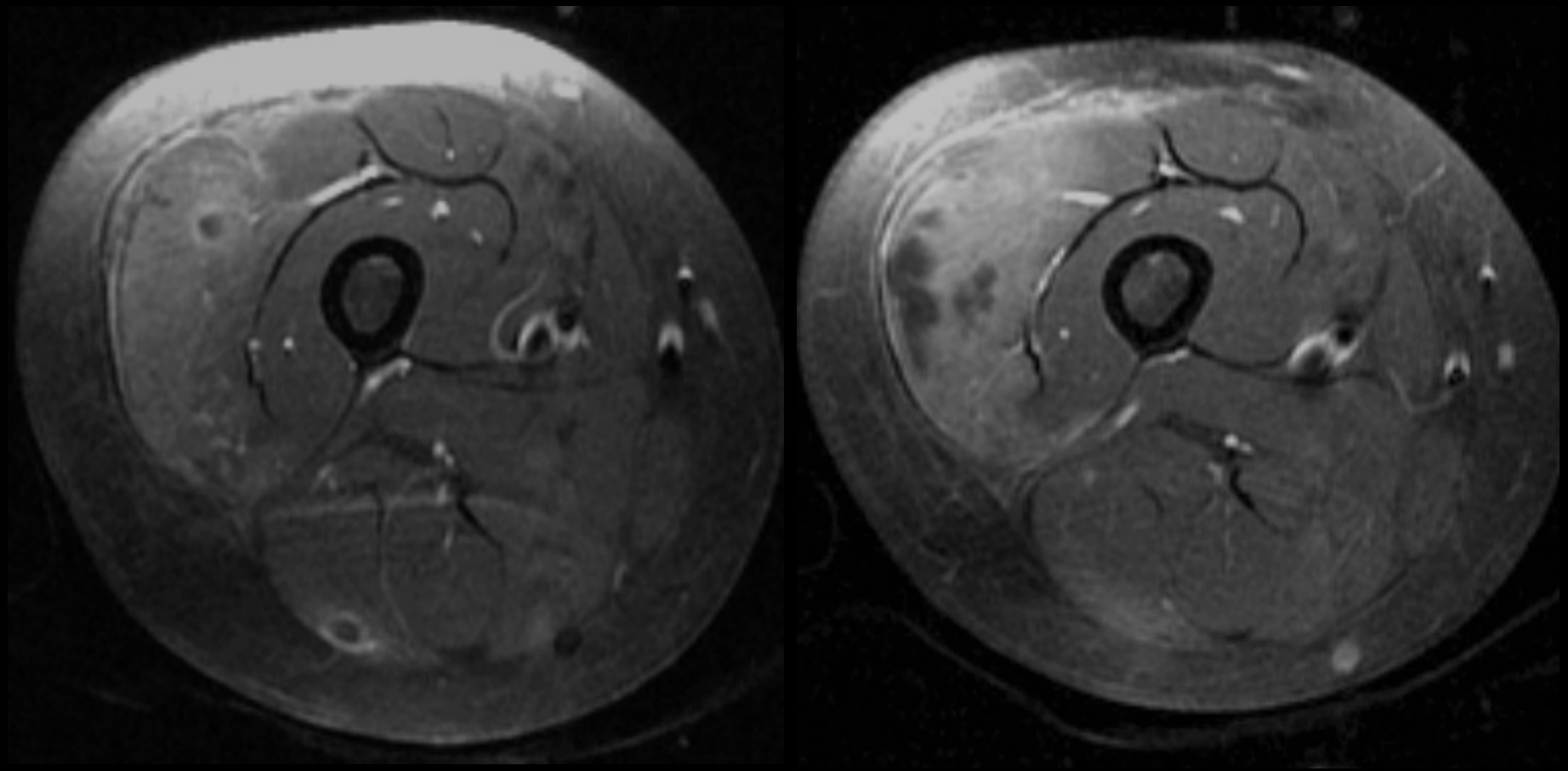
- Multiple high signal collections with peripheral ring of low signal



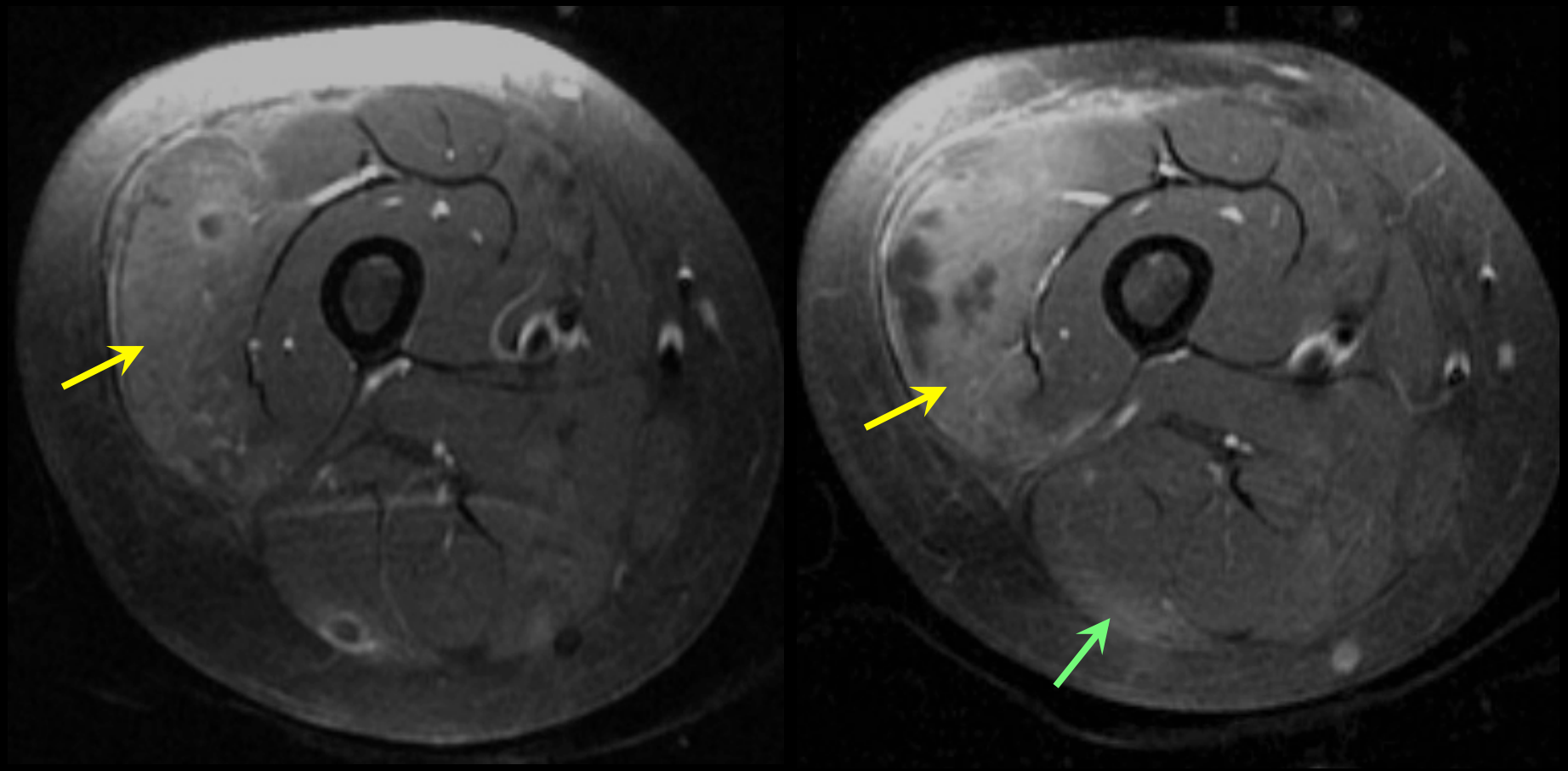
- Multiple high signal collections with peripheral ring of low signal (arrows)



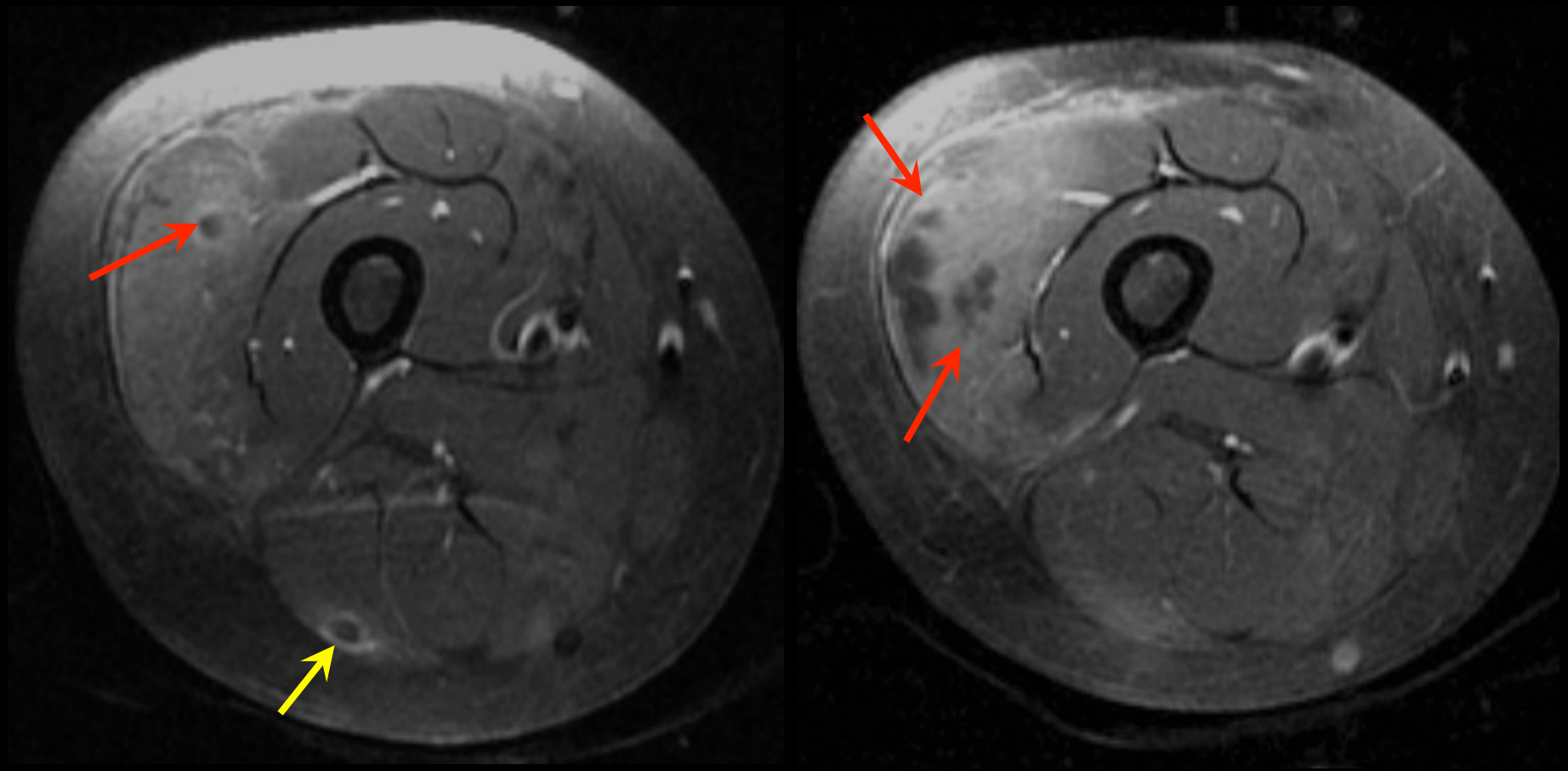
- Another high signal focus in the biceps femoris muscle (arrows)



- Diffuse contrast enhancement of the vastus lateralis muscle and focal enhancement of the biceps femoris muscle

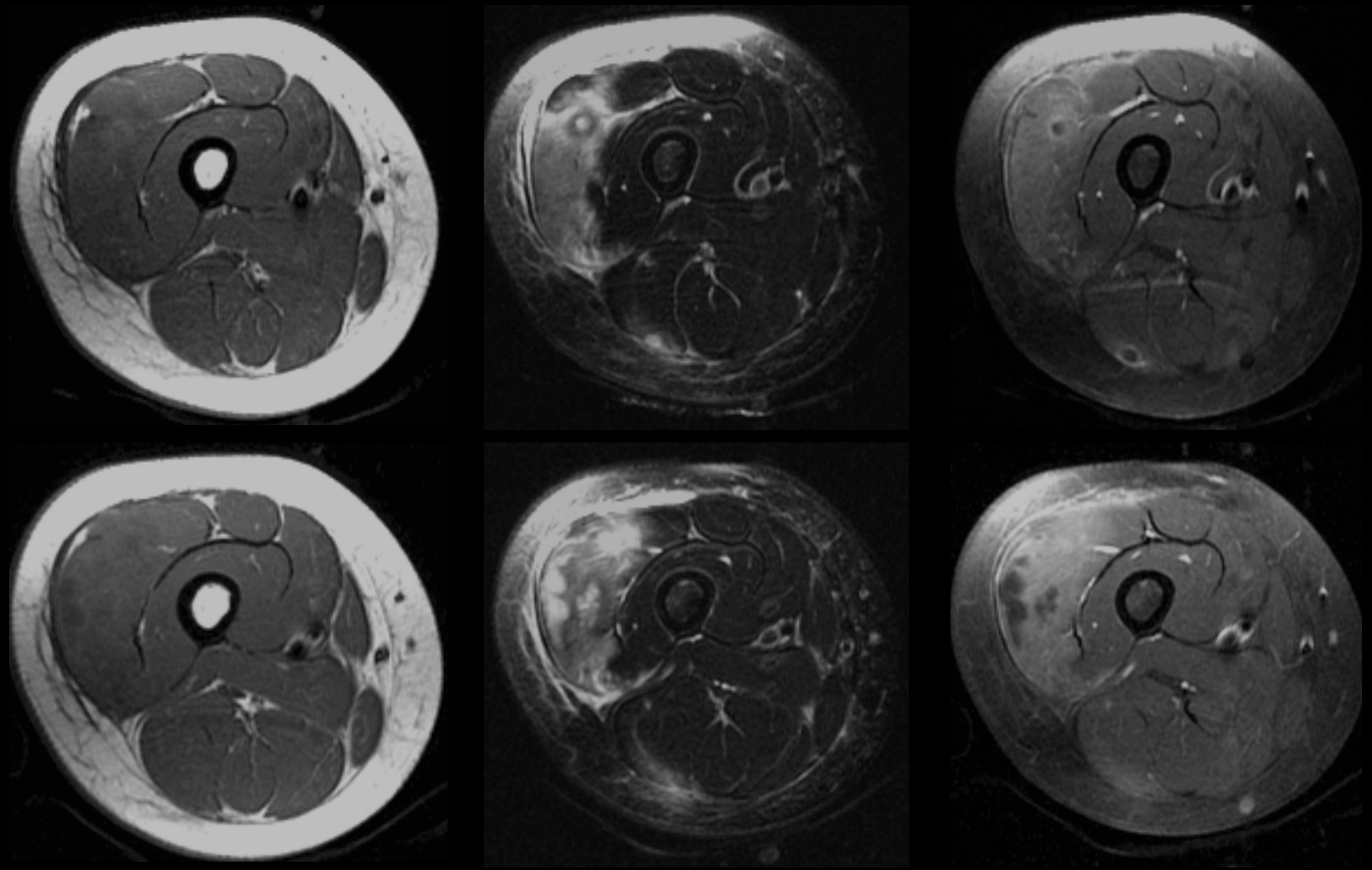


- Diffuse contrast enhancement of the vastus lateralis muscle (arrows) and focal enhancement of the biceps femoris muscle (arrow)



- Peripherlly enhancing collections in the vastus lateralis muscle (arrows) and in the biceps femoris muscle (arrow)

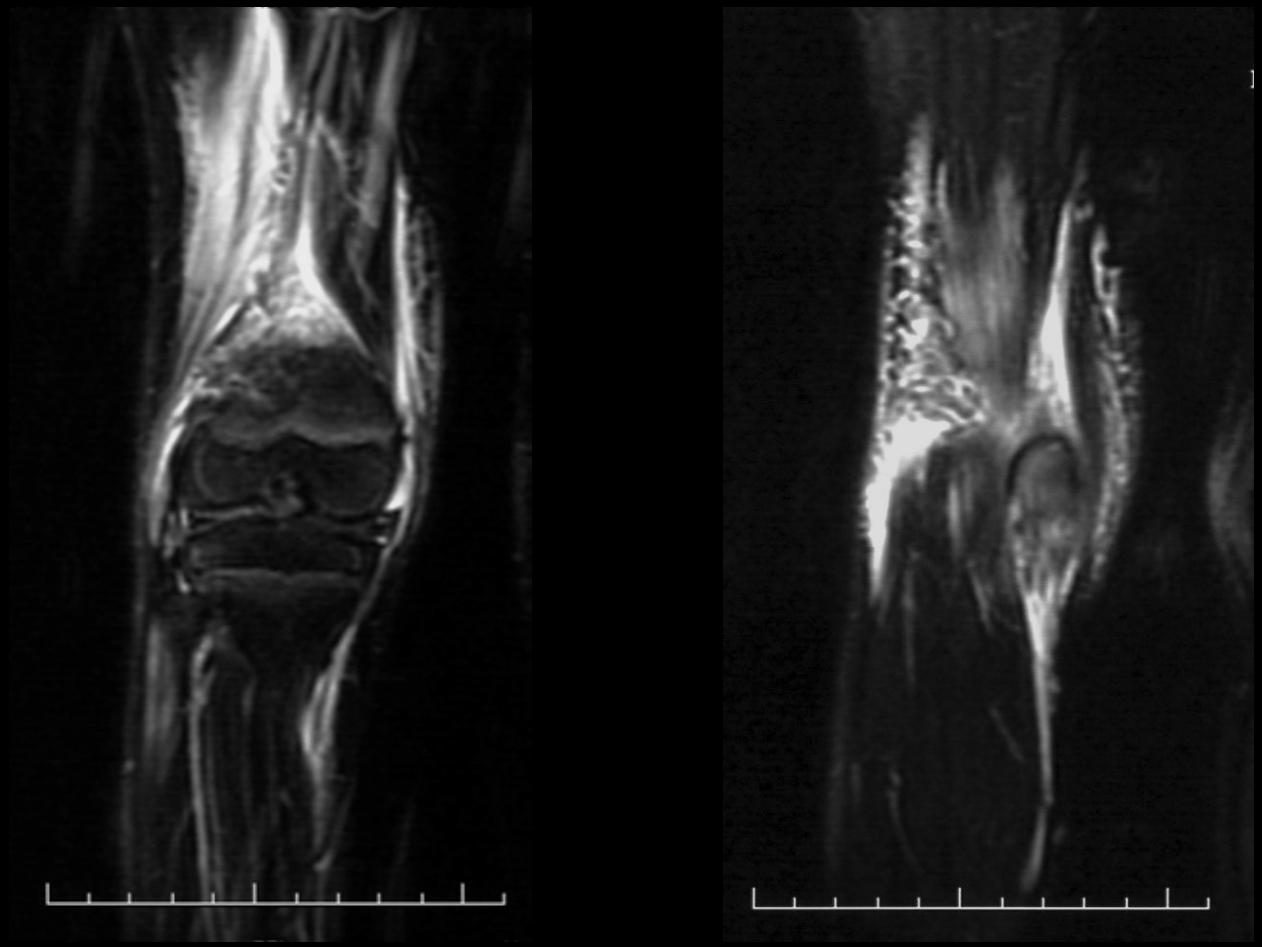
Multifocal Pyomyositis with Microabscesses



T1W T2W Post-contrast T1W

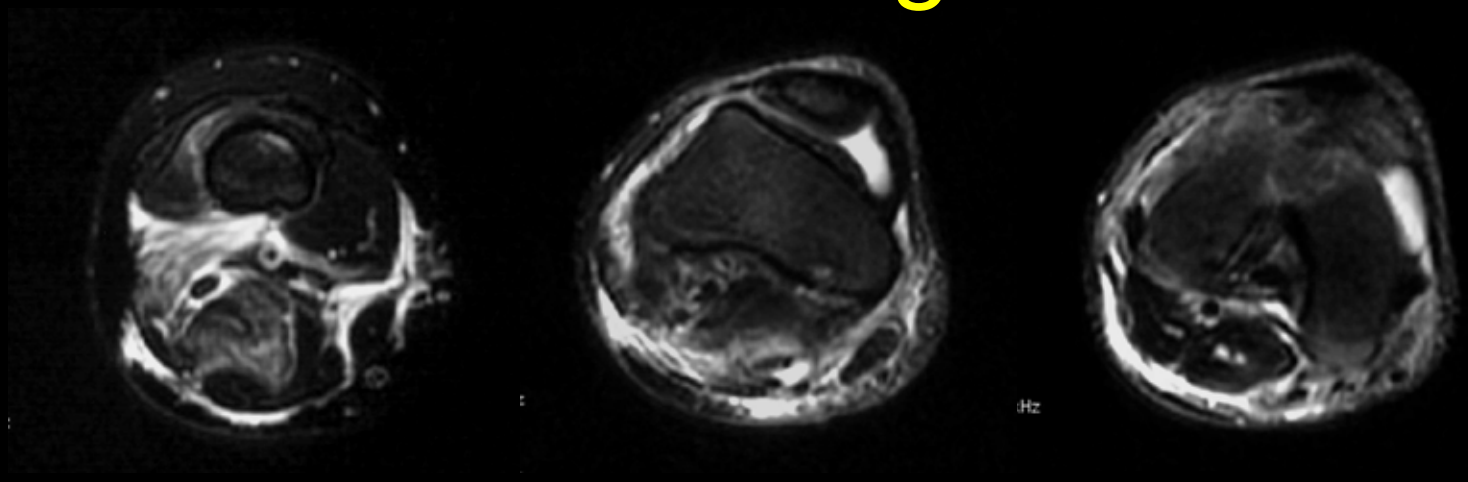
Case 6

5 y.o with right knee pain and swelling

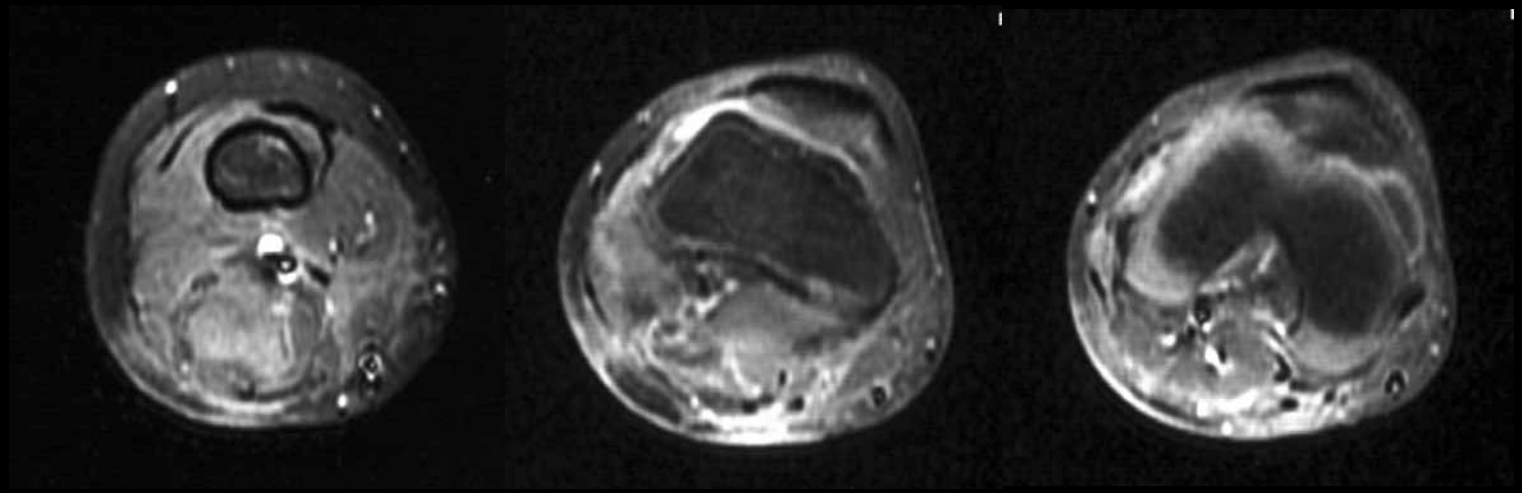


Coronal T2W

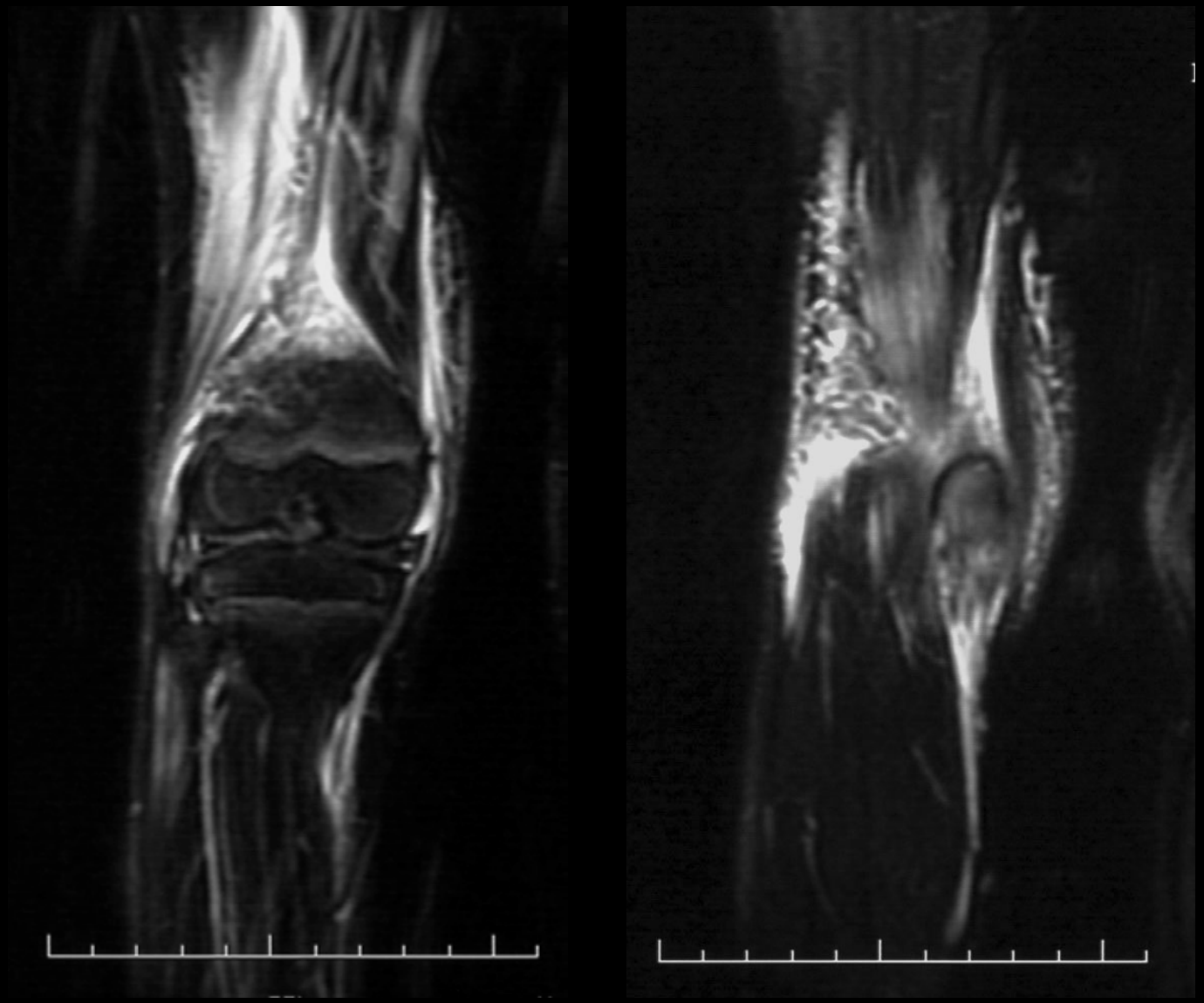
5 y.o with right knee pain and swelling



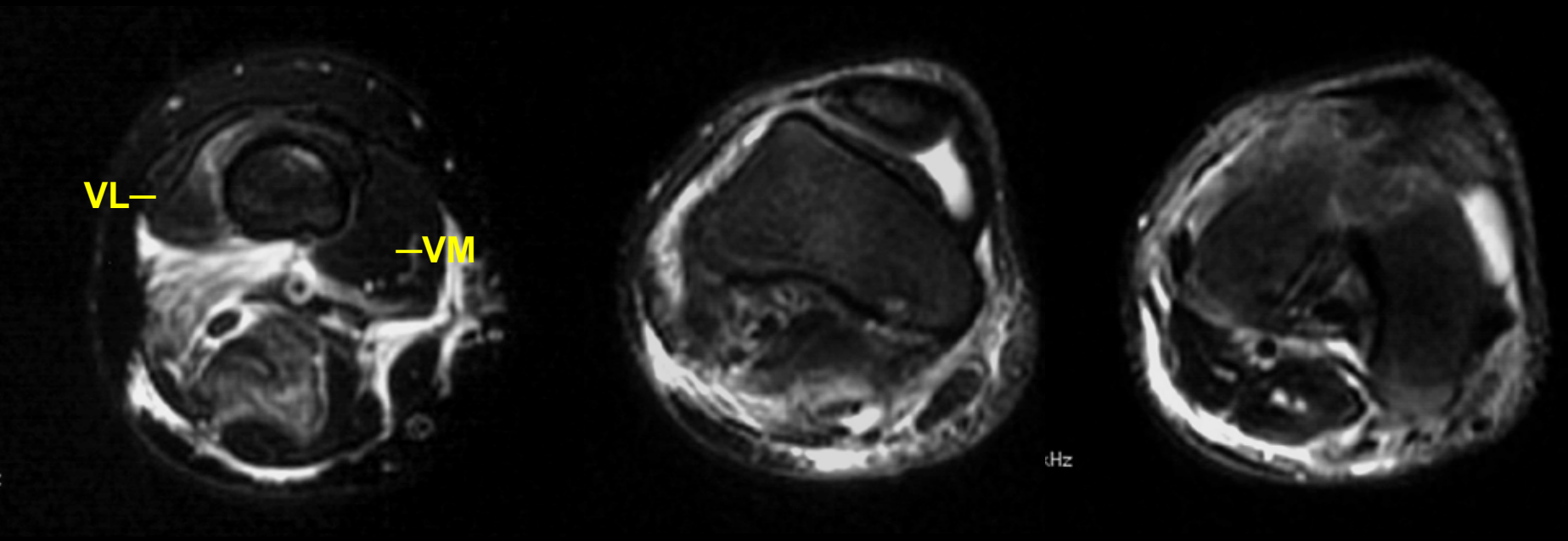
T2W



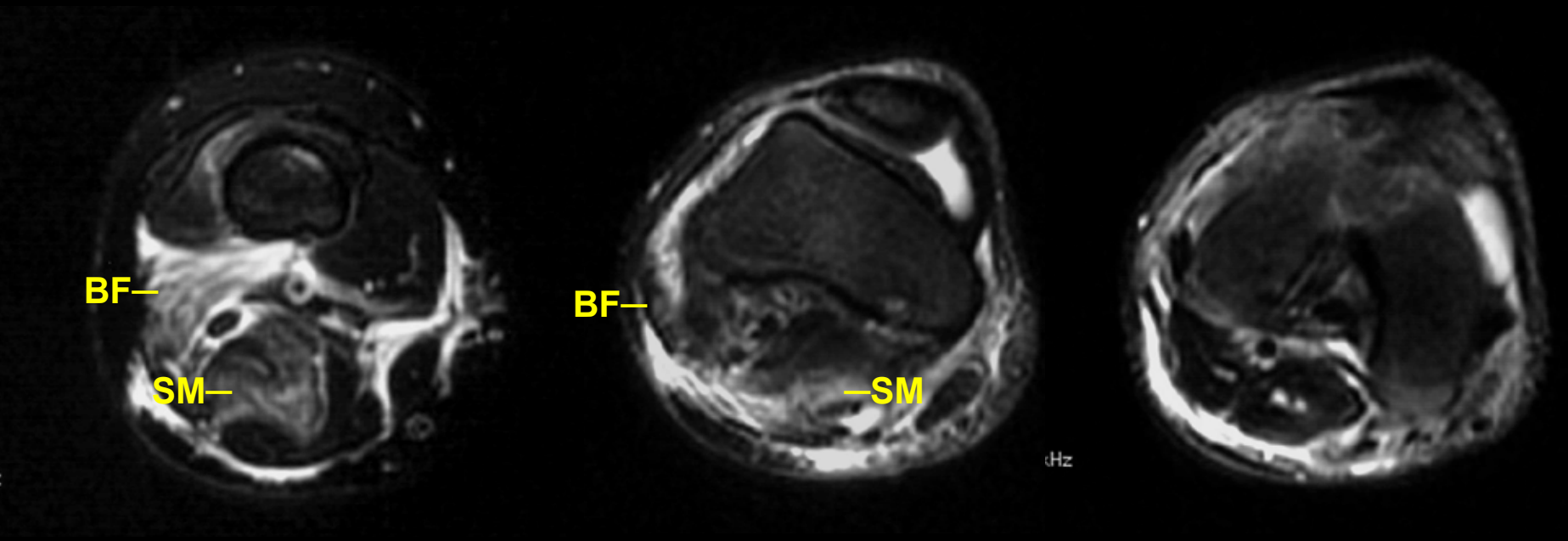
Post-contrast T1W



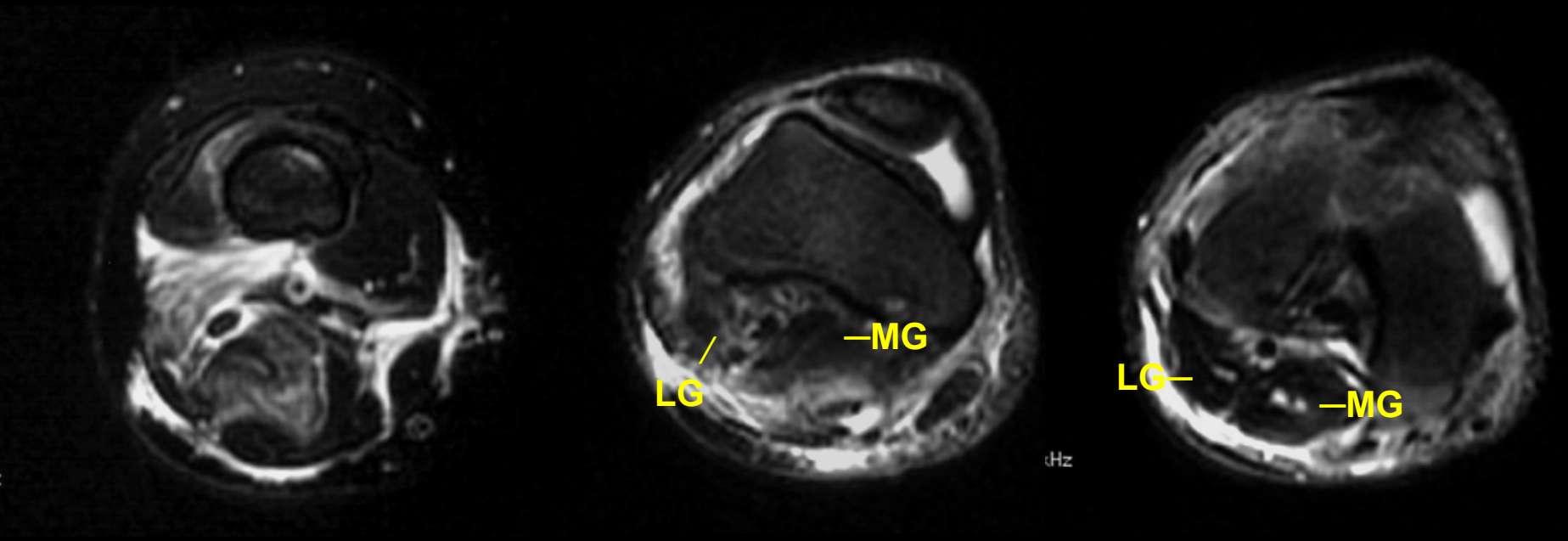
- Diffuse heterogeneous high signal in the quadriceps, hamstrings and calf muscles



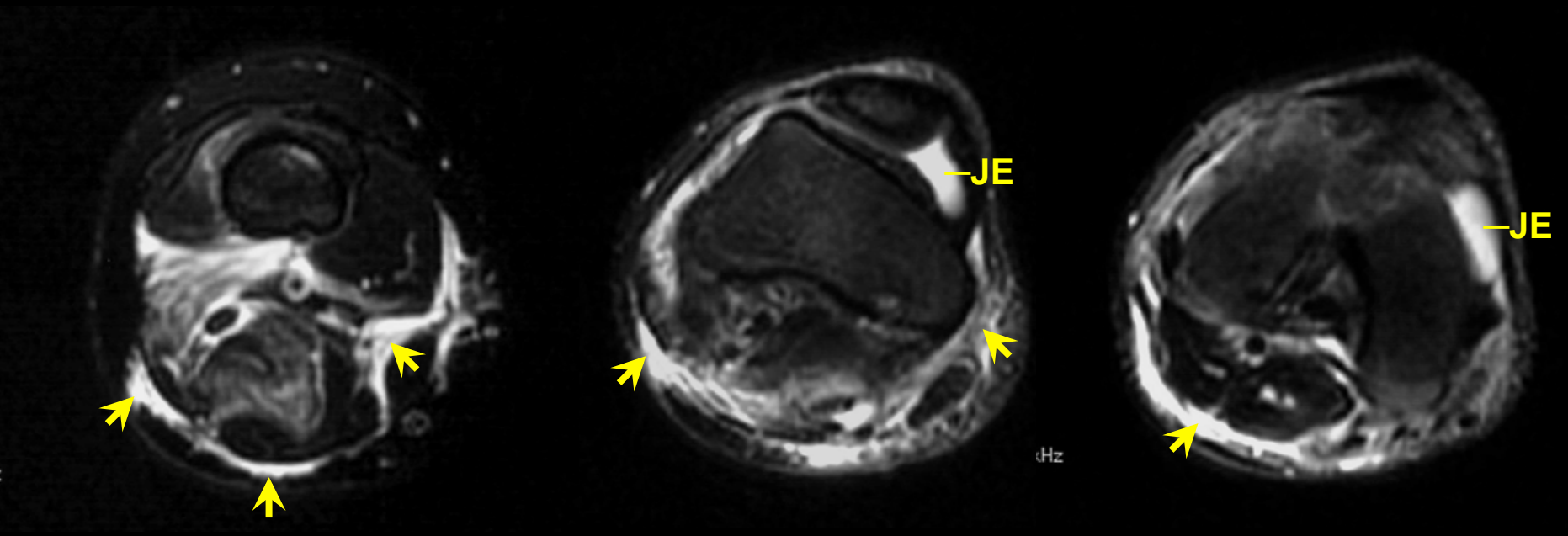
- Diffuse heterogeneous high signal in the vastus lateralis and medialis (VL, VM), biceps femoris semimembranosus medial and lateral heads gastrocnemius muscles, and the surrounding deep fascia with joint effusion



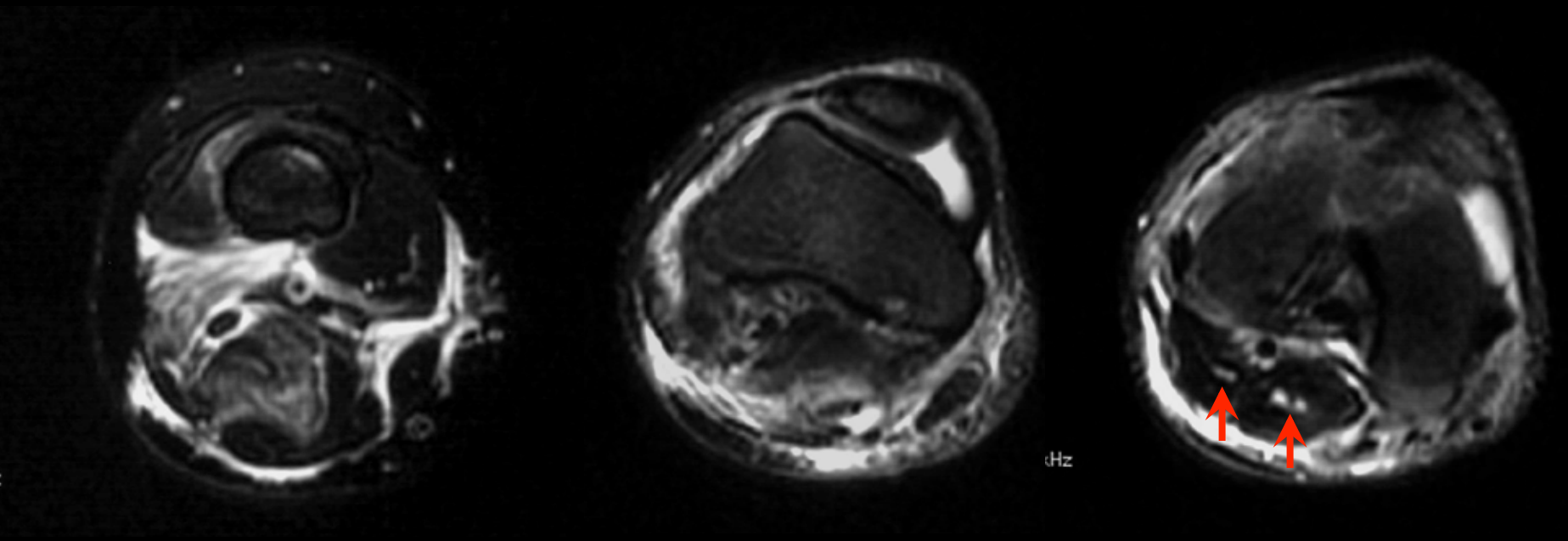
- Diffuse heterogeneous high signal in the vastus lateralis and medialis biceps femoris (BF), semimembranosus (SM), medial and lateral heads gastrocnemius muscles, and the surrounding deep fascia with joint effusion



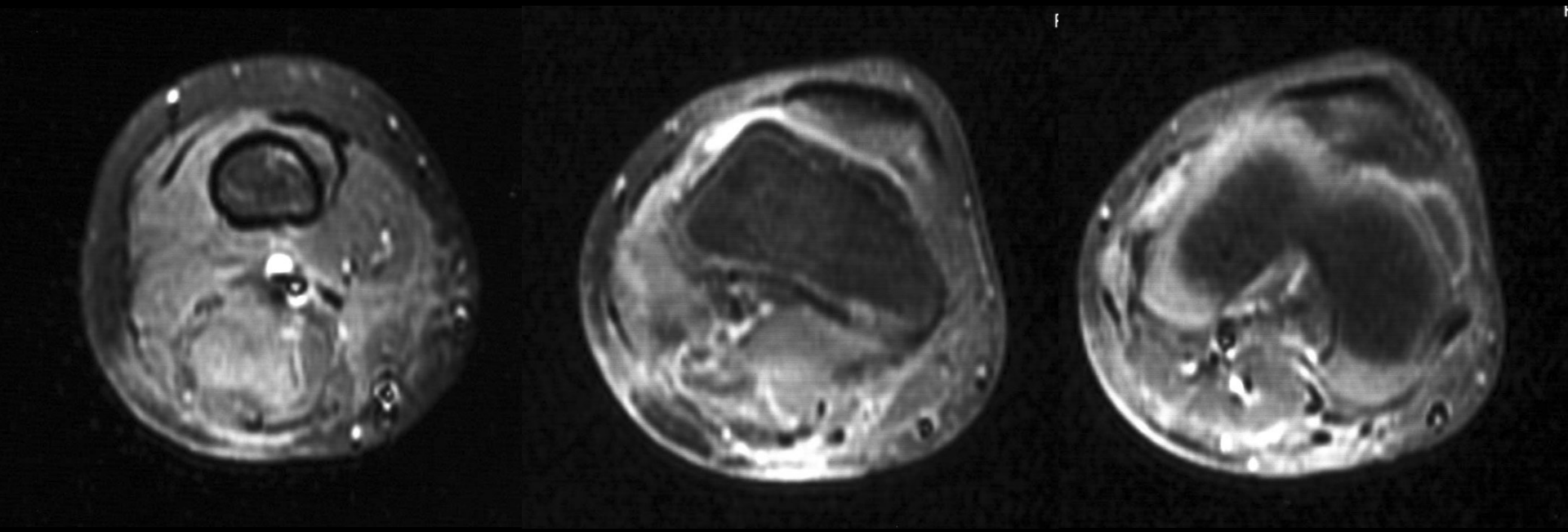
- Diffuse heterogeneous high signal in the vastus lateralis and medialis, biceps femoris, semimembranosus, medial and lateral heads gastrocnemius (MG, LG) muscles, and the surrounding deep fascia, with joint effusion



- Diffuse heterogeneous high signal in the vastus lateralis and medialis, biceps femoris, semimembranosus, medial and lateral heads gastrocnemius muscles, and the surrounding deep fascia (arrows), with joint effusion (JE)

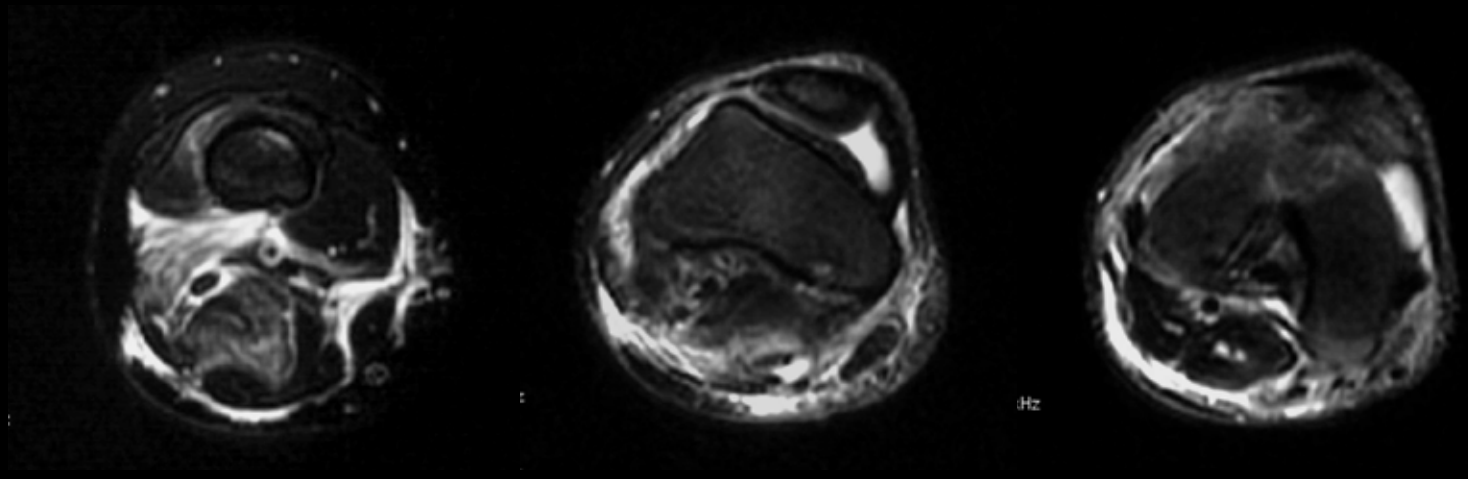


- Small collections in the gastrocnemius muscles (arrows)

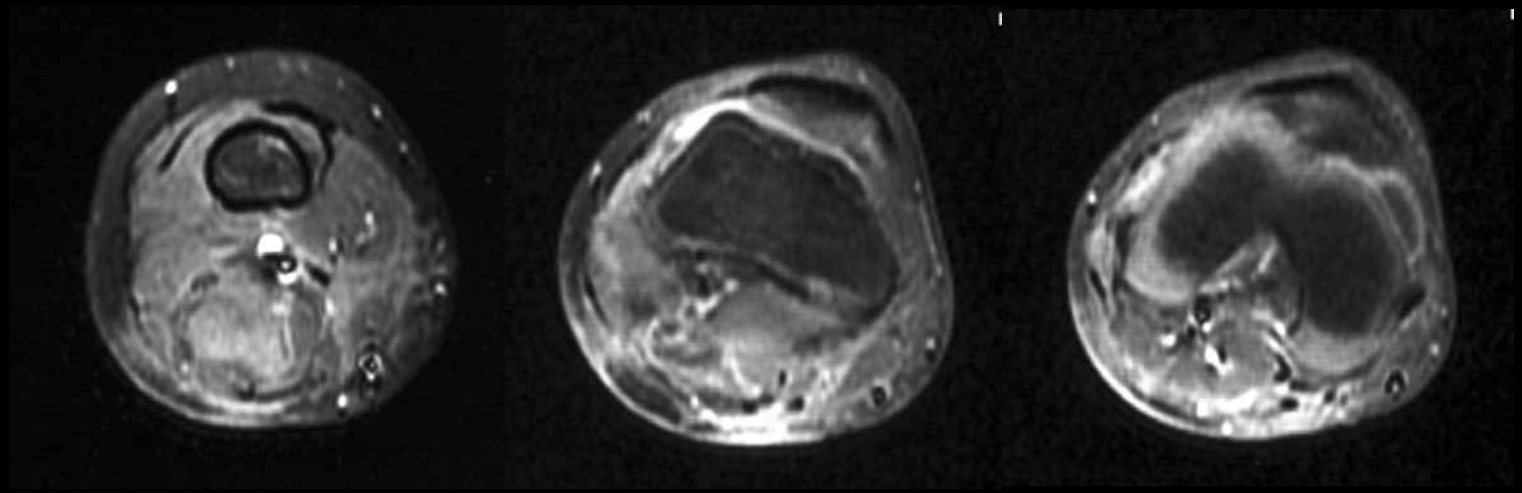


- Heterogeneous enhancement of the quadriceps, hamstring and calf muscles, and the surrounding deep fascia

Diffuse Pyomyositis and Fasciitis with Microabscesses



T2W



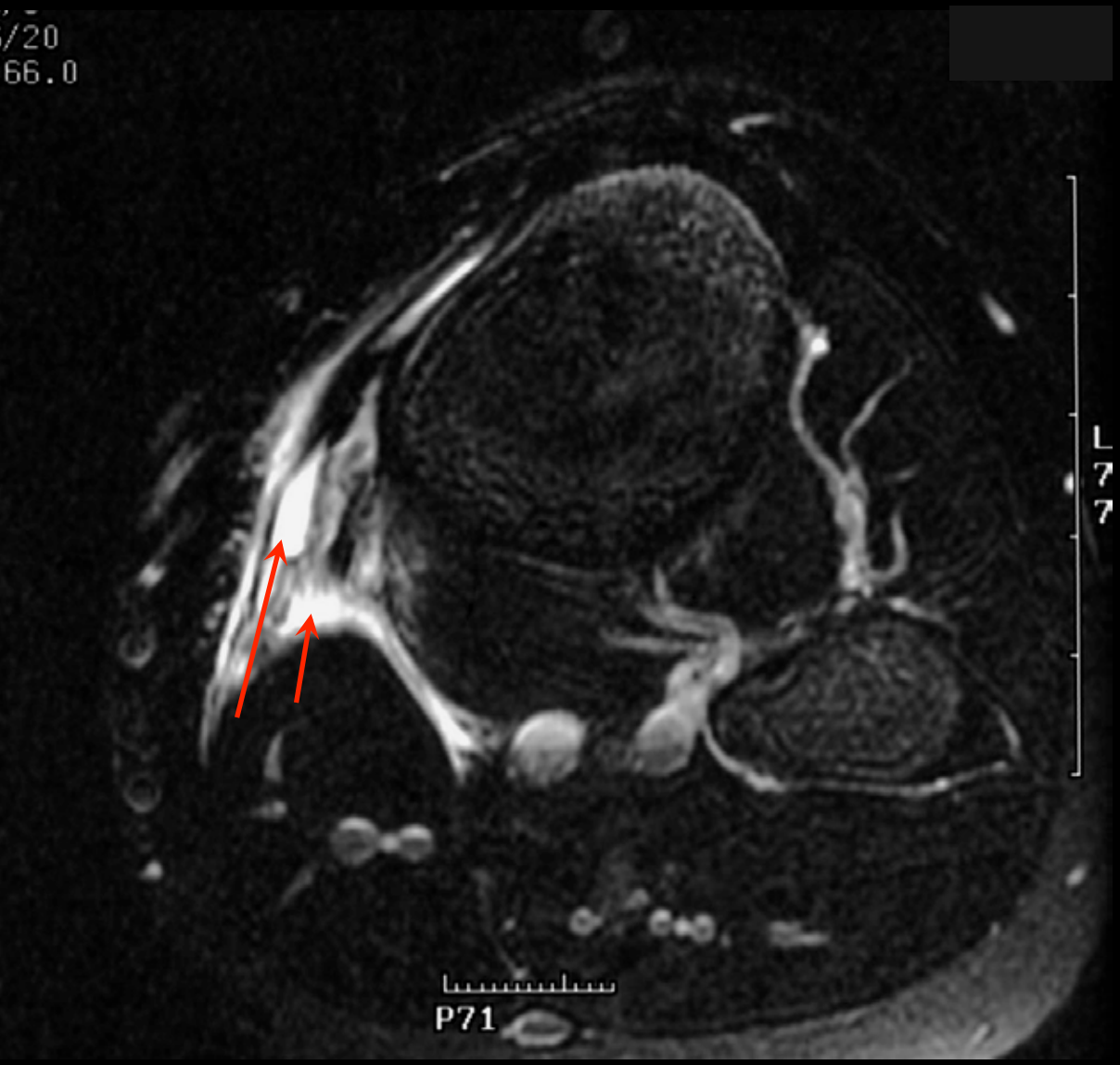
Post-contrast T1W

Case 7

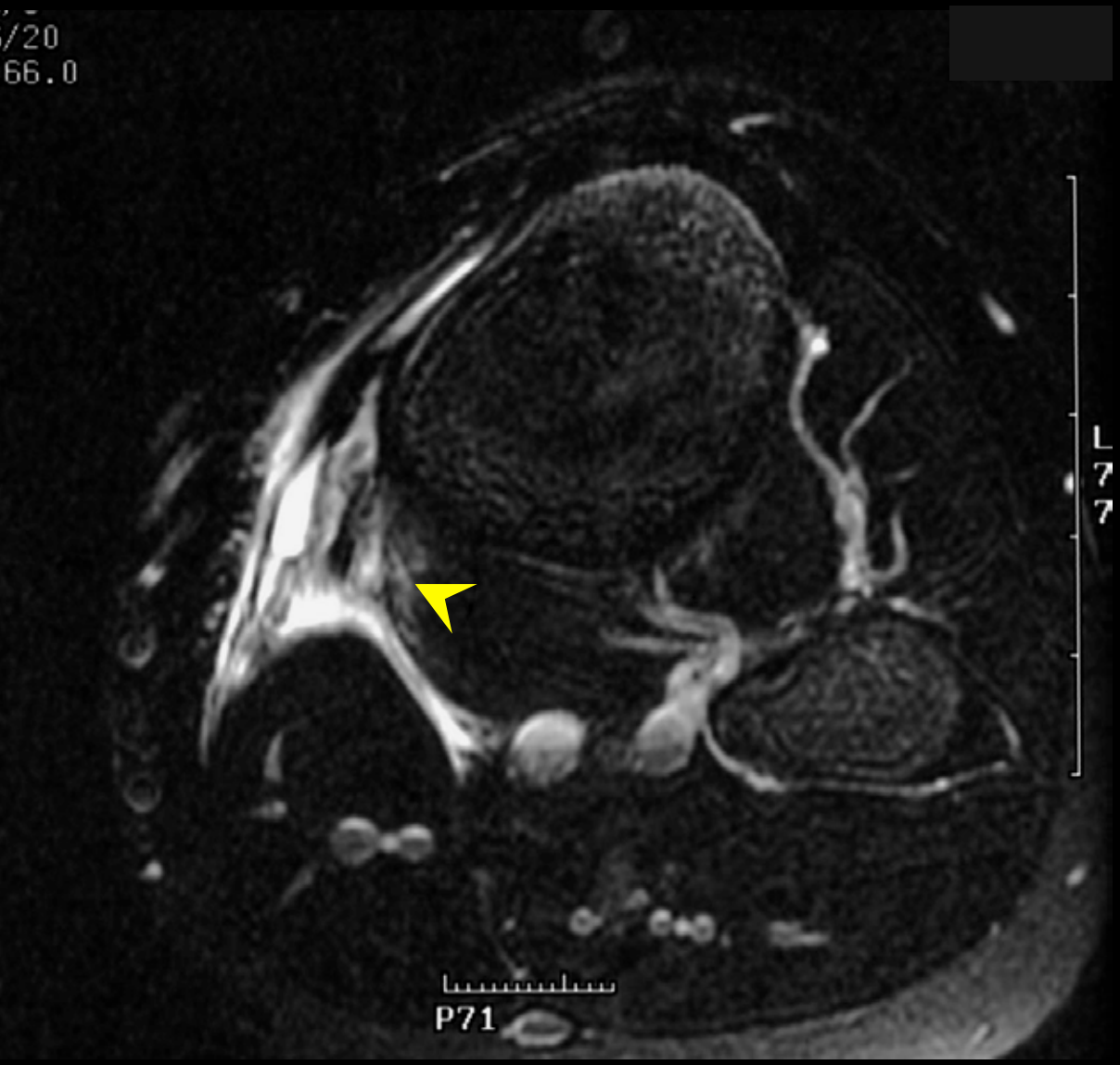
10 year old with left knee pain

T2W

Post-contrast T1W

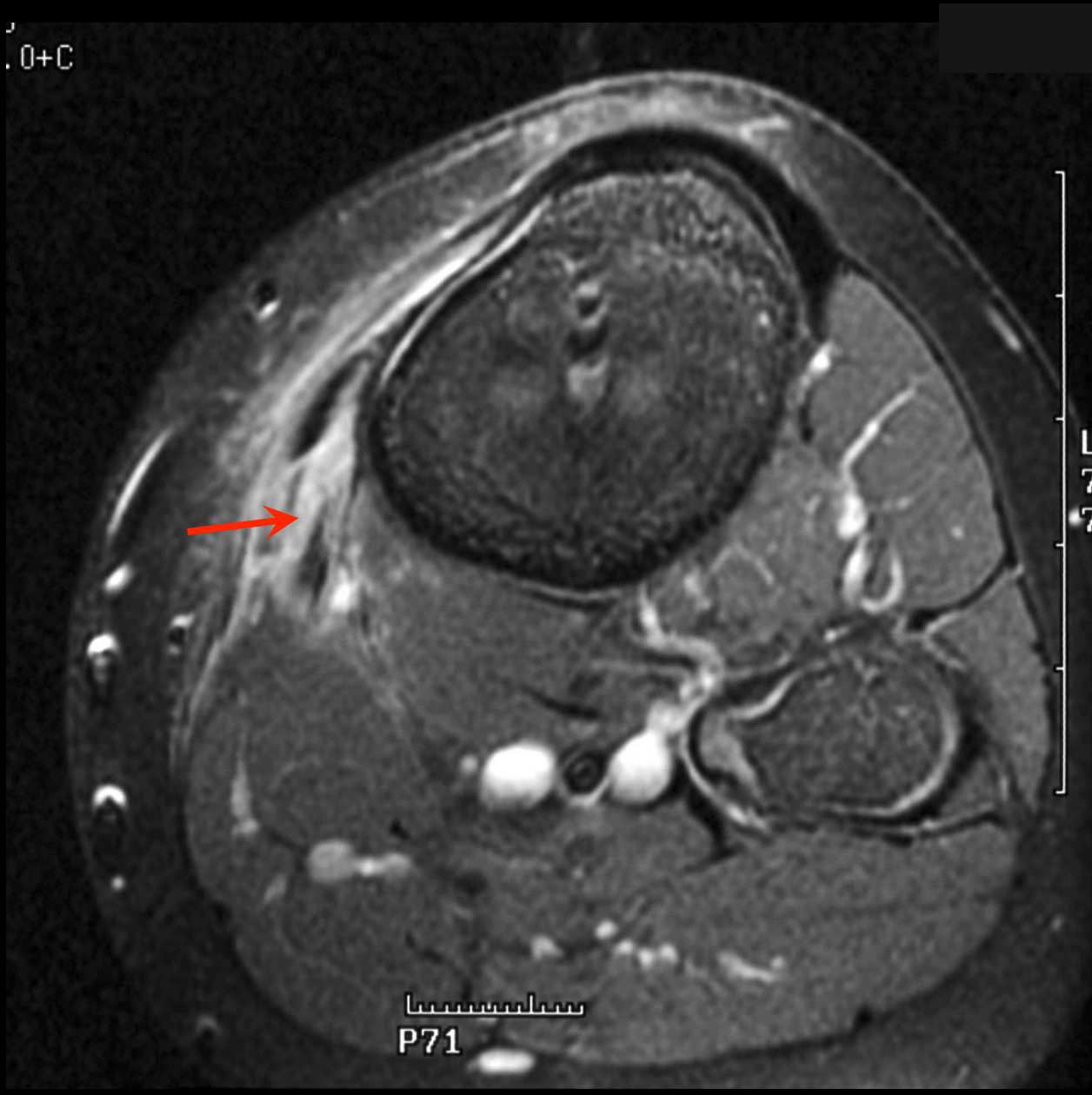


- Inflammation near the insertion site of the Pes anserinus (sartorius, gracilis and semitendinosus) tendons, bursa (arrows) and popliteus muscle

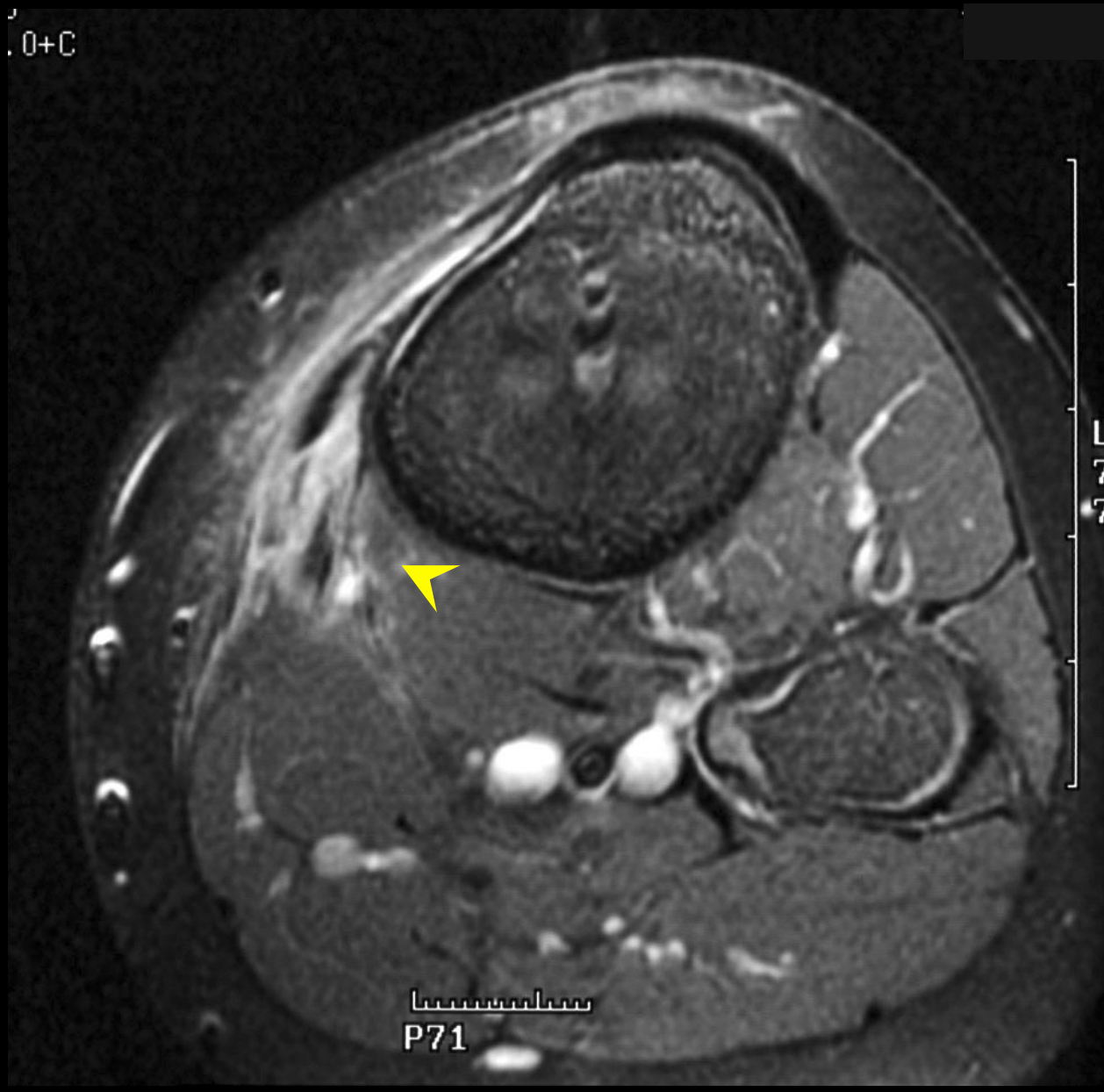


- Inflammation near the insertion site of the Pes anserinus (sartorius, gracilis and semitendinosus) tendons, bursa and popliteus muscle (arrowhead)

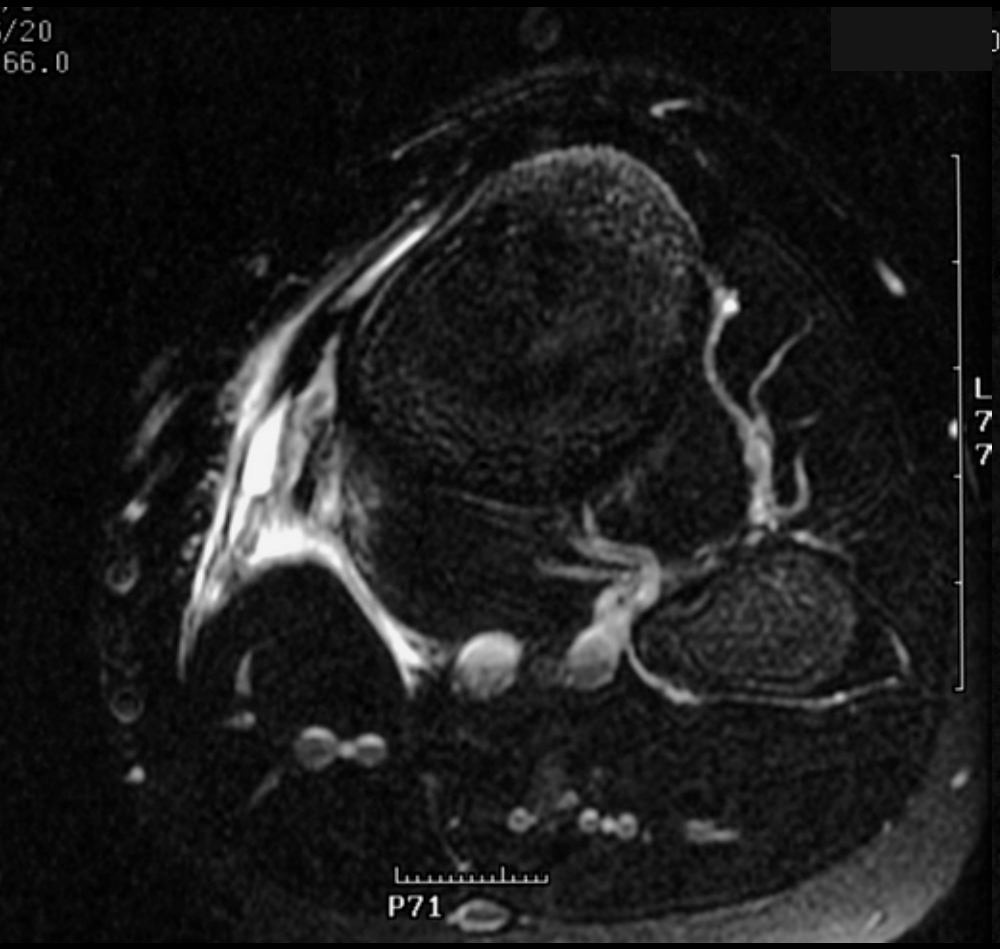
- Enhancement near the insertion site of the Pes anserinus (sartorius, gracilis and semitendinosus) tendons, bursa (arrow) and popliteus muscle



- Enhancement near the insertion site of the Pes anserinus (sartorius, gracilis and semitendinosus) tendons, bursa and popliteus muscle (arrowhead)



Myositis, Tendonitis, Bursitis

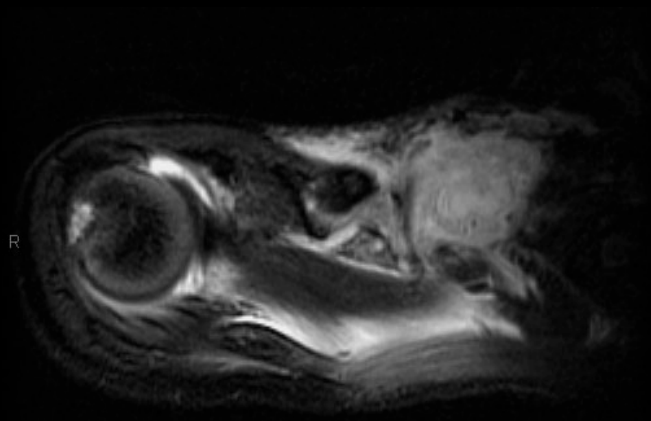


T2W

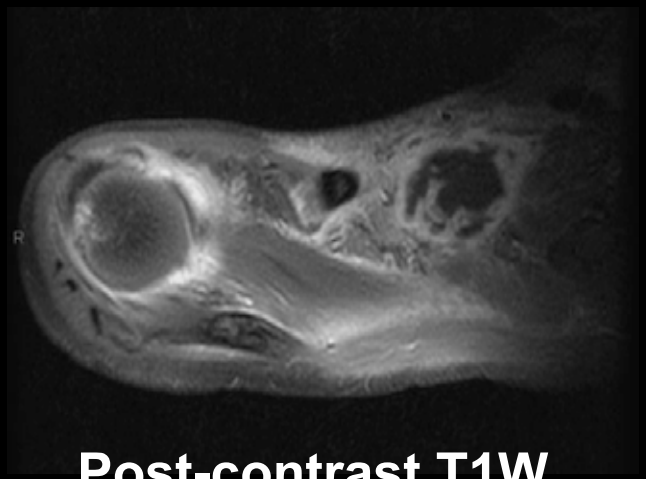
Post-contrast T1W

Case 8

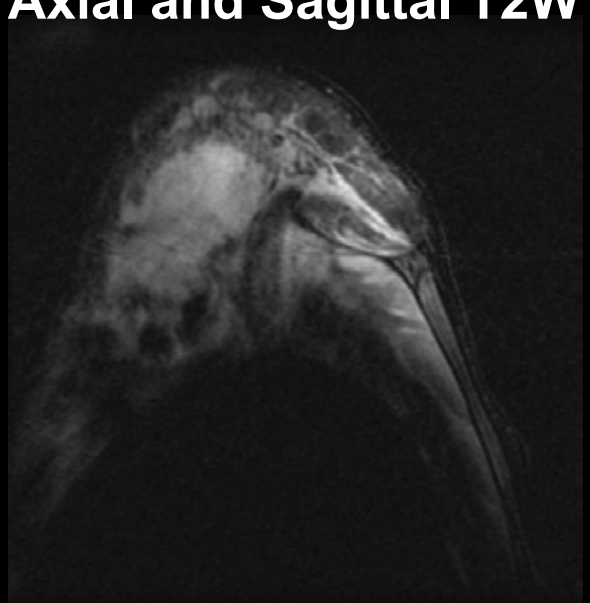
11 year old with right shoulder pain and fever

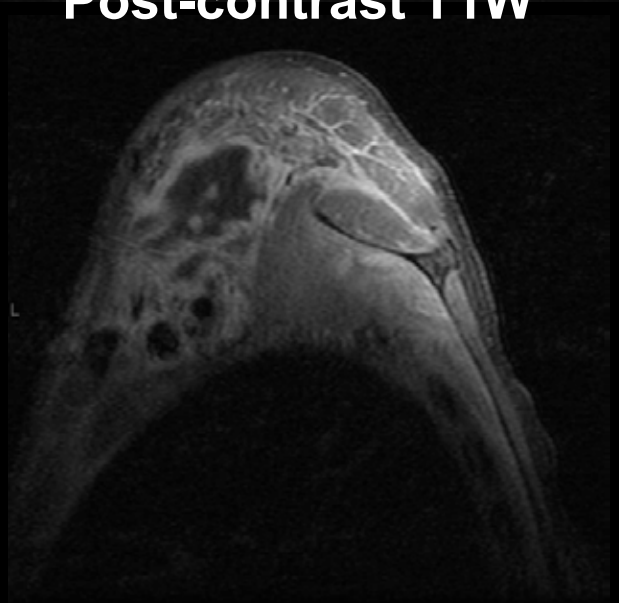


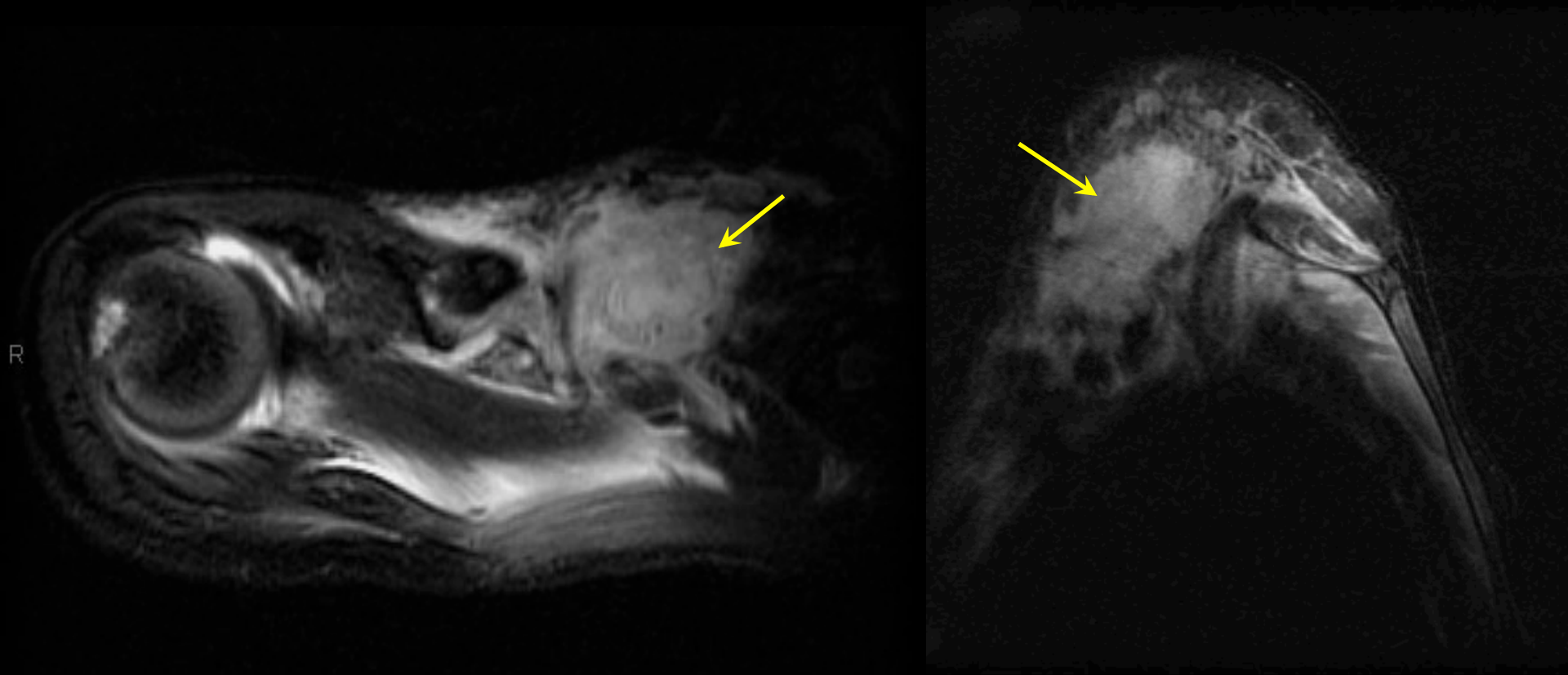
Axial and Sagittal T2W



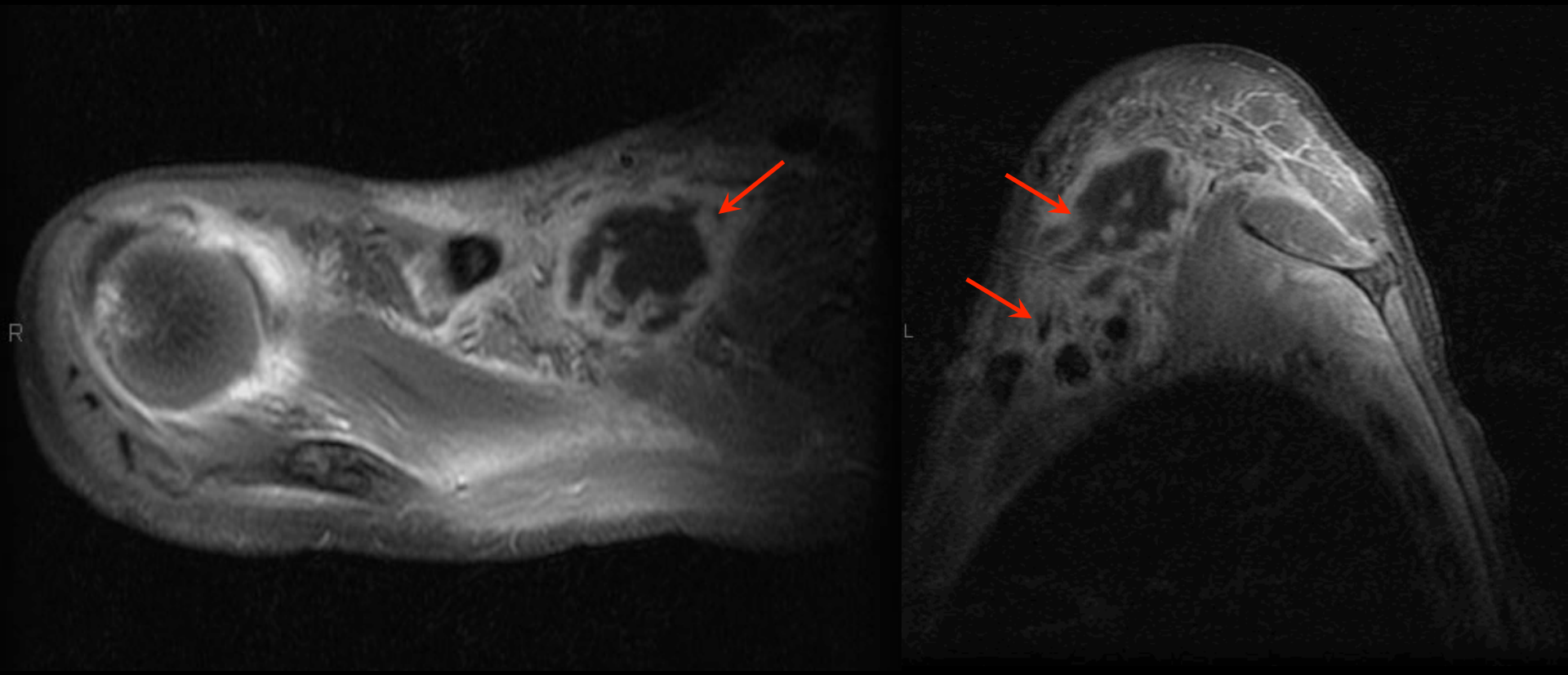
Post-contrast T1W



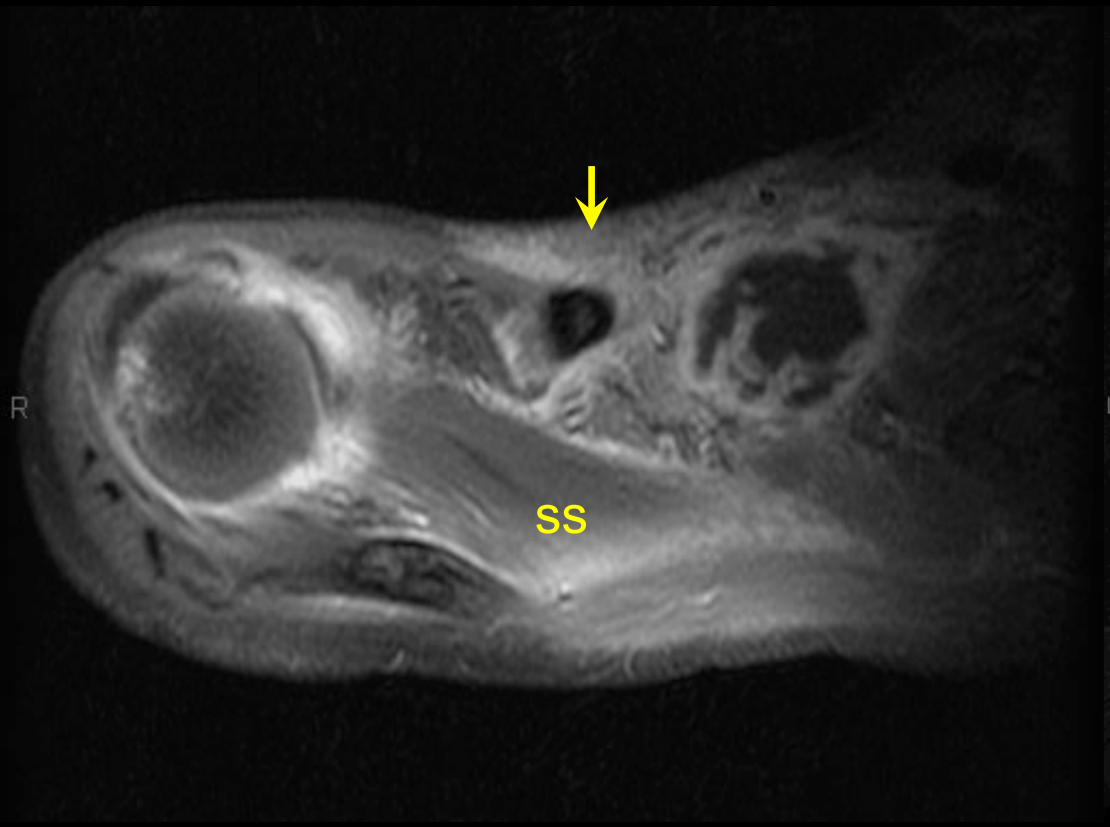


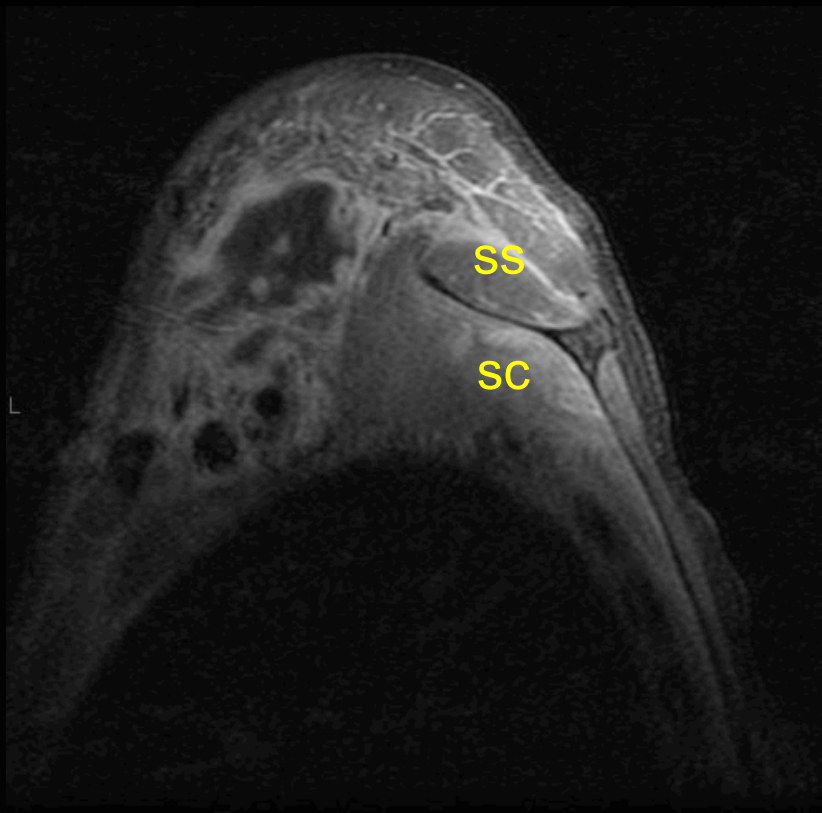


- High signal collection in the anterior supraclavicular region (arrows) and surrounding inflammation involving the rotator cuff muscles and subcutaneous tissues



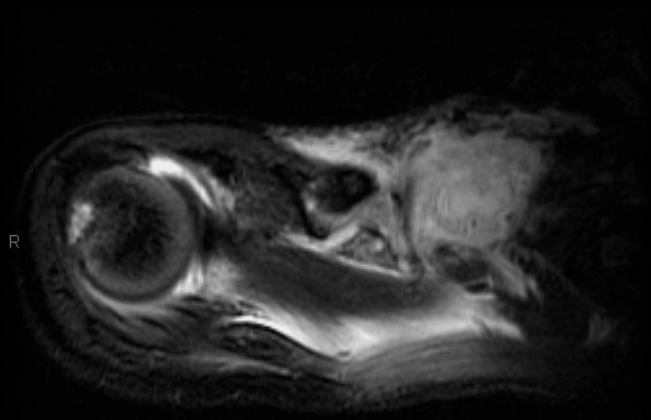
- Peripherally enhancing multiloculated abscess (arrows) and surrounding inflammation involving the rotator cuff muscles and subcutaneous tissues



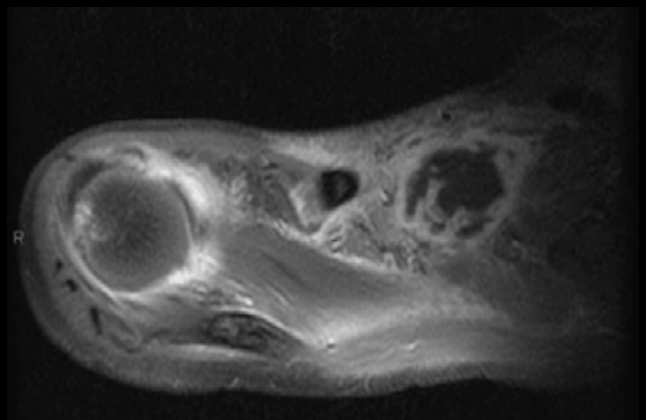


- Peripherally enhancing multiloculated abscess and surrounding inflammation involving the rotator cuff muscles (ss-supraspinatus, sc-subscapularis) and subcutaneous tissues (arrow)

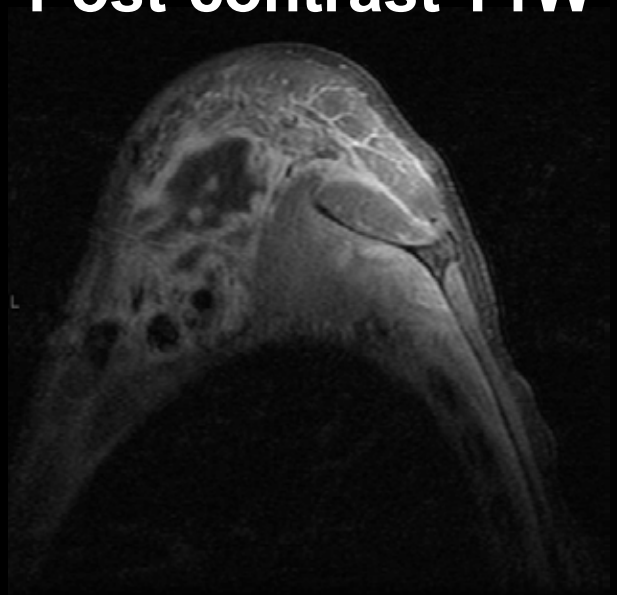
Pyomyositis with Abscess



T2W



Post-contrast T1W



Cellulitis - MRI Findings

- Diffuse or reticular pattern of increased signal of thickened tissue on T2-weighted images

- Post-gadolinium images show enhancement of affected tissue and peripheral enhancement of abscess cavities

Fasciitis - MRI Findings

- In addition to features of cellulitis there is increased signal in deep soft tissue excluding the muscles on T2-weighted images

- Post-gadolinium images show enhancement of affected tissue

Myositis - MRI Findings

- Diffuse muscle enlargement
- T1-weighted images show low signal or possible reticular or peripheral high signal
- T2-weighted images show diffuse high signal
- Post-gadolinium images show enhancement of affected tissue and peripheral enhancement of abscess cavities

Differential Diagnosis

- Includes:
  - Infection: Osteomyelitis, Septic arthritis, Bursitis
  - Trauma: Hematoma, Subacute muscle tear, Bursitis
  - Neoplastic: Sarcoma, Lymphoma, Congenital generalized fibromatosis (Desmoid tumor)

Discussion

- Isolated soft tissue infections in the pediatric age group may be focal, multi-focal or diffuse
- The skin and superficial subcutaneous tissues may only be involved - Cellulitis
- The deep subcutaneous tissues and muscle sheath may be affected - Fasciitis
- Muscle may be involved - Pyomyositis

Discussion

- More than one soft tissue element is commonly involved, but isolated infection may occur
- Concurrent abscesses may occur
- Other associated findings may include tendonitis, bursitis, joint effusion

Discussion

- Common pathogens include Streptococcus pyogenes and Staphylococcus aureus, but cultures are not always positive due prior antibiotic treatment

- Imaging is very useful for treatment planning such as percutaneous or surgical drainage and debridement

Conclusion

- Primary musculoskeletal soft tissue infections, especially involving the deeper structures, in otherwise healthy pediatric population are uncommon, but awareness is crucial

- MRI is beneficial in these cases, aiding prompt diagnosis, encouraging adequate treatment and decreasing morbidity

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Thank you.