

# Novel Imaging of Juvenile Inflammatory Arthritis AMC-experience *Seeking the truth*

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# Learning objectives

- To illustrate the various new imaging strategies we explored
- To enhance synergetic approach
- To explain way of working in AMC-Amsterdam
- Historic Overview

# 4C's

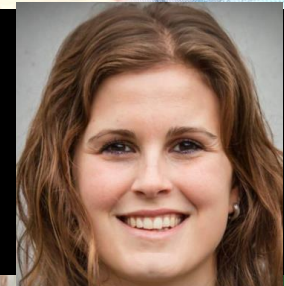
- Coincidence
- Curiousness
- Collaboration
- Community



# COMMUNITY

means Synergy  $1+1=3$

- Technicians
- Physicists
- Medical students
- PhD students
- Residents



# Coincidence 2006



# Imaging in JIA

Imaging important role in:

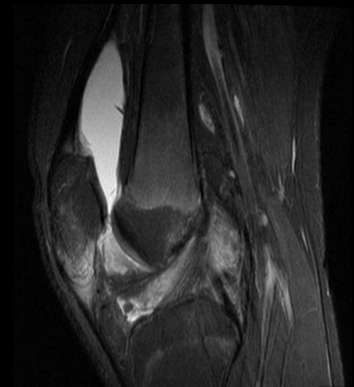
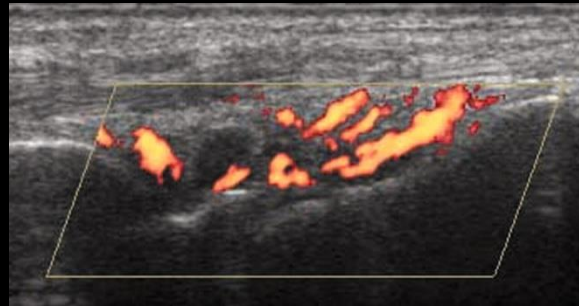
- Assessment of disease activity
- Checking response to therapy
- Monitoring disease progression
- Evaluation of complications



# Imaging in JIA

## Imaging modalities

- Radiography
- Ultrasound
- Magnetic Resonance Imaging



# MRI in JIA

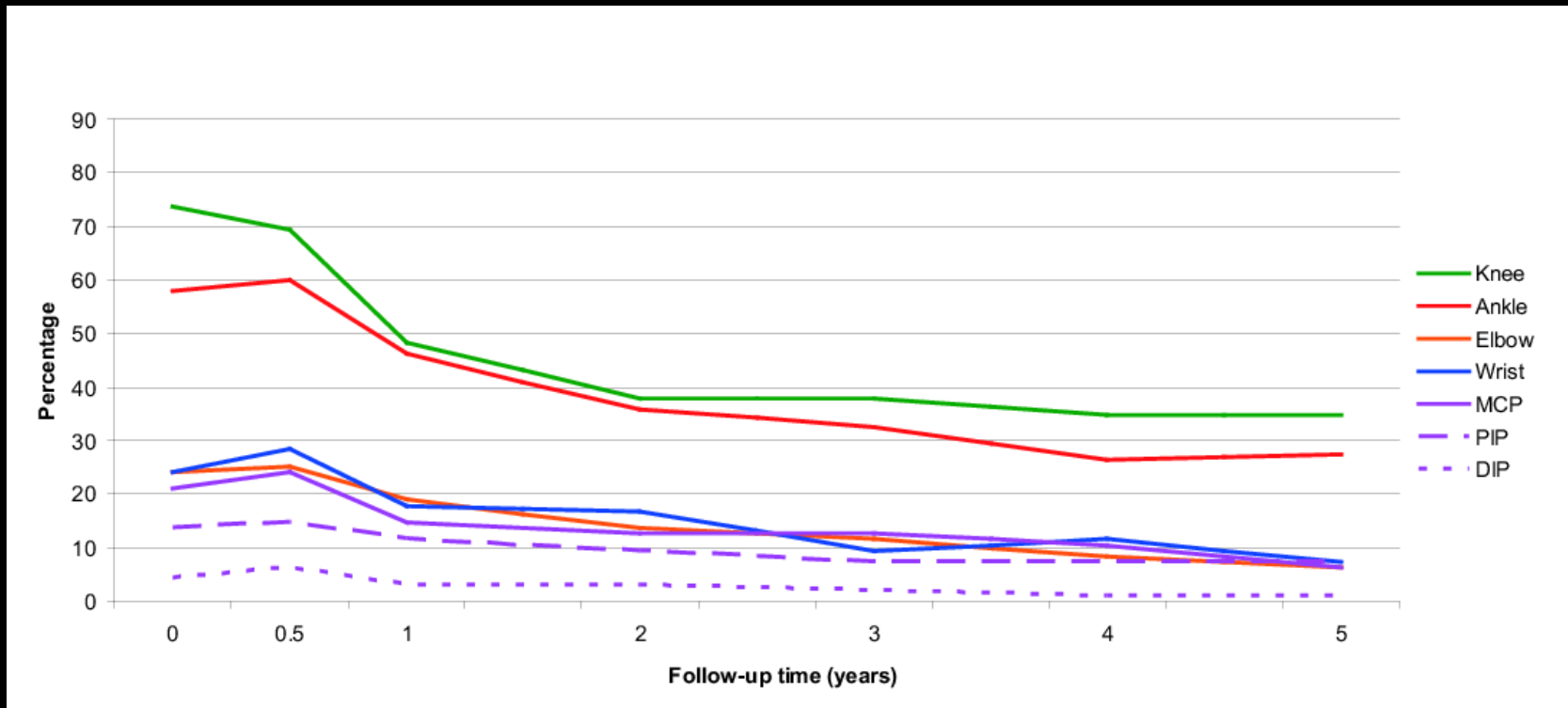
## Magnetic Resonance Imaging

- Most sensitive tool for detecting synovitis
- State of the art imaging modality able to visualize bone marrow changes





# BACKGROUND



<sup>1</sup> Hemke et al. – Rheumatol Int. 2014

# CURIOUS



- Feasibility (Open) MRI<sup>1</sup>
- IV contrast necessary<sup>2</sup>
- Bilateral scanning no additional value<sup>2</sup>
- Juvenile Arthritis MRI Scoring (JAMRIS) system<sup>3</sup>

<sup>1</sup> Hemke et al. – 2012

<sup>2</sup> Hemke et al. – 2013

<sup>3</sup> Hemke et al. – 2012

# JIA features on MRI

## Soft-tissue

- 'Synovitis'
- Effusion
- Tenosynovitis

## Osteochondral

- Bone marrow edema
- Cartilage
- Erosions

# ..... Marked synovial hypertrophy .....



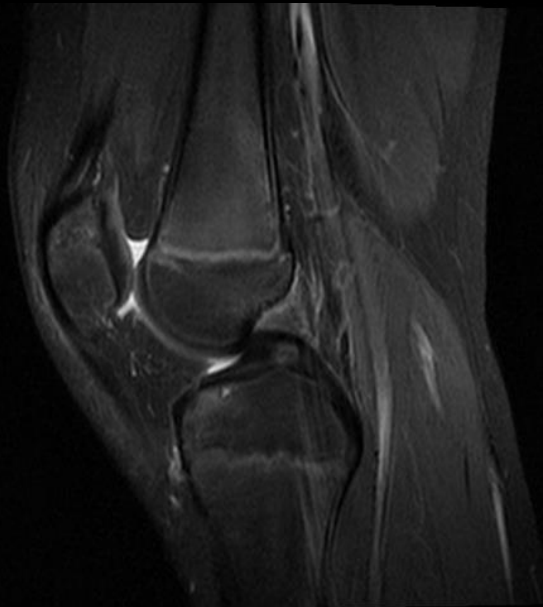
T2W fatsat

T1W -Gd

T1W +Gd

First reading (GG)

# Subtle synovial hypertrophy



T2W fatsat



T1W -Gd



T1W +Gd

First reading (Gd)

# Methods

## Patients

- 46 JIA patients included
- 28 (61%) female patients
- Mean age 12 years (SD 2.8)



# Methods

MRI dataset independently scored by 2 readers

- First reading consisted of unenhanced images only (-Gd)
- Second reading consisted of complete data set; contrast-enhanced and unenhanced images (+Gd)



# Methods

Sequence	Plane	FS	Gd	TR (ms)	TE (mm)	ST (mm)	Gap (mm)	FOV (mm)	Matrix	Time (min)
T2 SPIR	Sag	+	-							
T2 SPIR	Cor	+	-							
T2 SPIR	Ax	+	-							
T1 TSE	Sag	-	-							
T1 TSE	Sag	-	+							
T1 SPIR	Ax	+	+							

Second reading (+Gd)





# Results

Diagnostic accuracy of MRI without Gd-enhancement compared with Gd-enhanced MRI as the reference standard

	Sensitivity	Specificity	PPV	NPV
Synovial hypertrophy	0.60	0.98	0.90	0.85
Bone marrow changes	0.89	0.99	0.97	0.94
Cartilage lesions	0.73	1.00	1.00	0.95
Bone erosions	1.00	1.00	1.00	1.00

PPV: positive predictive value

NPV: negative predictive value



# Results

## Reliability

	Single measure ICC	
	-Gd	+Gd
Synovial hypertrophy	0.76	0.88
Bone marrow changes	0.87	0.88
Cartilage lesions	1.00	0.97
Bone erosions	0.93	0.93

ICC: Intraclass Correlation Coefficient



# Summary

T1W GBCA -

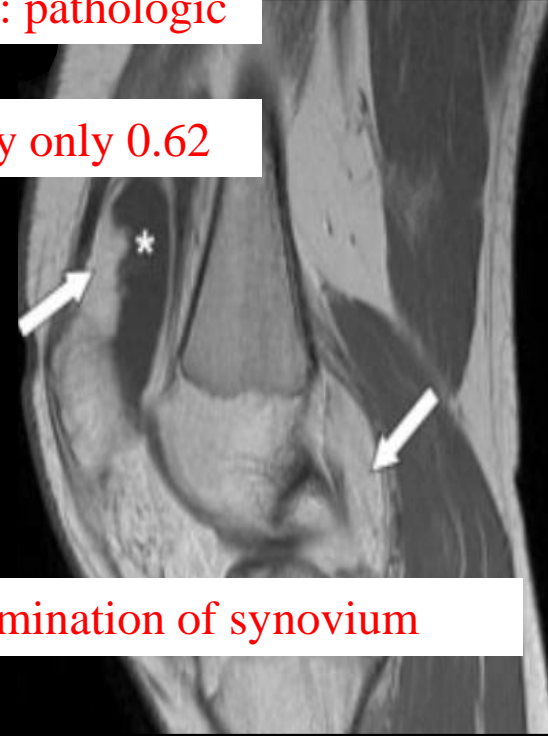
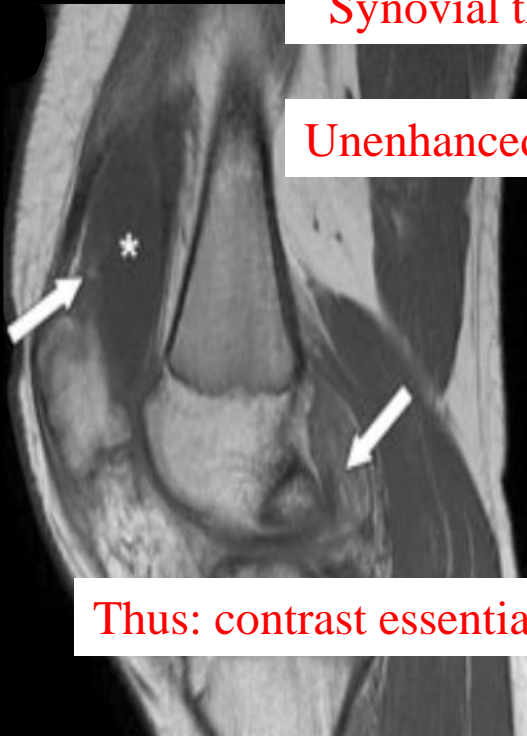
T1W GBCA +

Synovial thickness  $\geq 2$  mm: pathologic

Unenhanced MRI: sensitivity only 0.62

Thus: contrast essential for reliable examination of synovium

Synovial enhancement and thickening!



MSK  
SYNERGY

# Contrast enhanced MRI in JIA

Conclusions; omitting Gd contrast injection:

- Is unimportant in the assessment of
  - Bone marrow changes
  - Cartilage lesions
  - Bone erosions
- Decreases the reliability in the evaluation of
  - Synovial hypertrophy

# JAMRIS system for the knee

Synovial hypertrophy

Bone marrow changes

Cartilage lesions

Bone erosions



# Juvenile Arthritis MRI Scoring (JAMRIS) system for the knee

## Synovial hypertrophy score (maximal synovial thickness)

Location	0-2mm	2-4mm	>4mm
Retropatellar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Suprapatellar recesses	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Infrapatellar fat pad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cruciate ligaments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Medial posterior-condylar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lateral posterior-condylar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Bone marrow change score (involvement of bone volume)

Location	None	<10%	10-25%	>25%
Patella, lateral	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Patella, medial	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Femur, medial condyl	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Femur, lateral condyl	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Femur, medial weight-bearing region	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Femur, lateral weight-bearing region	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tibia, medial tibia plateau	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tibia, lateral tibia plateau	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

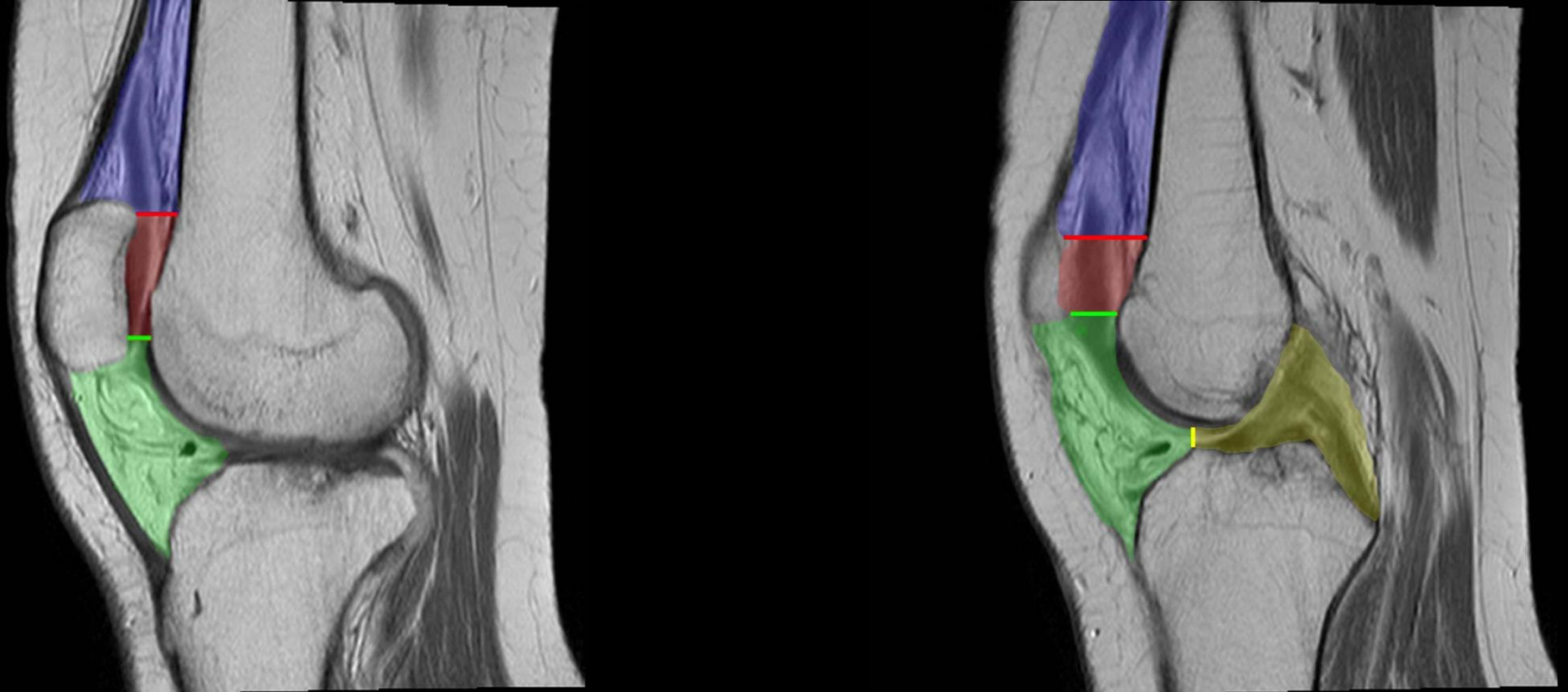
## Cartilage lesion score (involvement of cartilage surface area)

Location	None	<10%	10-25%	>25%
Patella, lateral	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Patella, medial	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Femur, medial condyl	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Femur, lateral condyl	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Femur, medial weight-bearing region	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Femur, lateral weight-bearing region	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tibia, medial tibia plateau	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tibia, lateral tibia plateau	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Bone erosion score (involvement of bone volume)

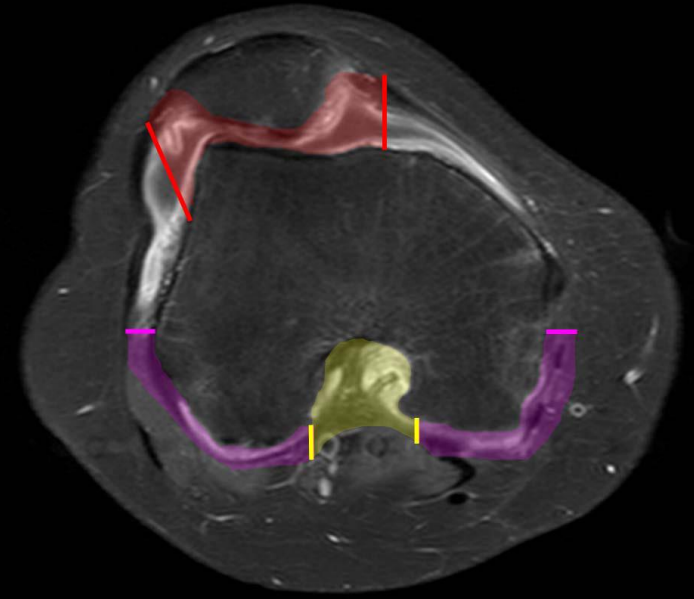
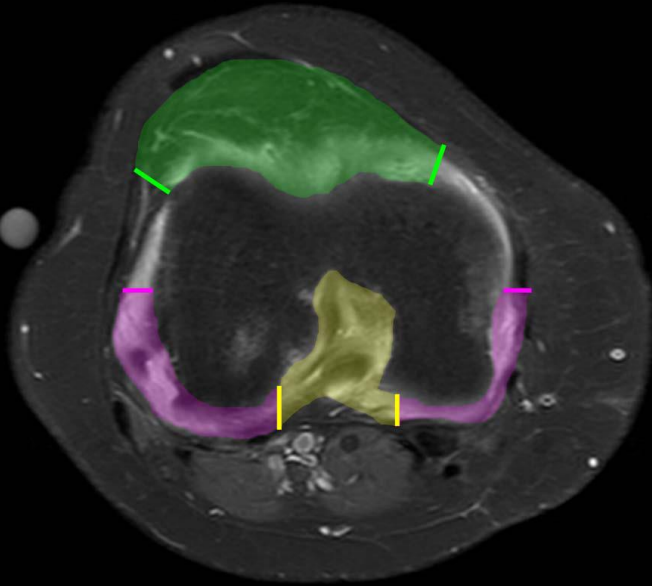
Location	None	<10%	10-25%	>25%
Patella, lateral	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Patella, medial	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Femur, medial condyl	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Femur, lateral condyl	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Femur, medial weight-bearing region	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Femur, lateral weight-bearing region	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tibia, medial tibia plateau	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tibia, lateral tibia plateau	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

# Synovial thickness



- Patellofemoral, **red**
- Suprapatellar recesses, **blue**
- Infrapatellar fat pad, **green**
- Adjacent to the ACL & PCL, **yellow**

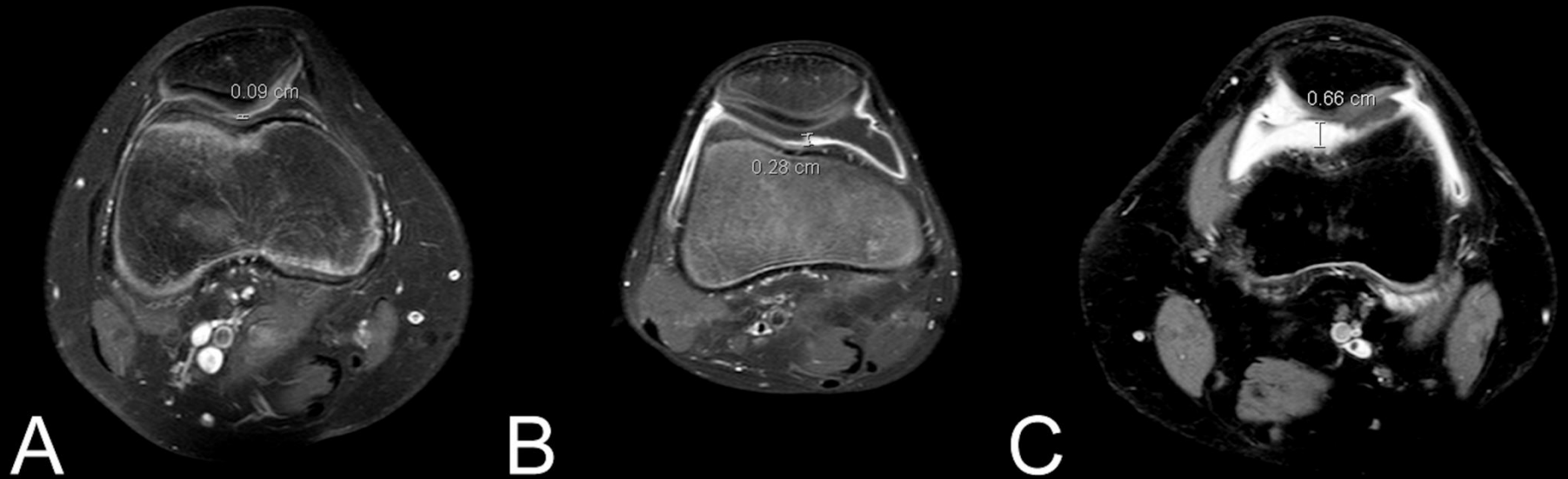
# Synovial thickness



- Patellofemoral, red
- Infrapatellar fat pad, green
- Adjacent to the ACL & PCL, yellow
- Medial- & lateral posterior-condylar, pink



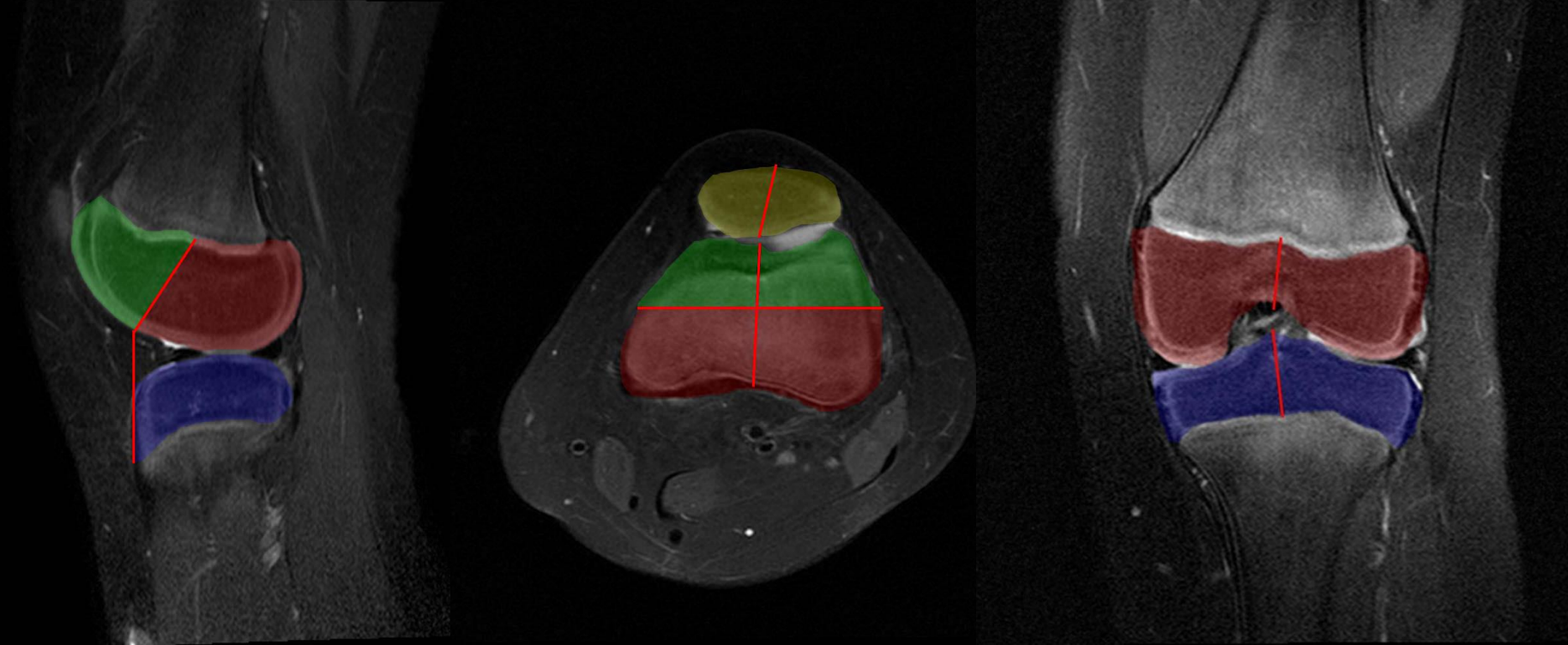
# Example synovial hypertrophy



## Patellofemoral

- Grade 0;  $<2$  mm (A)
- Grade 1;  $\geq 2$ -4 mm (B)
- Grade 2;  $>4$  mm (C)

# Bone marrow changes



- Femur; weight-bearing region, **red**
- Femur; condylar, **green**
- Tibia plateau, **blue**
- Patella, **yellow**

# Example bone marrow changes



Femur, lateral weight-bearing region

- Grade 0; none (A)
- Grade 1; <10% of bone volume (B)
- Grade 2; 10-25% of bone volume (C)
- Grade 3; >25% of bone volume (D)

# JAMRIS system for the knee

## Highly reliable

Inter-observer ICC 0.86-0.95

Intra-observer ICC 0.92-1.00

## Feasible

Median scoring time 6.6 min

## Responsive

Substantial effect synovial hypertrophy scores

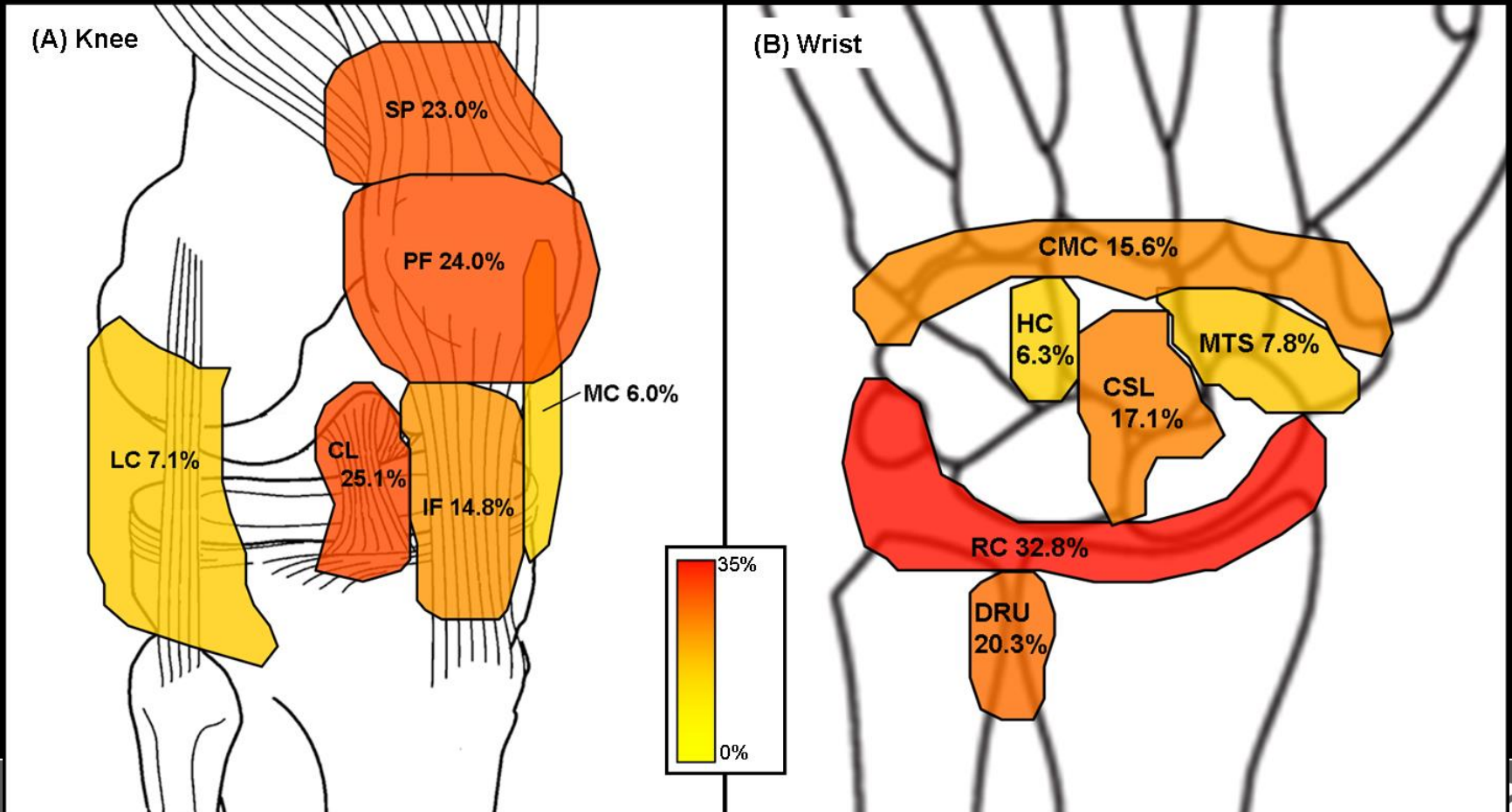
Standardized Response Mean (SRM) -0.65

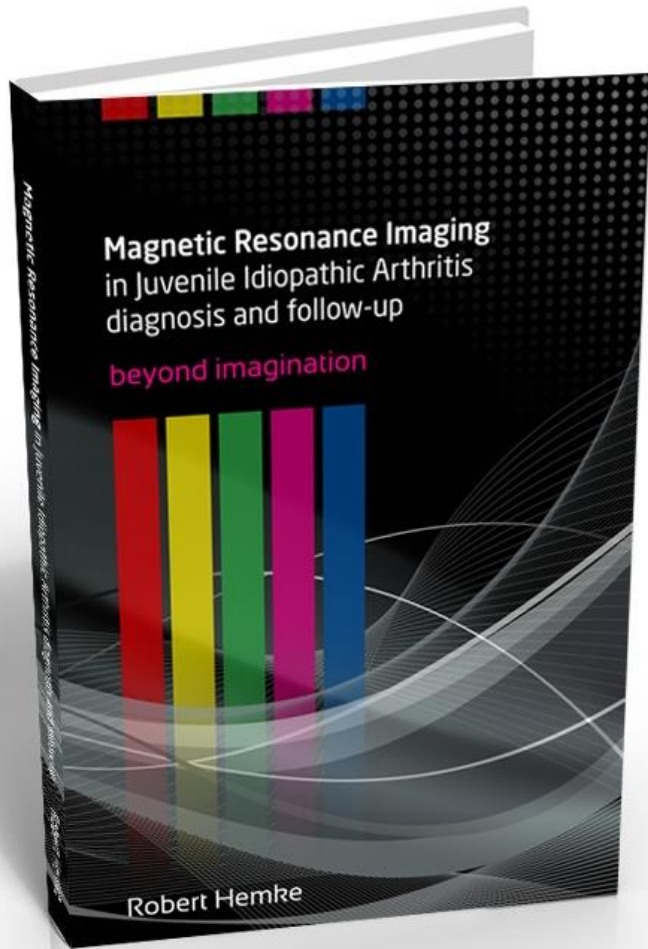
# Predeliction

110 MRI knee & 43 MRI wrist

Clinically active (5 criteria)

Presence of synovitis?





INNOVATING IMAGING  
IN JUVENILE IDIOPATHIC ARTHRITIS:  
AN ONGOING QUEST

CHARLOTTE M. NUSMAN



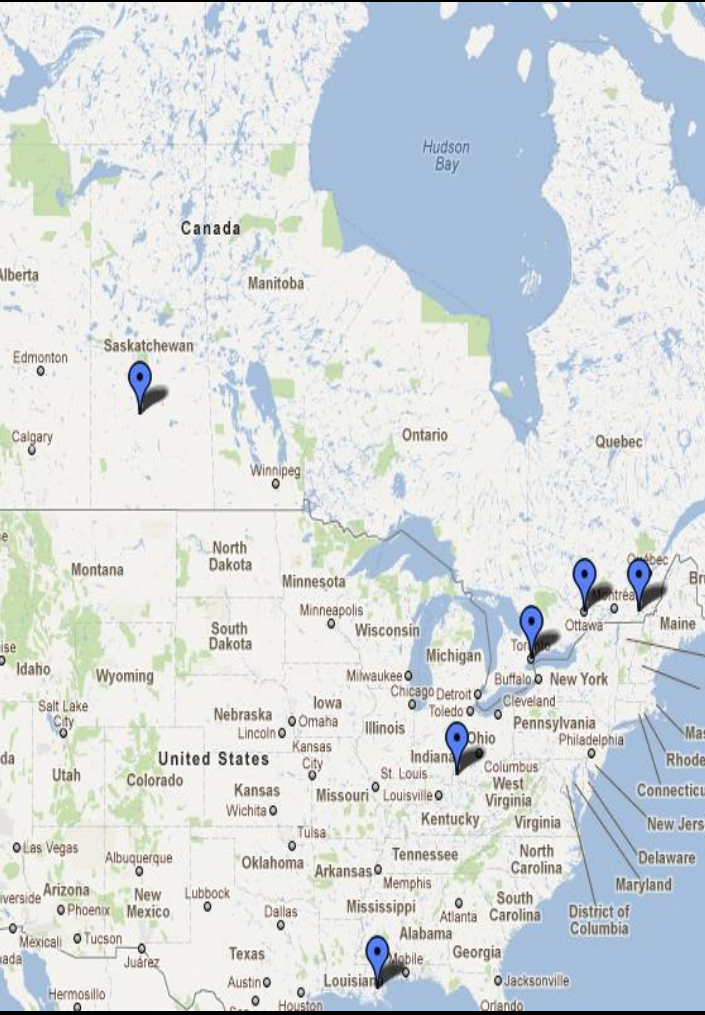


# International presentations RSNA





# COLLABORATION - I OMERACT



# COLLABORATION II

## Amsterdam & Partners

International collaboration is inevitable

Together we can find the truth

Join forces of existing groups

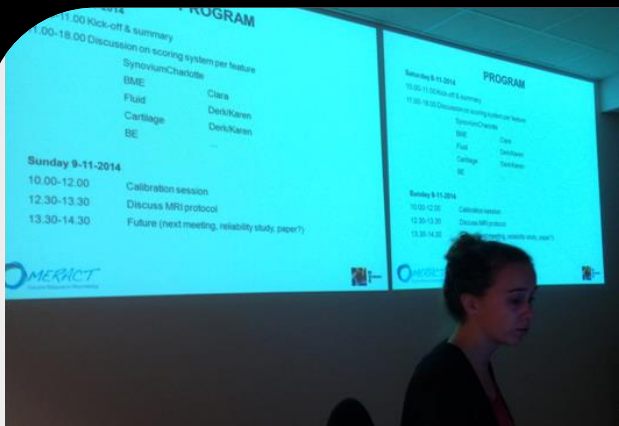
**'Amsterdam November Meeting' – ANOME**

**→ KNEE & WRIST**



# PARTICIPANTS (11)

Name	Country	Profession	Joint(s)
Andrea Doria	Canada	Radiologist	Large & small
Nikolay Tzaribachev	Germany	Ped. Rheumatologist	Large & small
Mario Maas	Netherlands	Radiologist	Large & small
Marion van Rossum	Netherlands	Ped. Rheumatologist	Large & small
Robert Hemke	Netherlands	Radiology resident	Large & small
Charlotte Nusman	Netherlands	PhD student	Large & small
Charlotte van Gulik	Netherlands	PhD student	Large & small
Karen Rosendahl	Norway	Radiologist	Small
Lil-Sofie Ording-Muller	Norway	Radiologist	Small
Derk Avenarius	Norway	Radiologist	Small
Clara Malattia	Italy	Ped. Rheumatologist	Small
Anouk Barendregt	Netherlands	PhD student	Large & small



# ANOME-MEETINGS

	<b>ANOME 1</b>	<b>ANOME 2</b>	<b>ANOME 3</b>	<b>ANOME 4</b>
<b>Date</b>	22-24 Nov 2013	26-28 Sep 2014	8-9 Nov 2014	3-4 Oct 2015
<b>Focus joint</b>	Knee & wrist	Knee	Wrist	Wrist
<b>Achievements</b>	Agree knee scoring Discuss wrist scoring	Reliability st. knee 5 readers, n=20	MRI protocol wrist Calibration session wrist	Agree wrist scoring Inventory intern. collaborations
<b>Outcome</b>	Paper J Rheumatol.	Poster @ ESPR Oral @ NVVR	Letter-to-editor in J Rheumatol.	MS in preparation



# ANOME - WRIST

Previous efforts:

RAMRIS<sup>1</sup>, paediatric-targeted MRI scoring system<sup>2</sup> and  
Revised scores<sup>3,4,5</sup>

Well-established:

Synovitis, tenosynovitis

Difficulties in osteochondral domain<sup>6</sup>

MRI protocol

<sup>1</sup> Østergaard et al. – J Rheumatol. 2003

<sup>2</sup> Malattia et al. – Ann Rheum Dis. 2011

<sup>3</sup> Damasio et al. – Pediatr Radiol. 2012

<sup>4</sup> Tanturri de Horatio et al. – Pediatr Radiol. 2012

<sup>5</sup> Lambot et al. – Pediatr Radiol. 2013

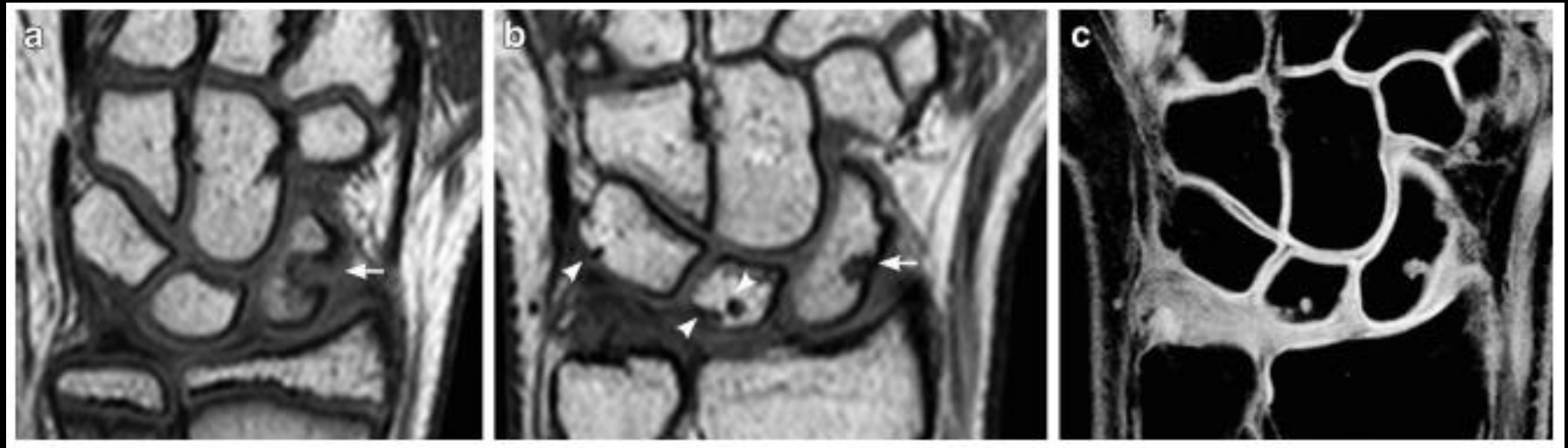
<sup>6</sup> Ording-Muller et al. – Pediatr Radiol. 2013



# OSTEOCHONDRAL DOMAIN

- Normal bony depressions mimicking erosions
- Overestimation of structural damage

*Avenarius et al. – Pediatr Radiol. 2015*



13-year old boy

4-years later

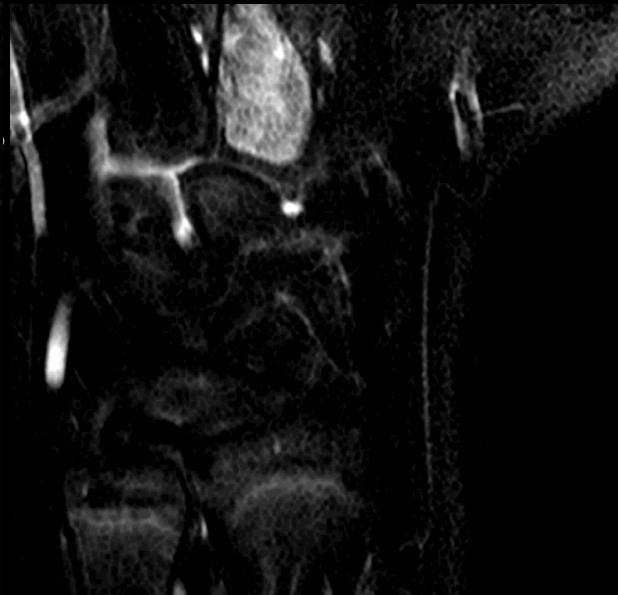
Cartilage coverage

# OSTEOCHONDRAL DOMAIN

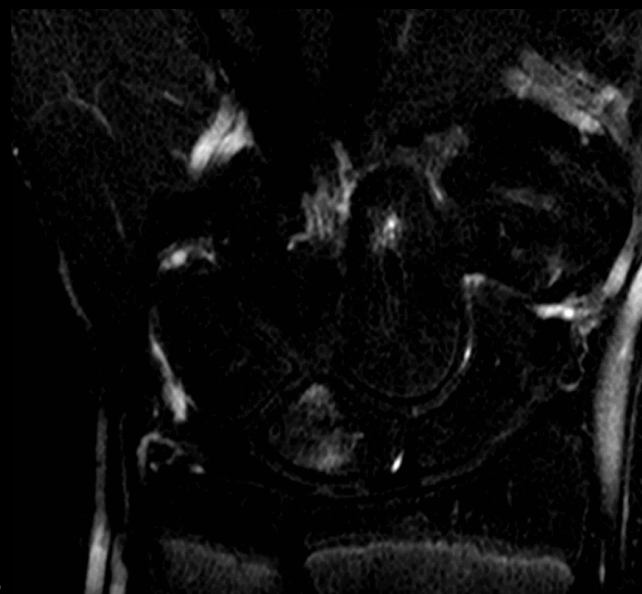
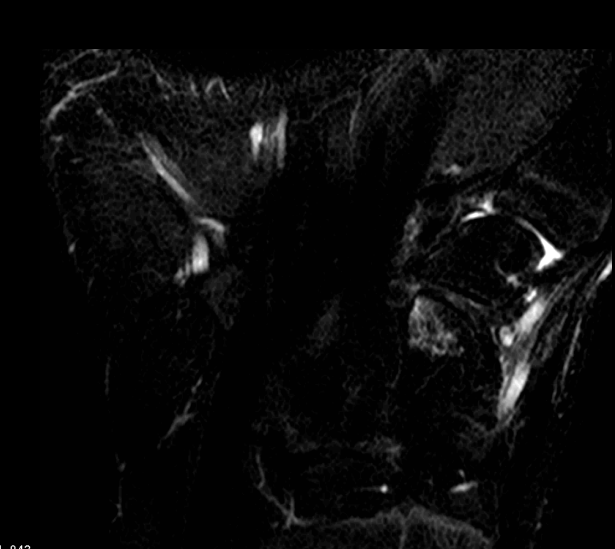
- No current scoring method for MRI available yet
- Possibilities:
  - Back to conventional radiography
  - Cartilage-sequences
  - Healthy MRI atlas

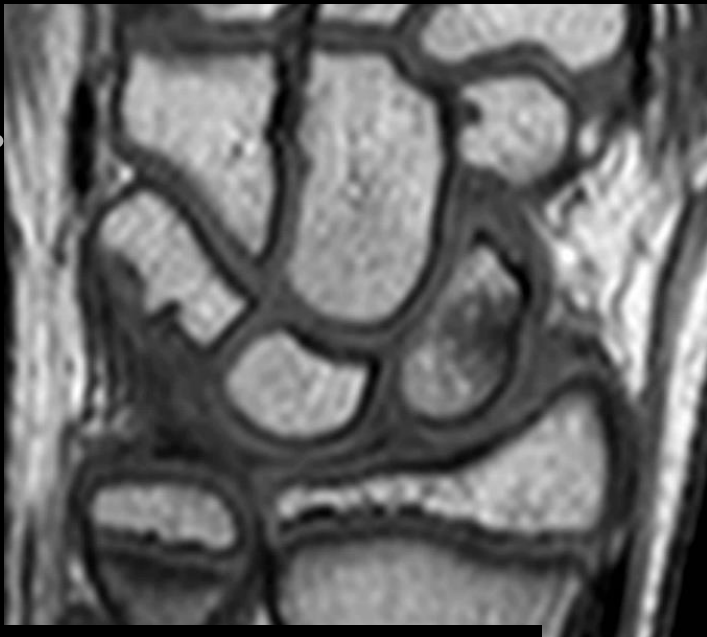




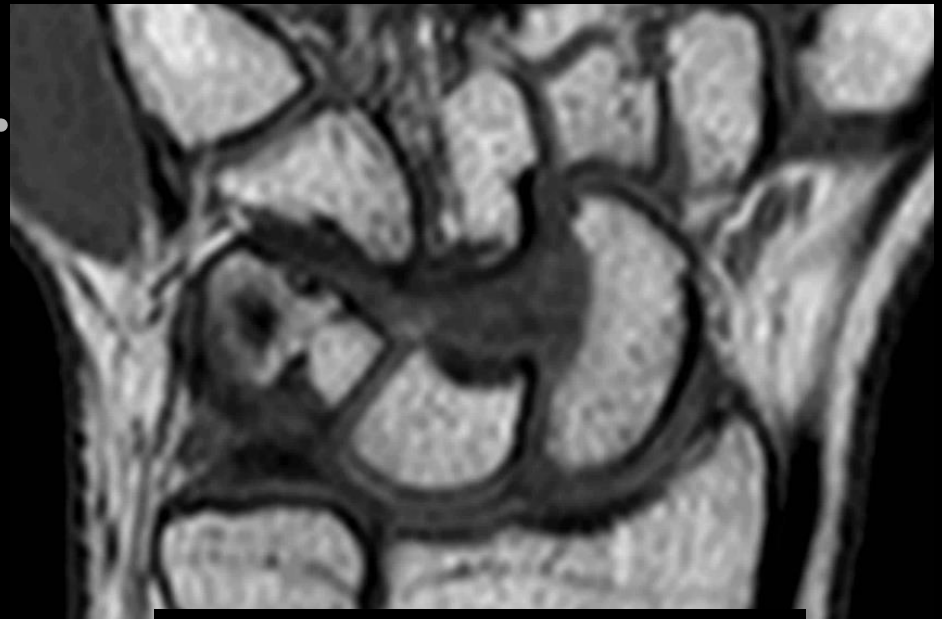


35% edema





Healthy child 13 years



4 year follow up- 17 years



WATS cartilage  
sequention.  
Depressions show  
cartilage layer

# COLLABORATION III: Amsterdam Pediatric rheumatologists –Building database



# Database features

- Modern and safe
- enables multicenter study
- 747 unique patients
- Clinical assessment / Imaging / Immunology



## Title: Clinical information

Page:

Save

Exit



Date of the visit 28-Jan-2016



\* dd/mmm/yyyy

## Clinicians view

- What's the impression of disease activity?
- Inactive \*
- Minimal
- Mild
- Moderate
- Severe

Enter a number between 0, no activity, and 100, overall active, or click in the box.

Disease activity score by clinician 29



## Additional symptoms

- Does the patient have/had uveitis?
- Active \*
- In the past
- No
- unknown

- Does the patient experience morning stiffness?
- Yes \*
- No
- Unknown

Are there any other additional symptoms?  Note

## Clinical information

- Does the patient have JIA?  Yes  No  Unknown \*

Date of Diagnosis 04-Nov-2014



\* Explain

## According to the definitions

Subtypes

JIA subtype Polyarthritis \* ILAR classification

- Rheumatoid Factor  Positive  Negative  Unknown \*

Disease activity

- Is there (in)active disease?  Active  Inactive \* Explain

Disease activity Smoldering \* Explain

## Medication

- Does the patient receive medication?  Yes  No  Unknown \*

Return to top

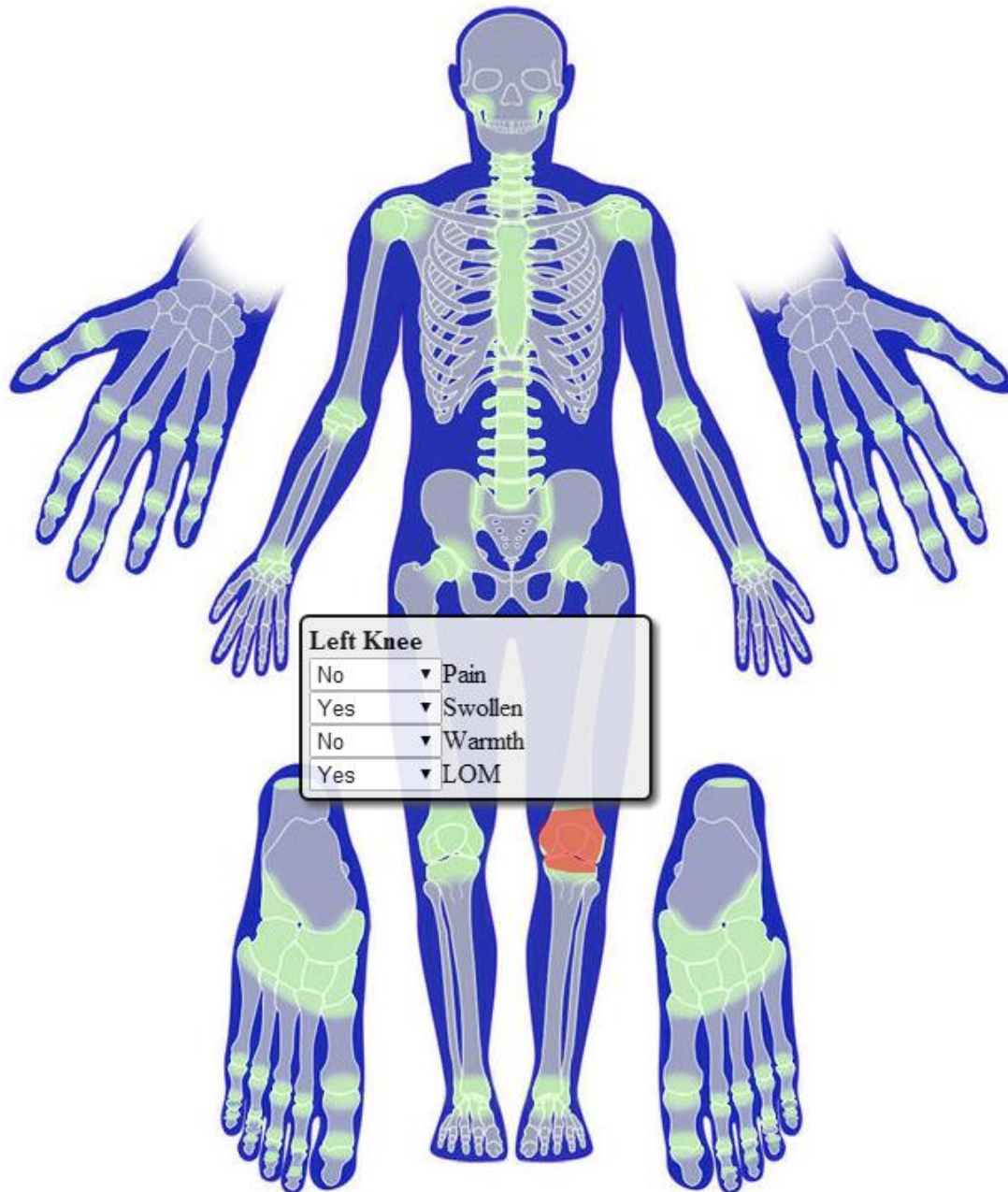
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Exit

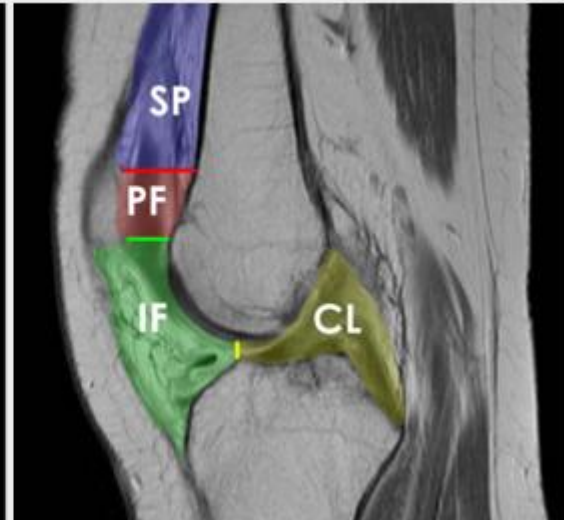
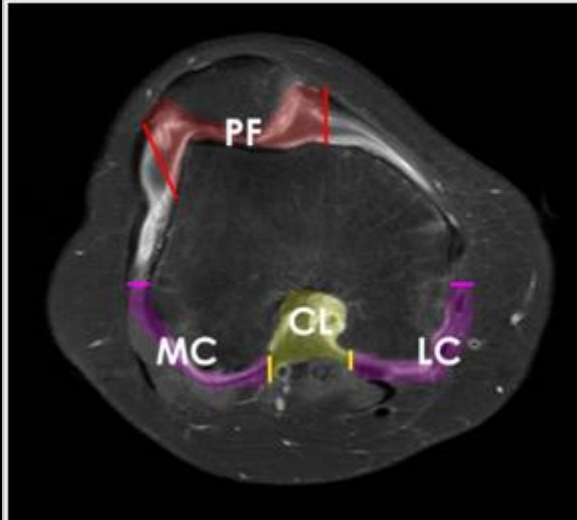


MSK SYNERGY





### Synovial Thickness / Hypertrophy

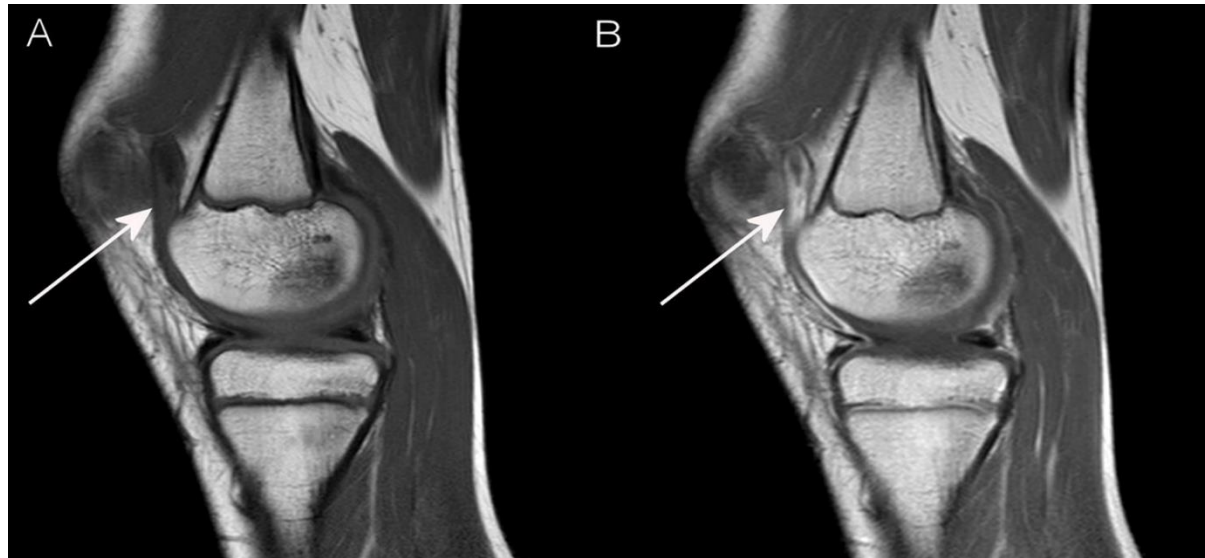


Patello femoral joint (PF)	<input type="text" value="0"/>	mm
Suprapatellar recesses (SP)	<input type="text" value="0"/>	mm
Infrapatellar fat pad (IF)	<input type="text" value="0"/>	mm
Cruciate ligaments (CL)	<input type="text" value="0"/>	mm
Medial posterior-condylar (MC)	<input type="text" value="0"/>	mm
Lateral posterior-condylar (LC)	<input type="text" value="0"/>	mm

# Discrepancies between clinical assessment and MR imaging in JIA

## Introduction

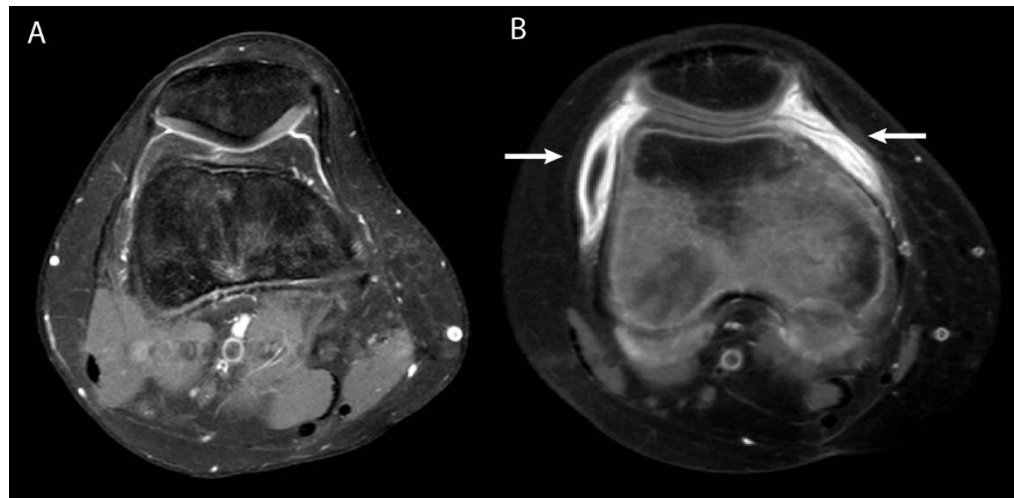
- Increased use of MR imaging in assessment of disease activity in JIA patients
- Discrepancies between MR imaging and clinical assessment pose a dilemma



An example of the sagittal T1-weighted MRI sequence pre-(a) and post-(b) contrast of the right knee in a 10-year old female with clinically inactive JIA of the oligoarticular subtype, with enhancing and thickened synovium at the patellofemoral region (arrow)



# Discrepancies between clinical assessment and MR imaging in JIA



Two examples of children with clinically active JIA as depicted with an axial, contrast-enhanced, T1 fat saturated MRI sequence. (A) a 15-year old girl without signs of synovitis on MRI, (B) an 8-year old girl with enhanced, thickened synovium at the patellofemoral region (arrows).

## Objective

- To explore the frequency of mismatching results between clinical assessment and MRI
- To define the group(s) of JIA patients in which the clinical assessment is discrepant with the MRI
- To form hypotheses on the meaning and cause of these discrepancies

# Discrepancies between clinical assessment and MR imaging in JIA

## Methods

- Prospectively collected data
- Clinical and laboratory assessment, followed by contrast enhanced MRI of the knee
- 1.0 T MRI
- A JAMRIS  $\geq 1$  means presence of synovial thickening

124 JIA patients

72 Clinically Active

52 Clinically Inactive

MRI

MRI

JAMRIS  $\geq 1$

JAMRIS = 0

JAMRIS = 0

JAMRIS  $\geq 1$

Comparison patient characteristics and disease activity parameters

Comparison patient characteristics and disease activity parameters

# Discrepancies between clinical assessment and MR imaging in JIA

## Results

Clinically Active n=72				Clinically Inactive n= 52			
	Concordant n=47	Discordant n=25	P		Concordant n=34	Discordant n=18	P
Age	10.9 yr	13.2 yr	0.006	Age	14.4 yr	10.7 yr	0.008
Oligo	45 %	8 %	0.001	Oligo	32 %	61 %	0.076
Poly	34 %	72 %	0.003	Poly	56 %	22 %	0.038

## Conclusions, statements and dilemmas

- Nearly 35% of the JIA patients showed discordant findings
- MRI may prevent overtreatment in clinically active patients
- The meaning of synovial thickening in the clinically inactive patient is still unknown.

## References

1. van Gulik EC, Welsink-Karssies MM, van den Berg JM, Schonenberg-Meinema D, Dolman KM, Barendregt AM, et al. Juvenile idiopathic arthritis: magnetic resonance imaging of the clinically unaffected knee. *Pediatric radiology*. 2018;48(3):333-40.
2. van Gulik EC, Hemke R, Welsink-Karssies MM, Schonenberg-Meinema D, Dolman KM, Barendregt AM, et al. Normal MRI findings of the knee in patients with clinically active juvenile idiopathic arthritis. *Eur J Radiol*. 2018;102:36-40.

# Essentials of Diffusion-weighted imaging (DWI)

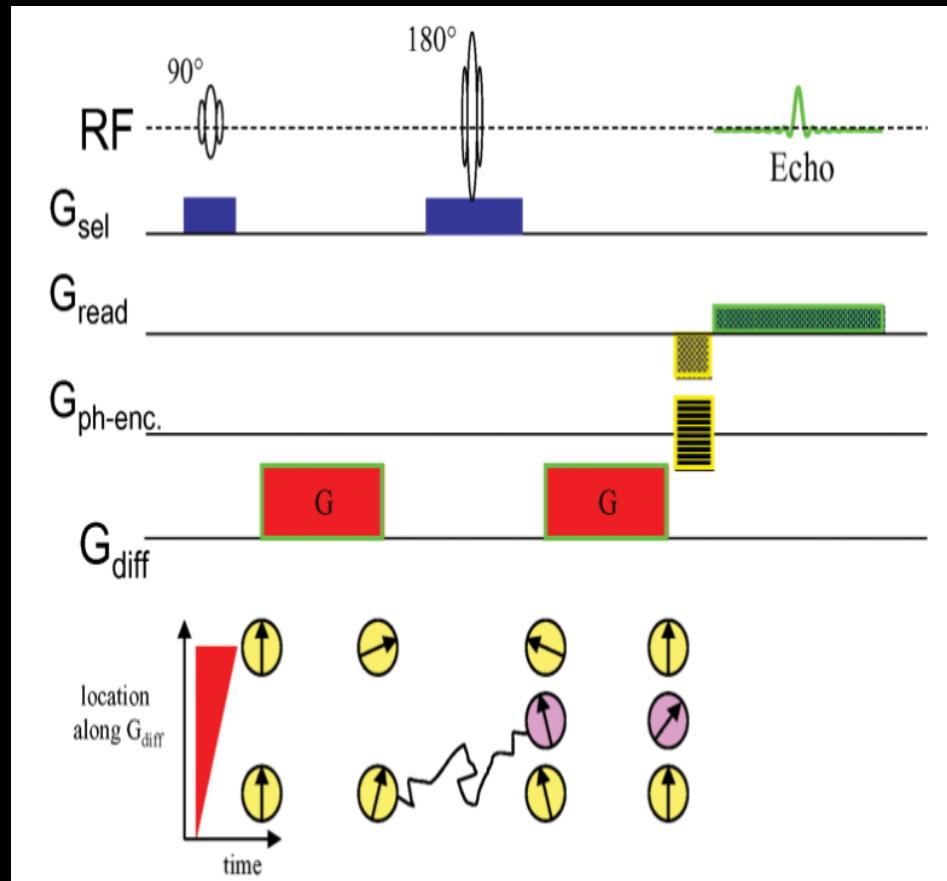
Advantage: non-contrast technique!



**M**  
**S**YNERGY  
**K**

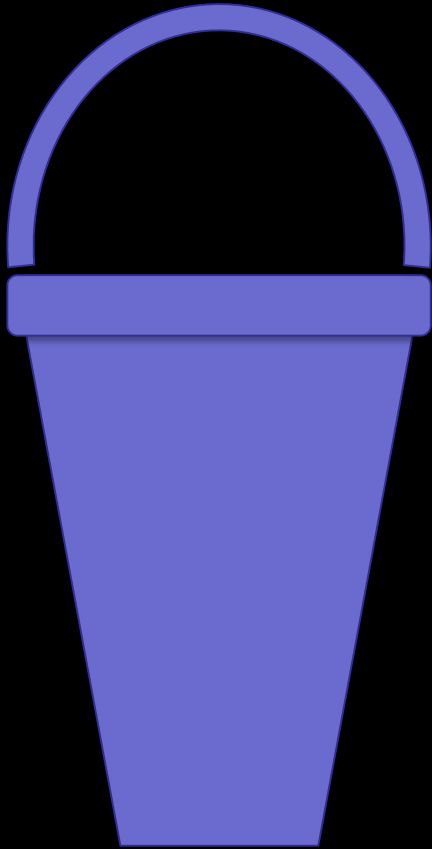
am 

# Diffusion-weighted imaging (DWI)



**M**  
**S**YNERGY  
**K**

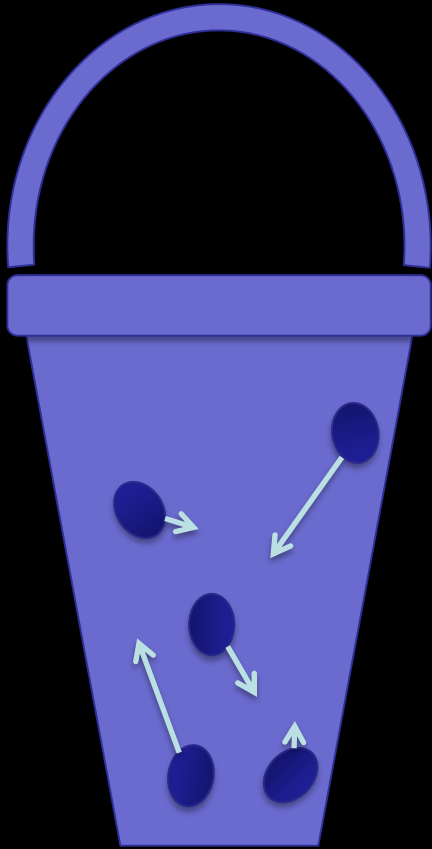
# Diffusion-weighted imaging (DWI)



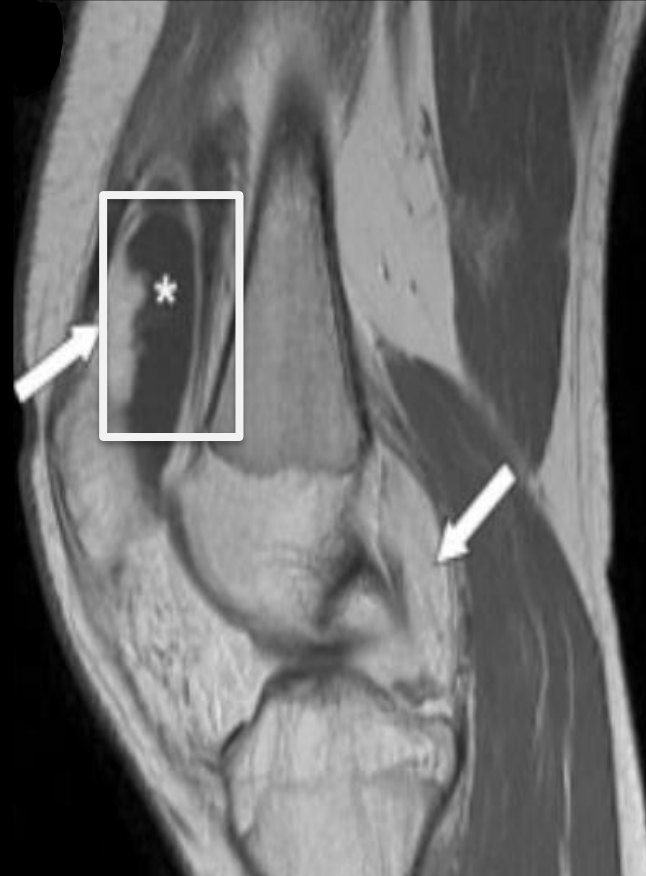
**M**  
**S**YNERGY  
**K**

*am* **C**

# Diffusion-weighted imaging (DWI)



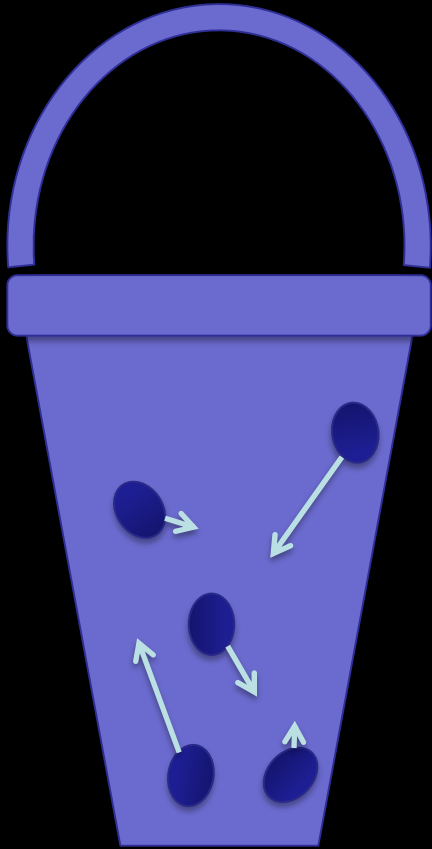
Free diffusion



MSK  
SYNERGY

amC

# Diffusion-weighted imaging (DWI)

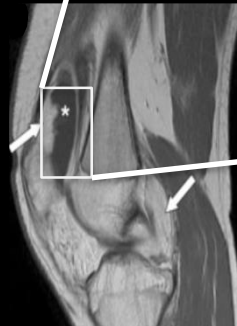
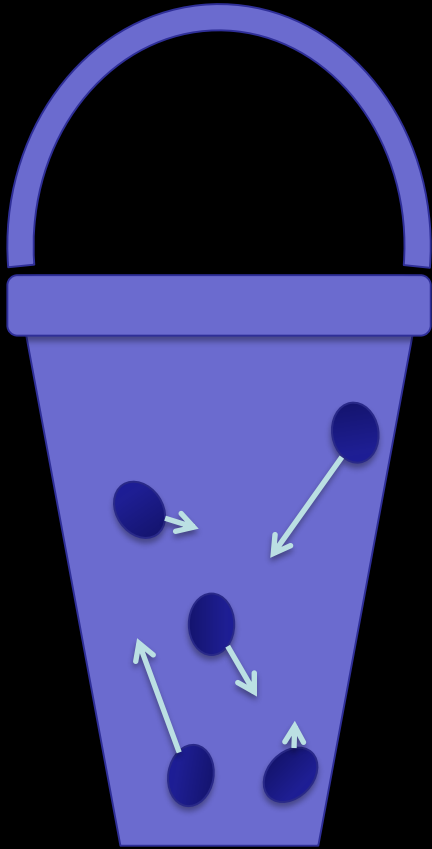


**M**  
**S**YNERGY  
**K**

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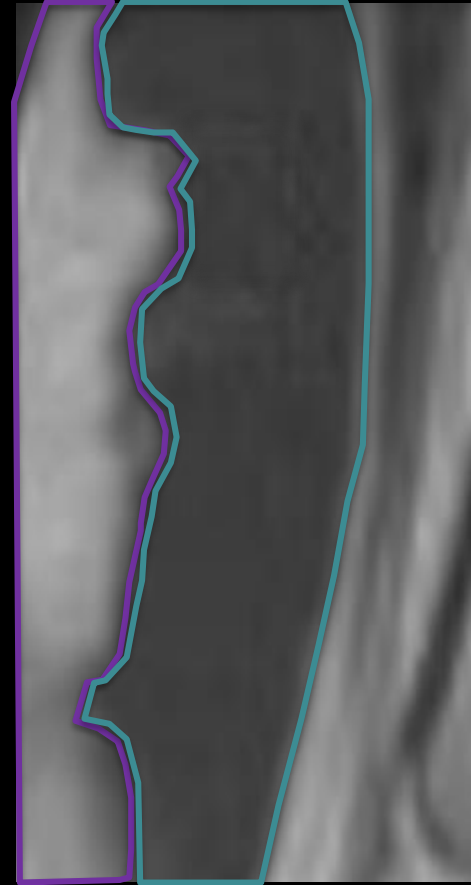
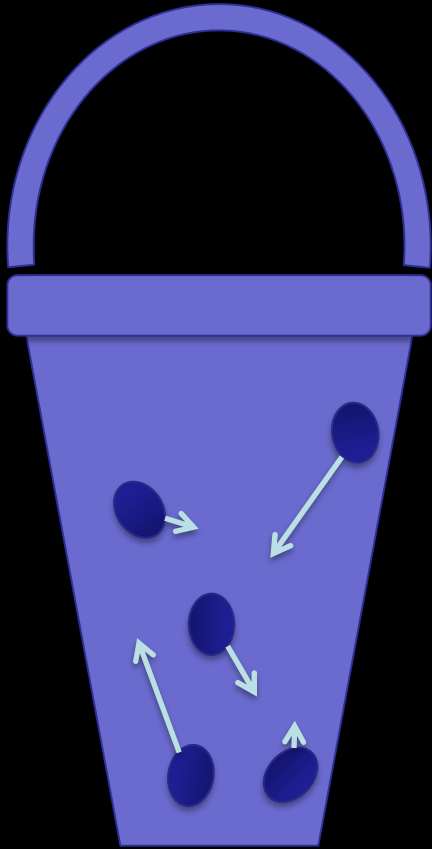
# Diffusion-weighted imaging (DWI)



**M**  
**S**YNERGY  
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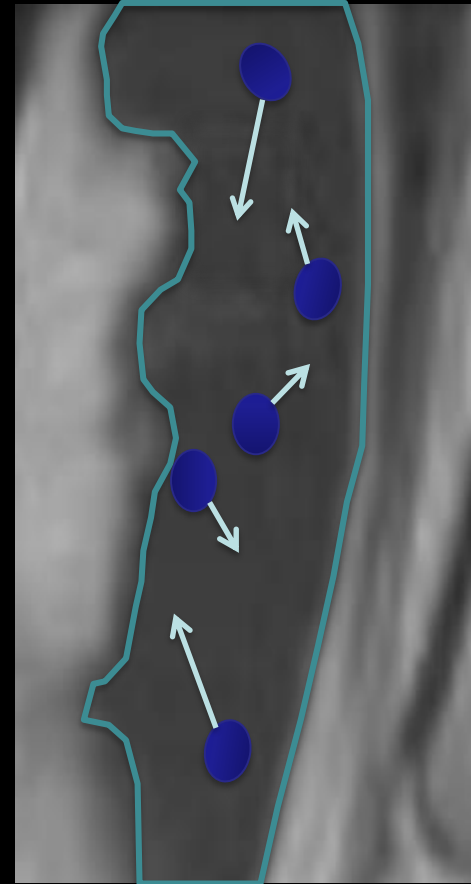
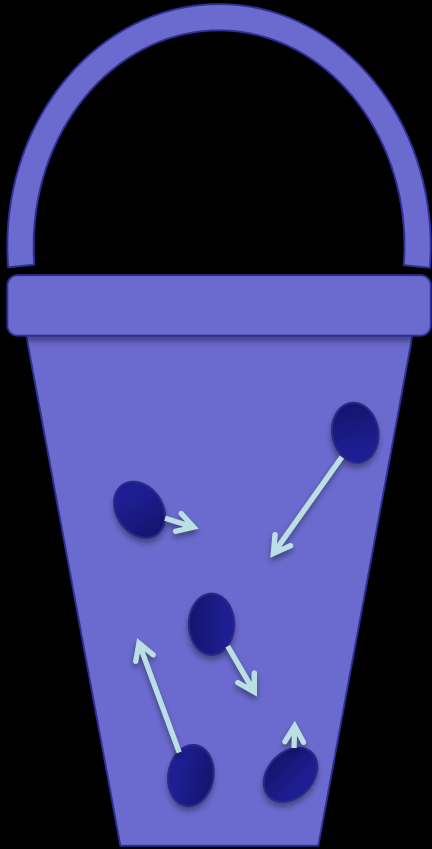
# Diffusion-weighted imaging (DWI)



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# Diffusion-weighted imaging (DWI)



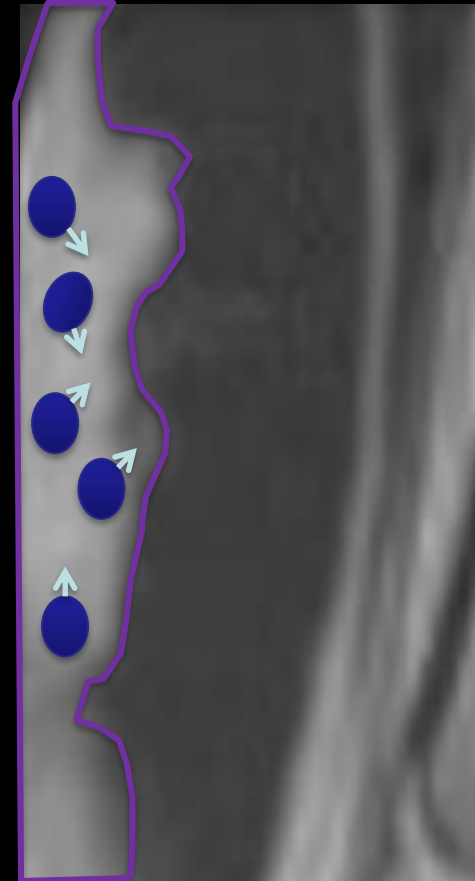
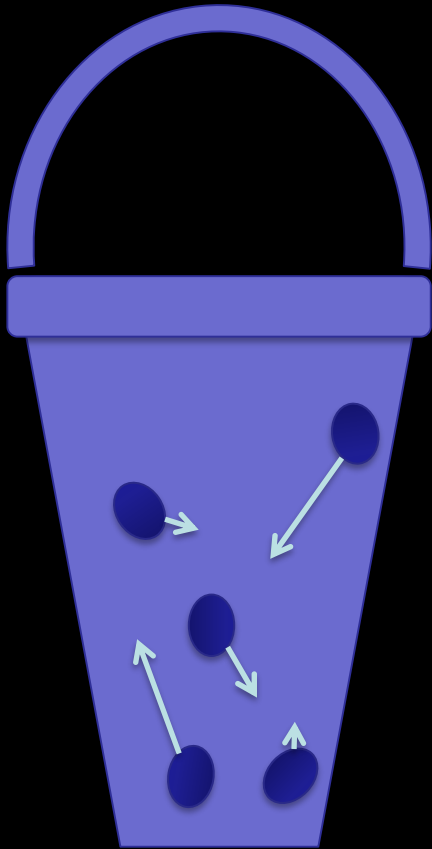
Effusion: 'free' diffusion



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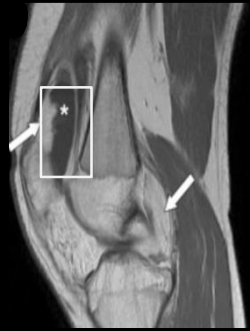
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# Diffusion-weighted imaging (DWI)

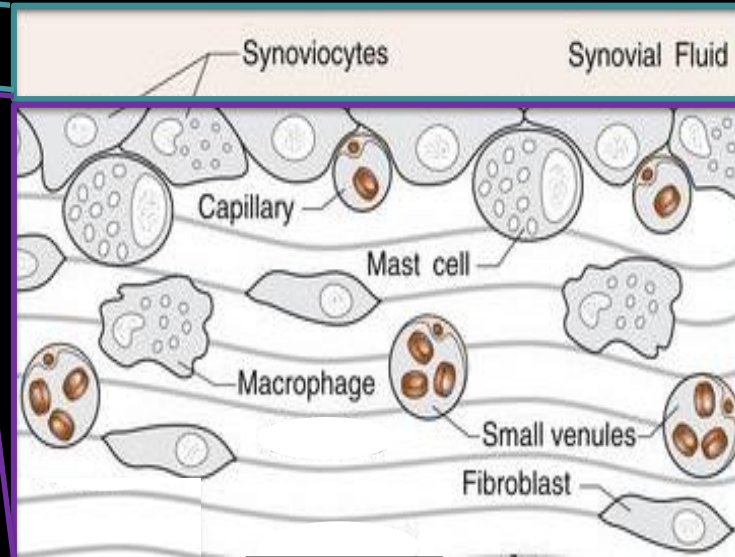
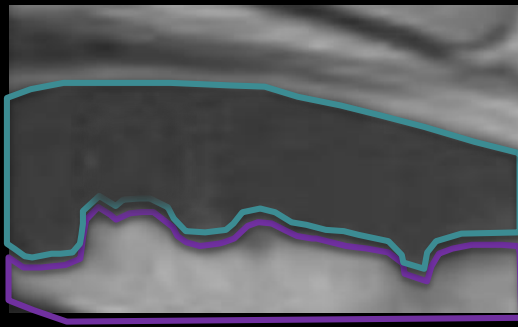


Synovium: restricted diffusion





# What are we looking at?



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<https://musculoskeletalkey.com/rheumatoid-arthritis-and-the-hand/>

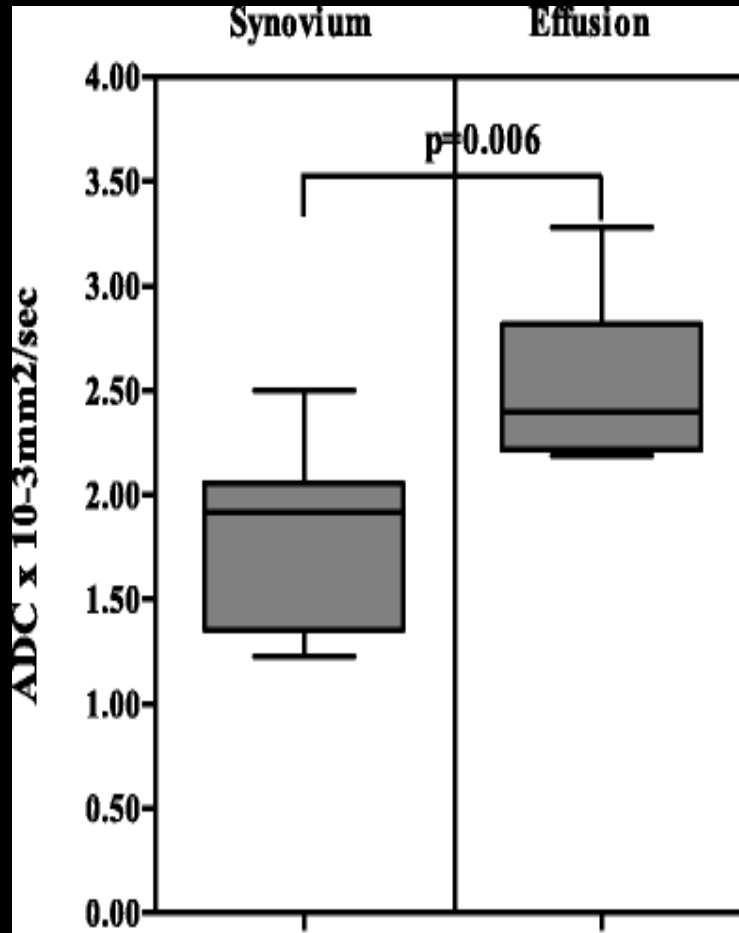


# Assessment of synovium using DWI

- Layers with different composition – fluid (acellular) vs. solid (cellular)
- Diffusion of H<sub>2</sub>O through synovium depends on microarchitecture -> increased cellularity in synovitis



# 1. Diffusion synovium $\neq$ effusion



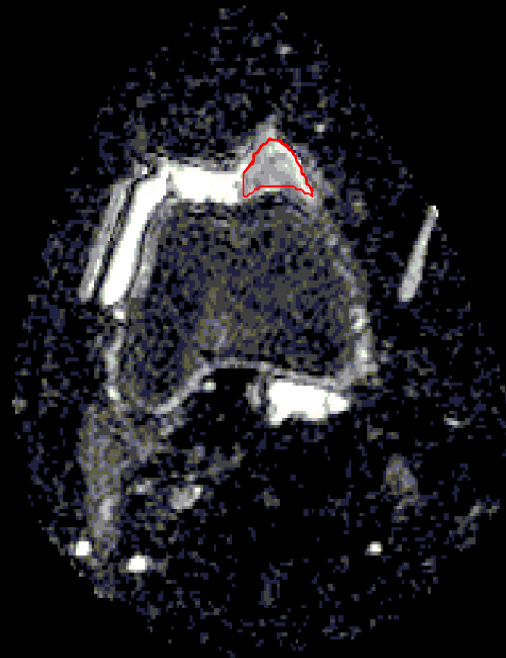
Low ADC = low/restricted diffusion

High ADC = high diffusion



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## 2. Diffusion higher in inflamed synovium



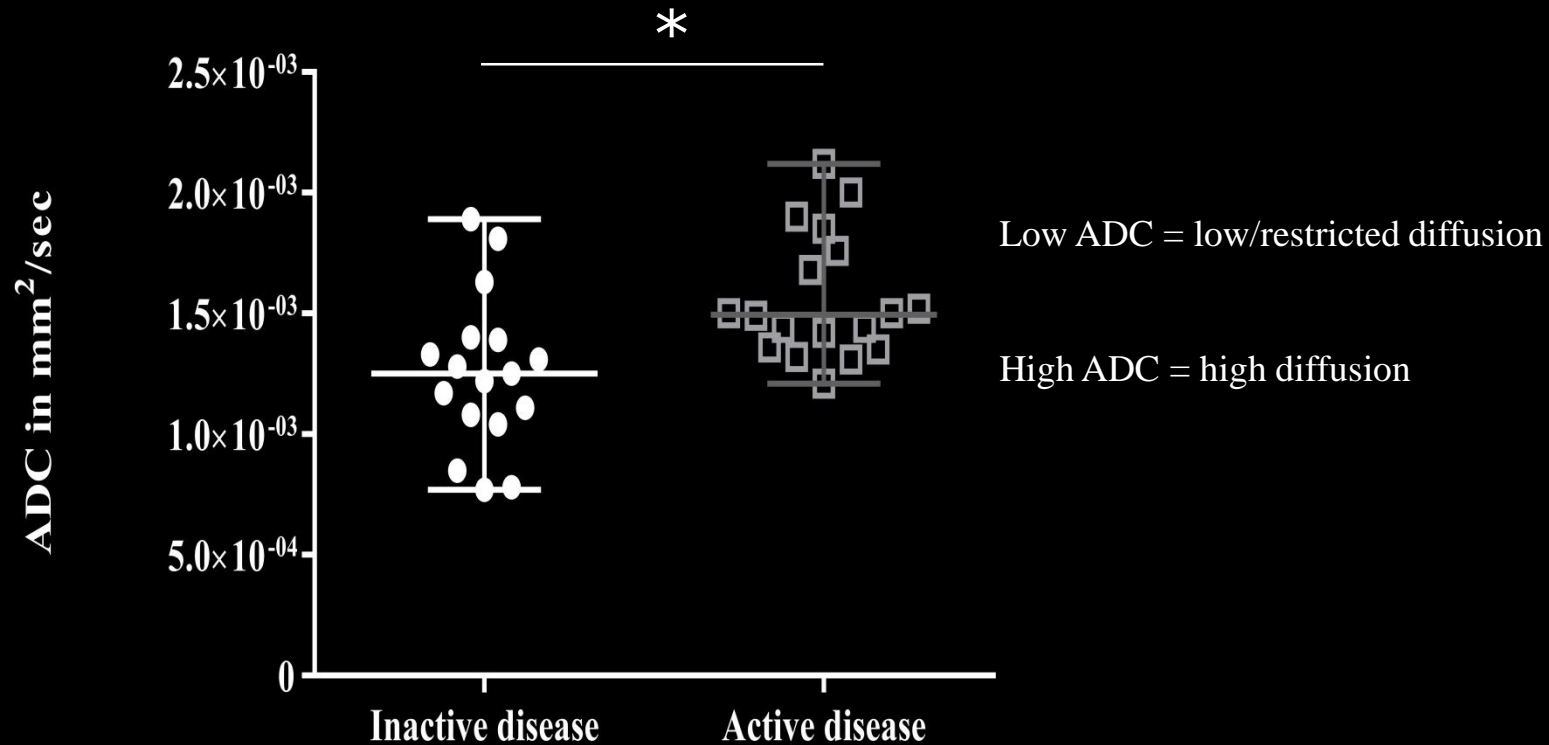
**M**  
**S**YNERGY  
**K**

Barendregt, Eur Radiol 2017

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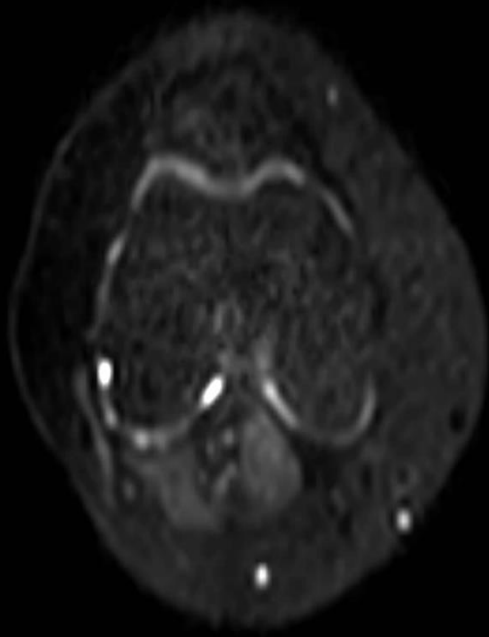


## 2. Diffusion higher in inflamed synovium



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**S** SYNERGY  
**K**

# Now: 3 Tesla DWI



Inactive disease

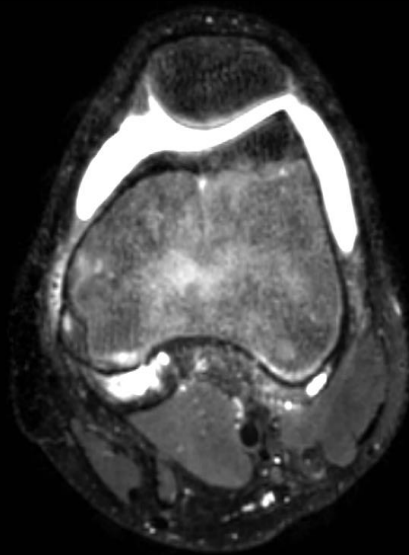


Active disease

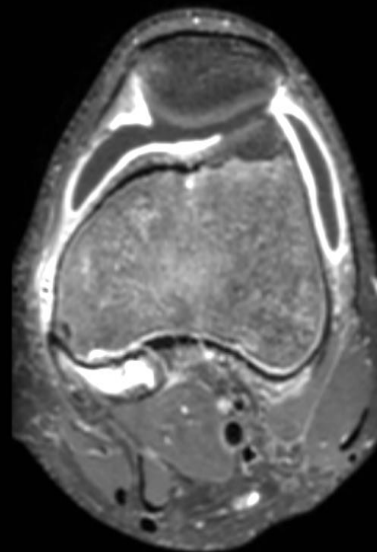


# 3 T. MRI, active JIA

T2W



T1W GBCA +



DWI



Case: 15-y ♂  
2 yrs prog. pain in right hip and knees  
ANA - ESR 22  
Oligo-art. JIA

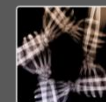


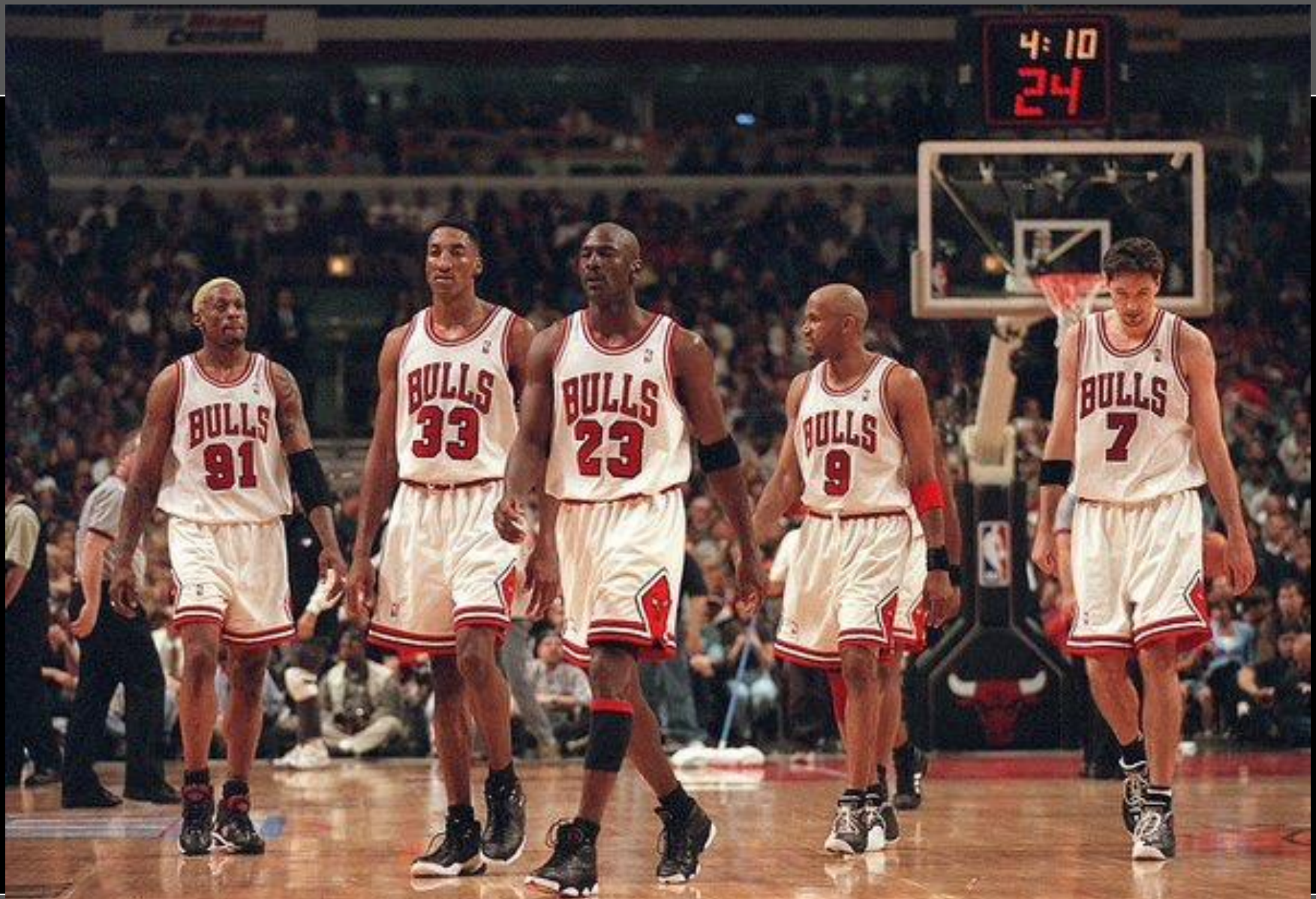
**M**  
SYNERGY  
**K**

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# To conclude

- On going quest
- Collaboration key
- Young talents are crucial





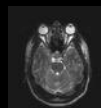
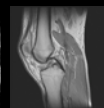
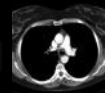
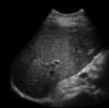




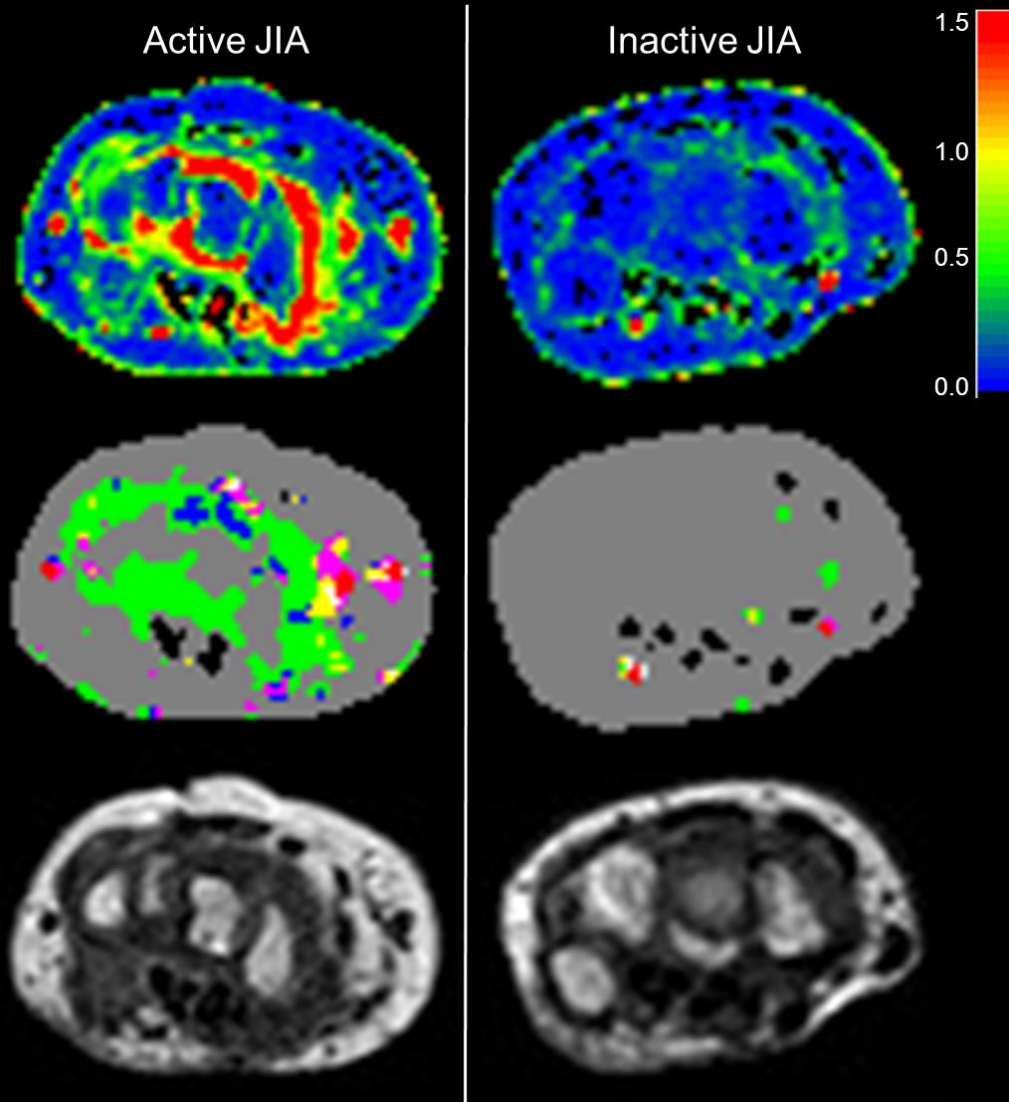


# Objective

To compare descriptive DCE-MRI features and the relative number of TIC shapes in clinically active and inactive JIA patients



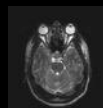
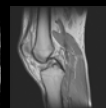
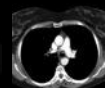
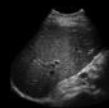
# DCE-MRI in wrist



# Conclusion

The DCE-MRI pixel-by-pixel TIC-shape method is able to differentiate groups of clinically active and inactive JIA patients by:

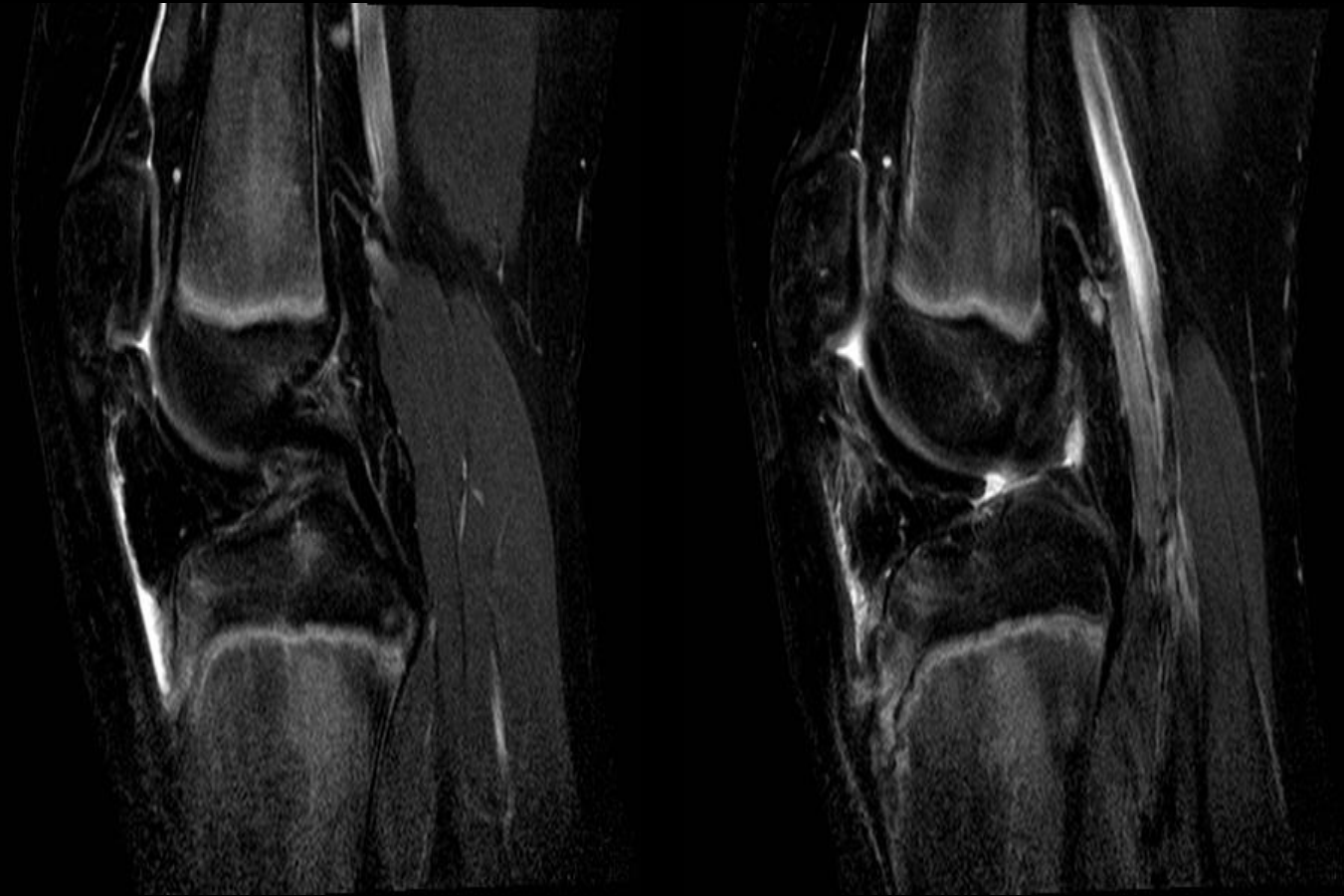
- TIC shape 4 and 5
- Maximal enhancement, slope, iAUC, enhancing volume



# Case 1 )

- 14-year old boy with history of right tibial # (after trauma)
- Bilateral knee pain < 1,5 y, unable to play football
- Swelling: +, morning stiffness: mild, night pain: +
- No infection, no thick bite, no IBD-features, no weight loss.
- Great-grandmother: RA
- PE: tibial tubercle painful on examination, warm and swollen.

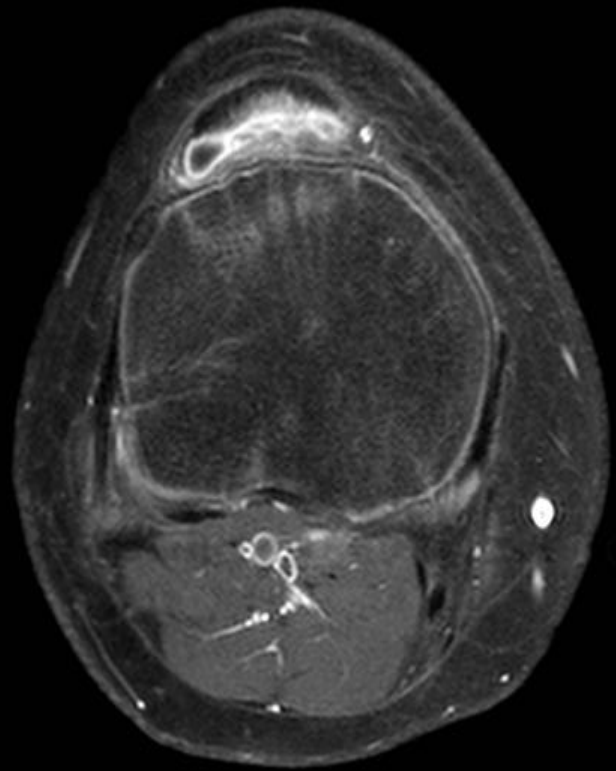
# Case 1 – sagittal T2 SPIR



..... Case 1 – sagittal T1 without and with iv contrast



... Case 1 – axial T2 and axial T1 fatsat with contrast



# diagnosis

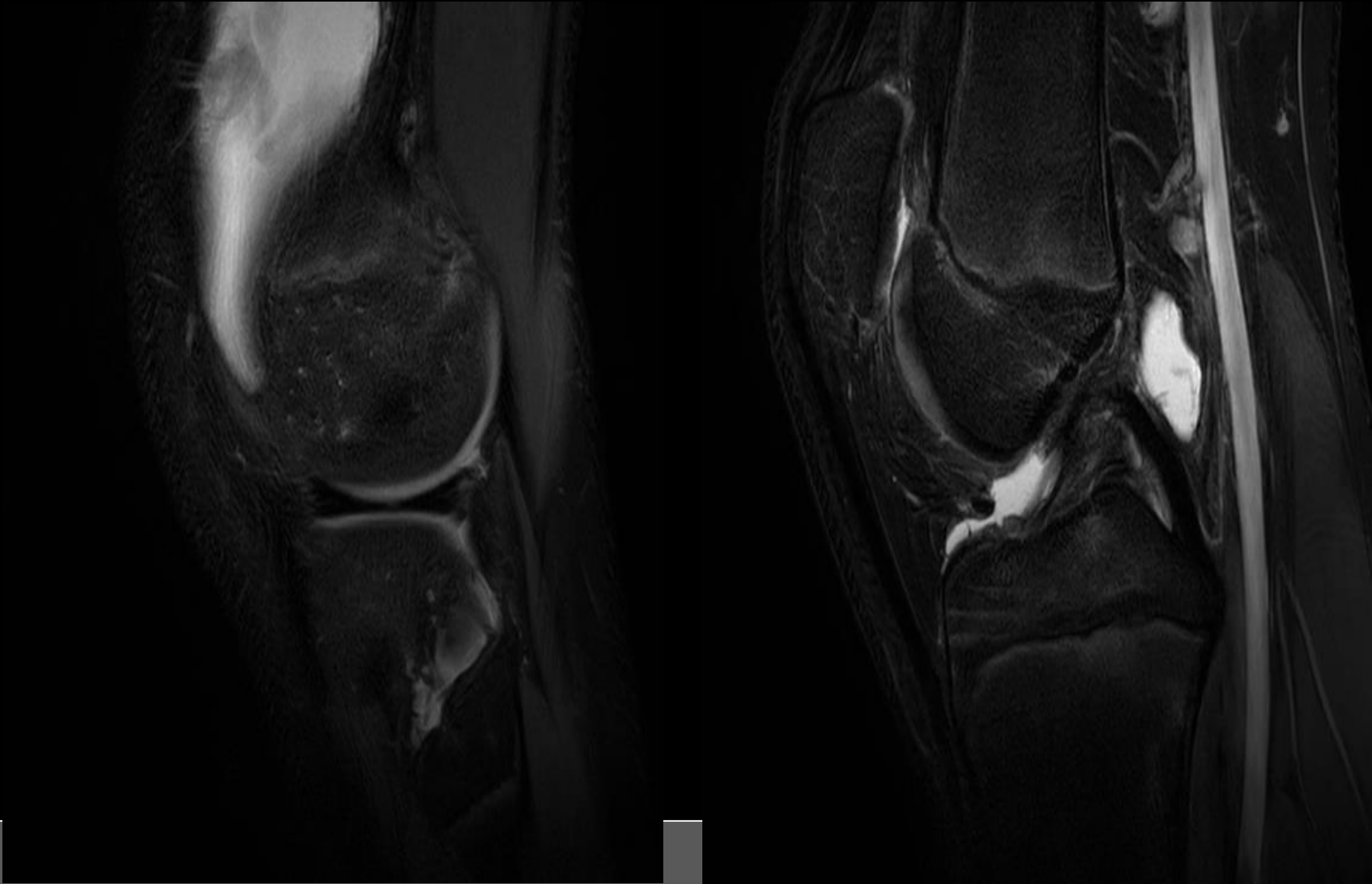
- Osgood schlatter disease: no inflammation



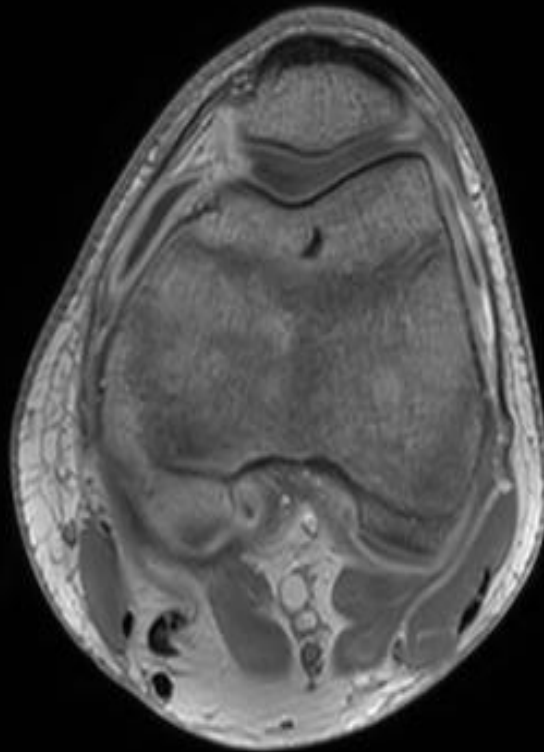
# Case 2 –

- 16-year old boy, length: 1,96 m
- 3x acute knee swelling left after minor trauma. Crepitations +
- No other joint complaints
- PE: left knee swollen, LOM in flexion. Hypermobility.
- DDx: hypermobility, Marfan's syndrome, coagulation disorder, JIA?

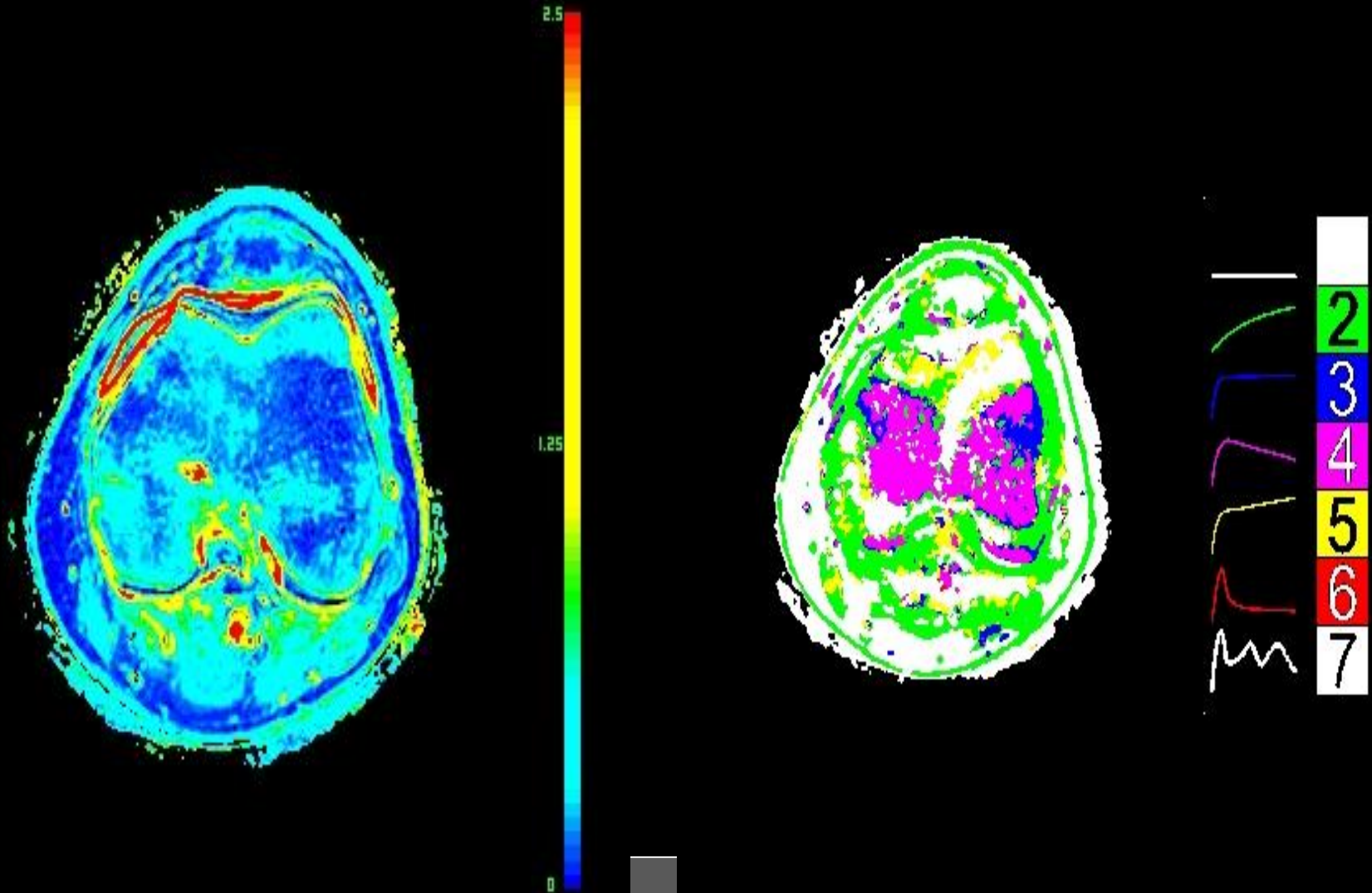
# Case 2 – sagittal DIXON water



# Case 2 – axial DIXON in phase +



# Case 2 – quantitative MRI - DCE

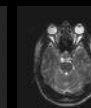
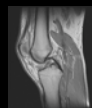
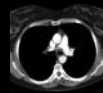
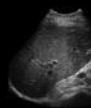
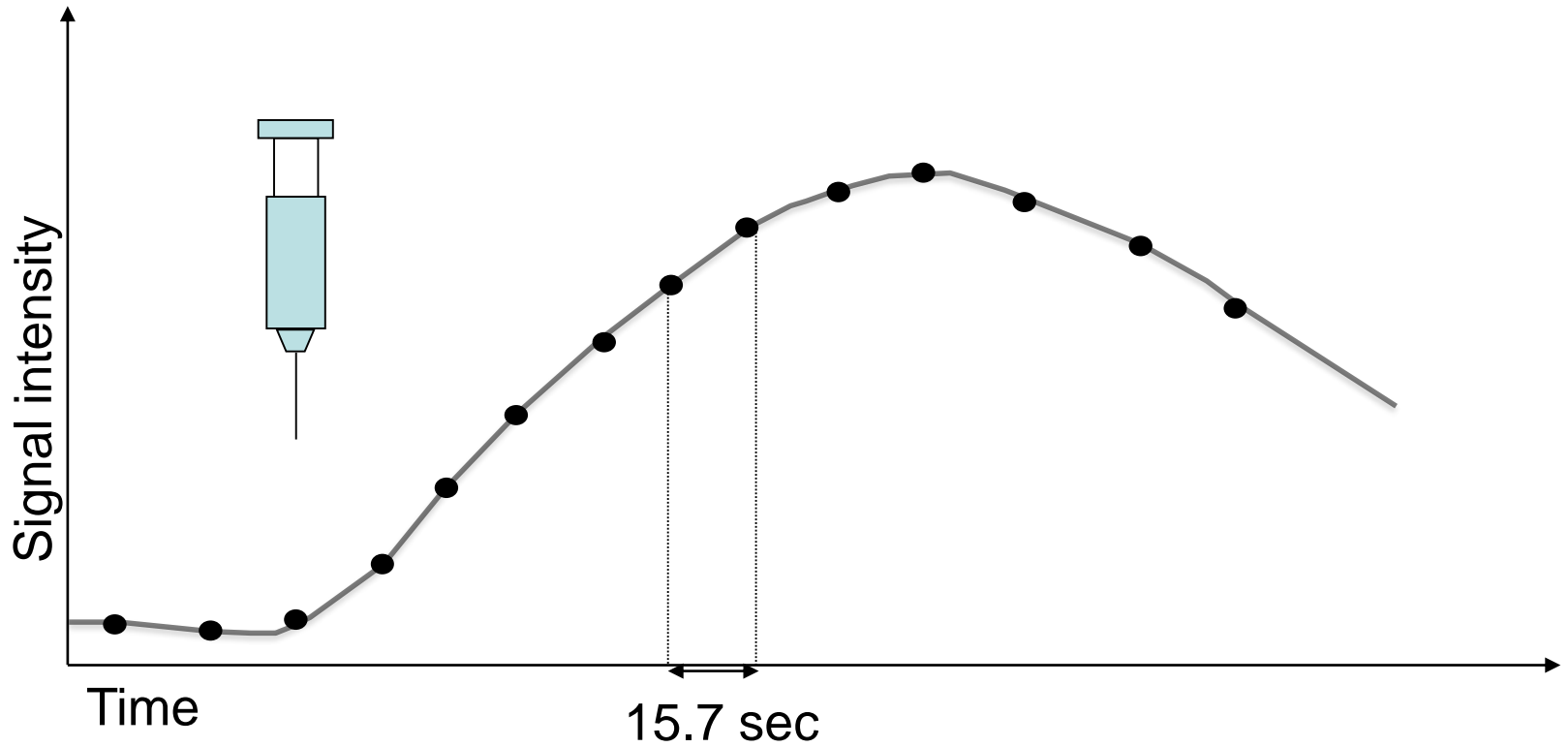


# DCE-MRI

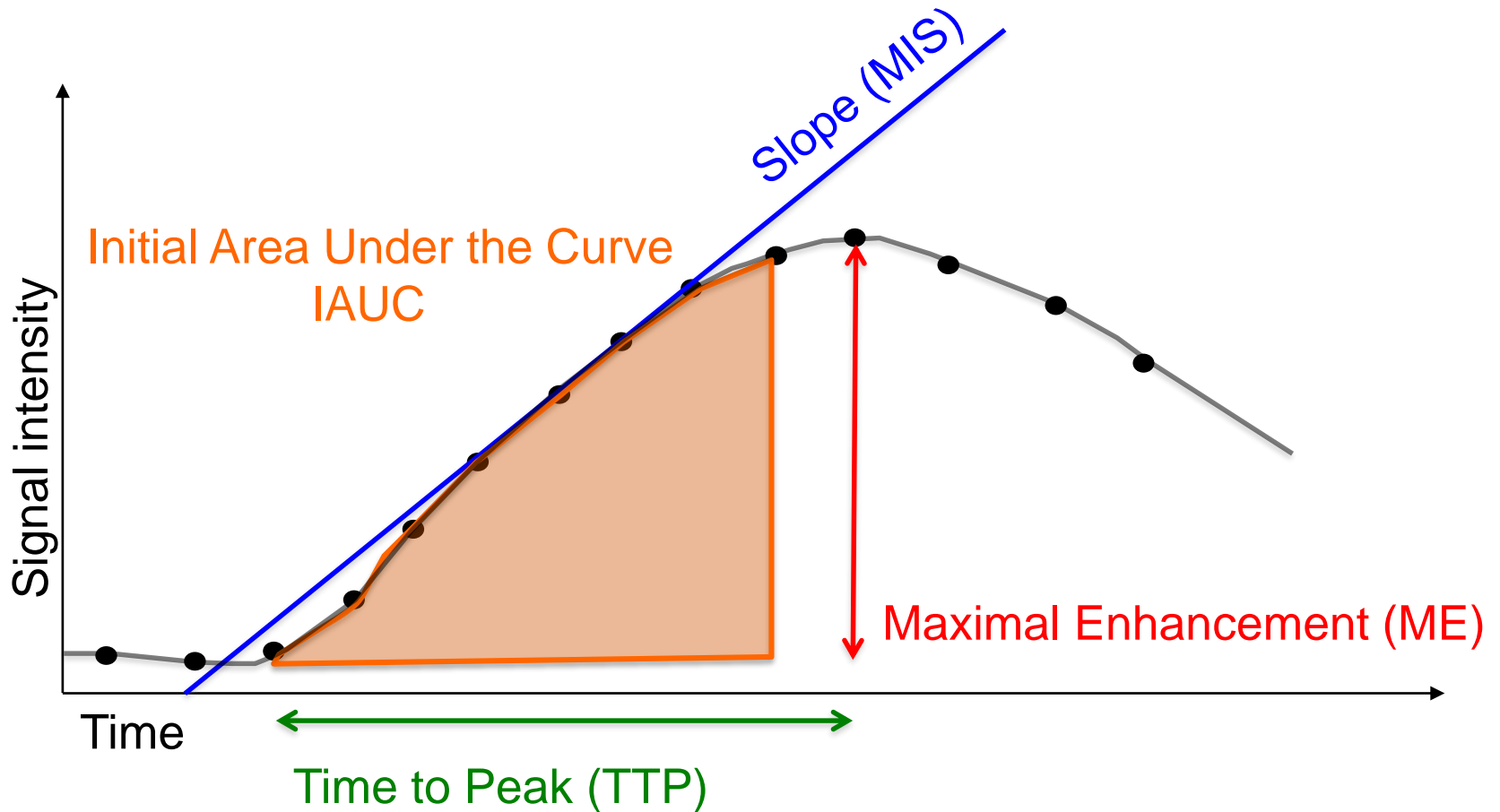
DCE-MRI is the time-dependent registration of changes in MR signal intensity during and after intravenous injection of a contrast agent



# Time Intensity Curve (TIC)

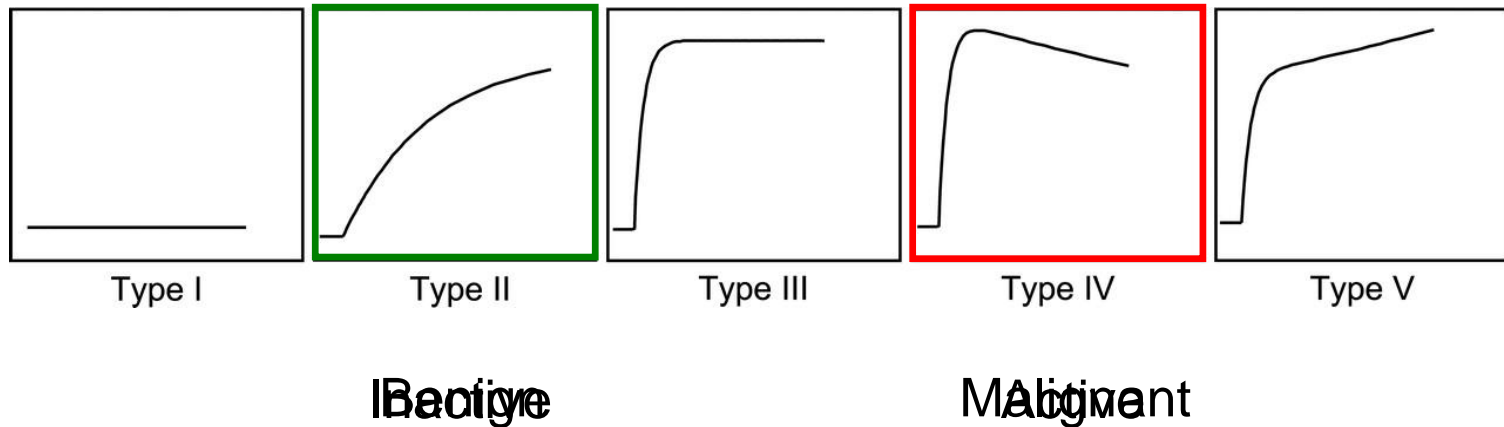


# Time Intensity Curve (TIC)



# Time Intensity Curves

Significant higher relative number of type 4 and RA patients as compared to healthy volunteers



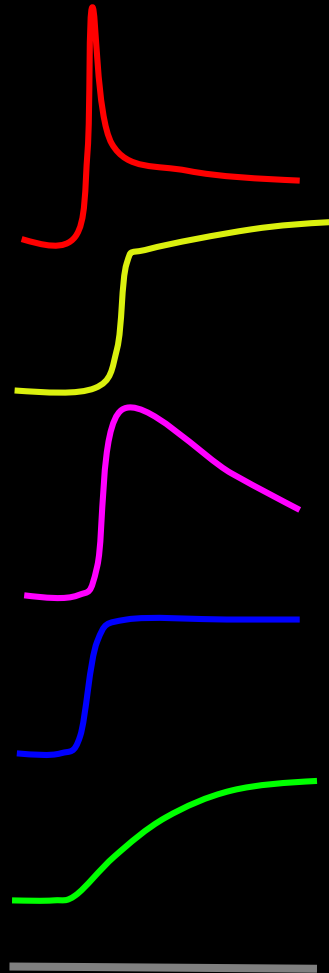
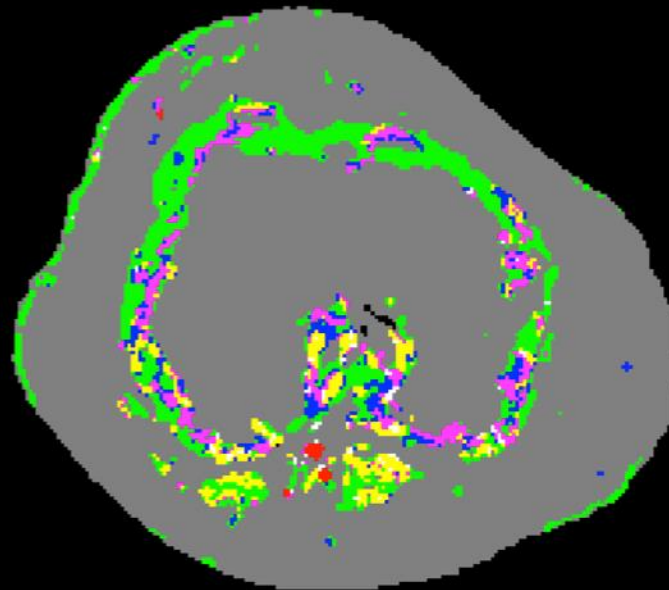
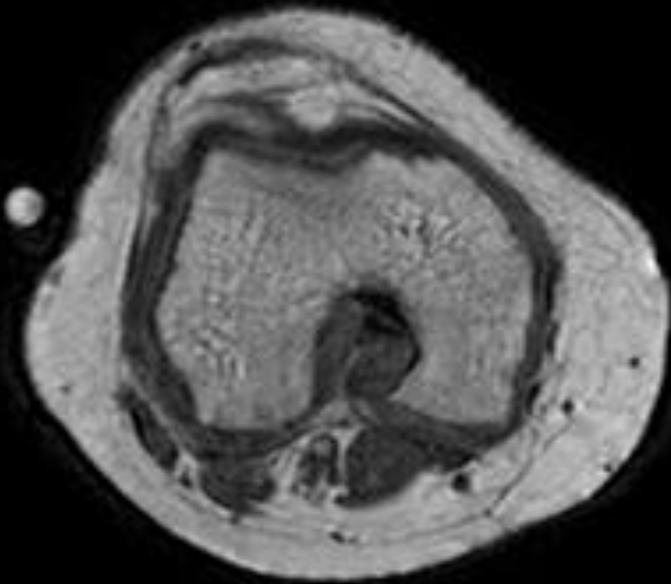
Van Rijswijk *et al.* Radiology 2004  
Van der Leij *et al.* Radiology 2009



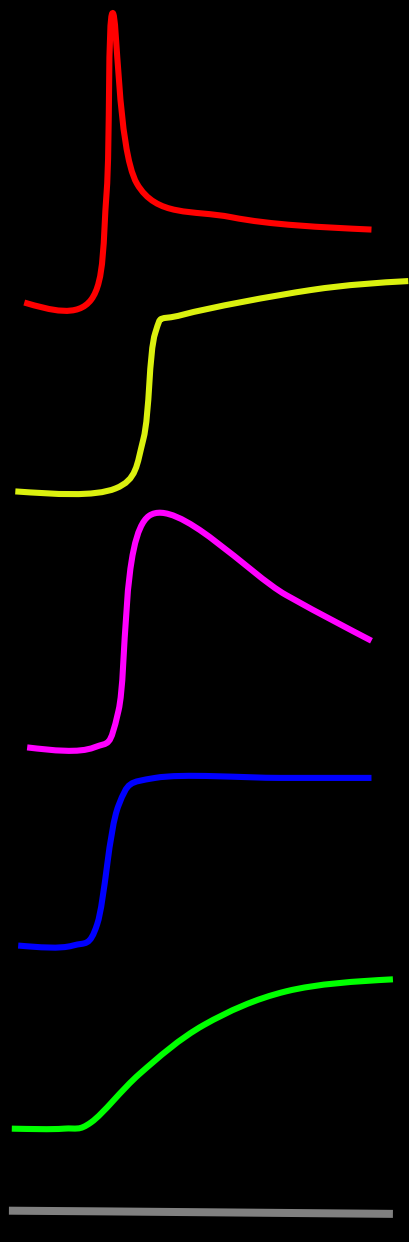
# Color-code TIC shape map

DCE T1-weighted images

TIC shape color-code map



# Time Intensity Curves



**Type 6**  
(artery)

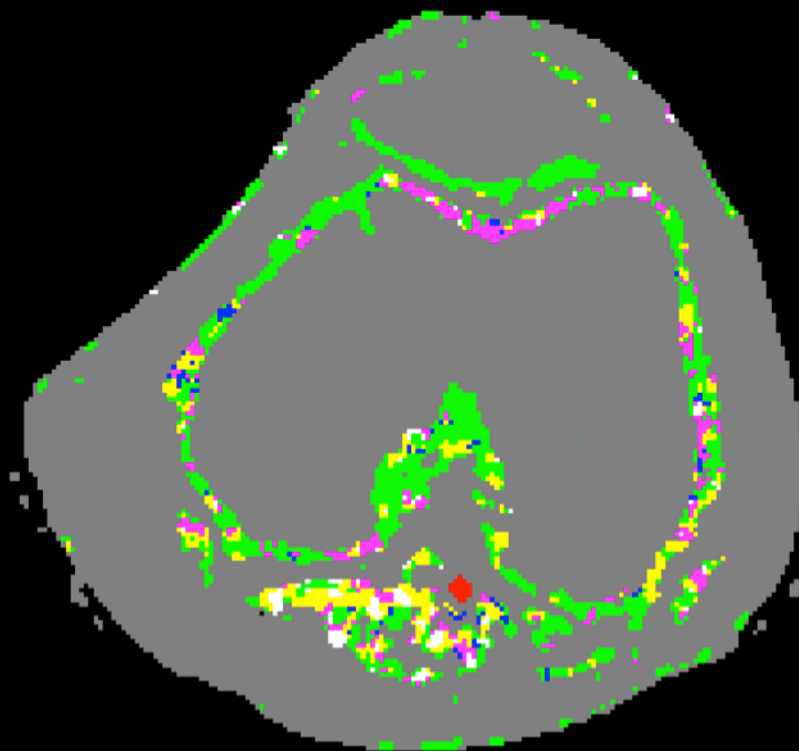
**Type 5**

**Type 4**

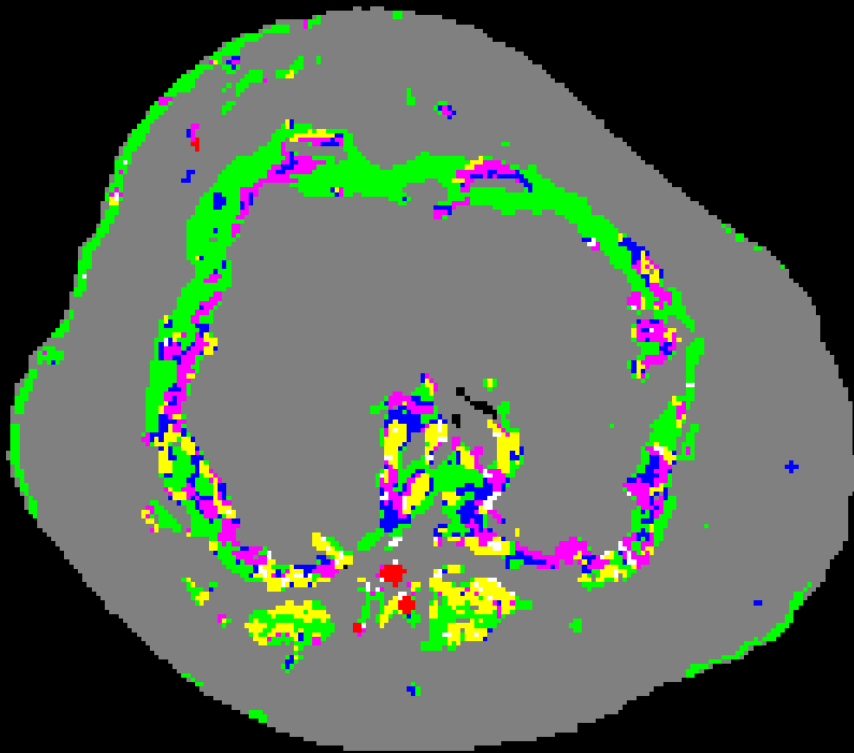
**Type 3**

**Type 2**

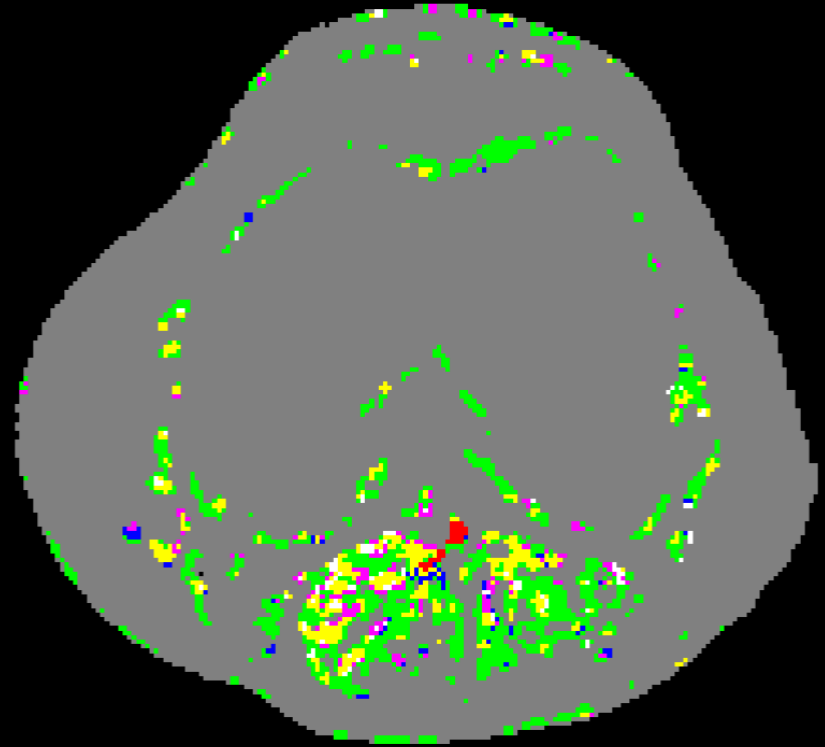
**Type 1**



# Example

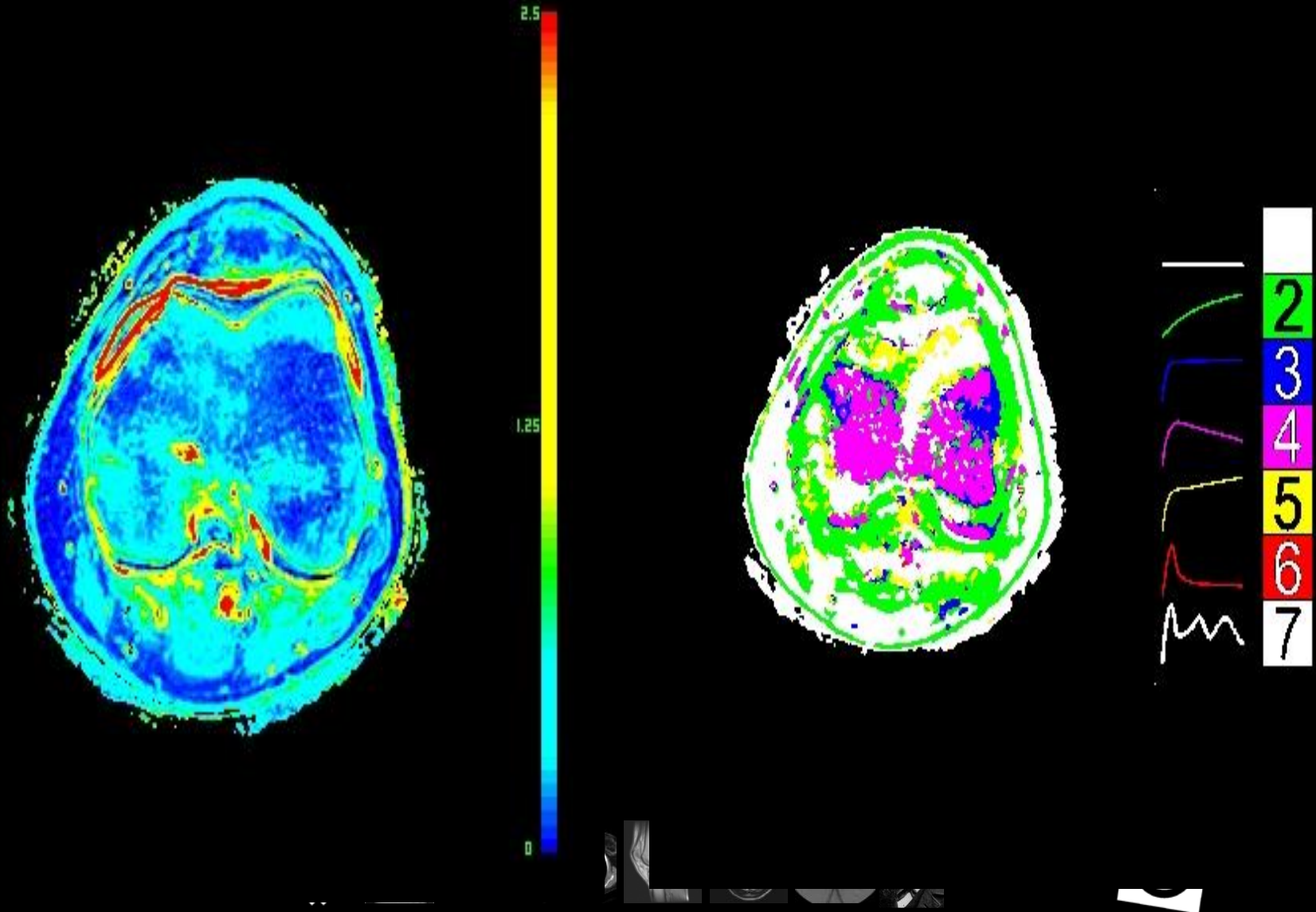


Active disease



Inactive disease

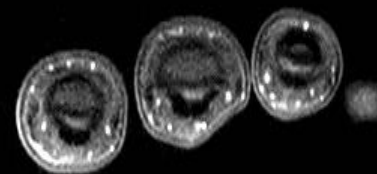
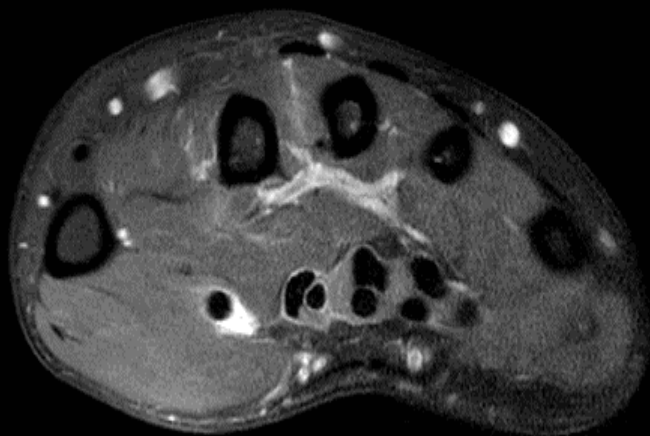
# Case 2 – quantitative MRI - DCE



# Case 3 )

- 18-year old girl, poly-articular RF&ACPA+ JIA diagnosed at age 15
- March 2017: flare in multiple joints, start MTX and anti-TNF
- January 2018: poly-articular flare (bilateral wrist, MTPs)
  - MRI wrist: inflammation status as compared to earlier MRI? Damage?

# Case 3 – axial T1 fatsat after contrast (2017 - 2018)



# Case 3 – coronal DIXON (2018)

