Imaging in juvenile idiopathic arthritis: a clinician's perspective

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Why imaging is important in JIA?

- In the last decade, there has been important progress in the management of JIA
- A reliable documentation of the recent advances requires sensitive methods that enable a precise monitoring of the course of the synovial inflammation process.
- It also makes desirable to be able to identify precociously patients with a high likelihood of developing erosive joint damage
- Of the diagnostic tools currently available, imaging studies are best suited for these purposes

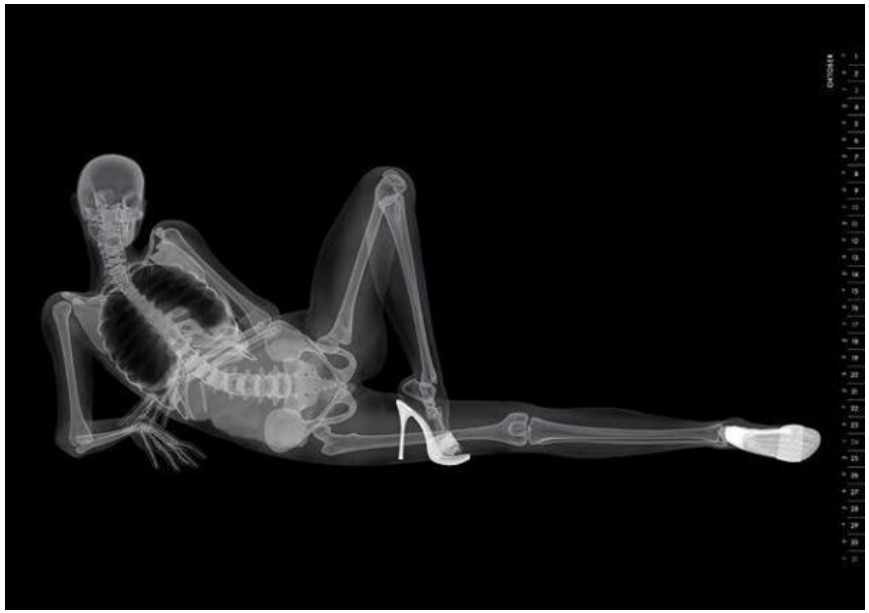
General challenges with imaging in JIA

- Unique features of the growing skeleton (e.g. age-related variations in the thickness of the articular cartilage and incomplete ossification)
- Children with chronic arthritis may develop distinctive abnormalities (e.g. disturbance of bone growth and maturation)
- Impossibility to assess reliably joint changes in pediatric patients without the availability of normal standards
- Findings from studies in adults not applicable to children

Imaging methods in JIA

- Conventional radiography
- Magnetic resonance imaging (MRI)
- Musculoskeletal ultrasonography (US)

Conventional radiography



Advantages and limitations of conventional X-ray

Advantages

- Demonstration of bone damage
- Visualization of disturbances of bone growth and maturation
- Suitable for longitudinal evaluation of damage progression
- Validated scoring methods
- Widespread availability
- Low cost

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Limitations

- Inability to visualize soft tissue inflammation
- Inability to visualize cartilage
- Low reliability for early diagnosis of arthritis
- Late detection of erosions
- Projectional superimposition
- Exposure to ionizing radiations

Change in bone morphology and width of joint spaces with age

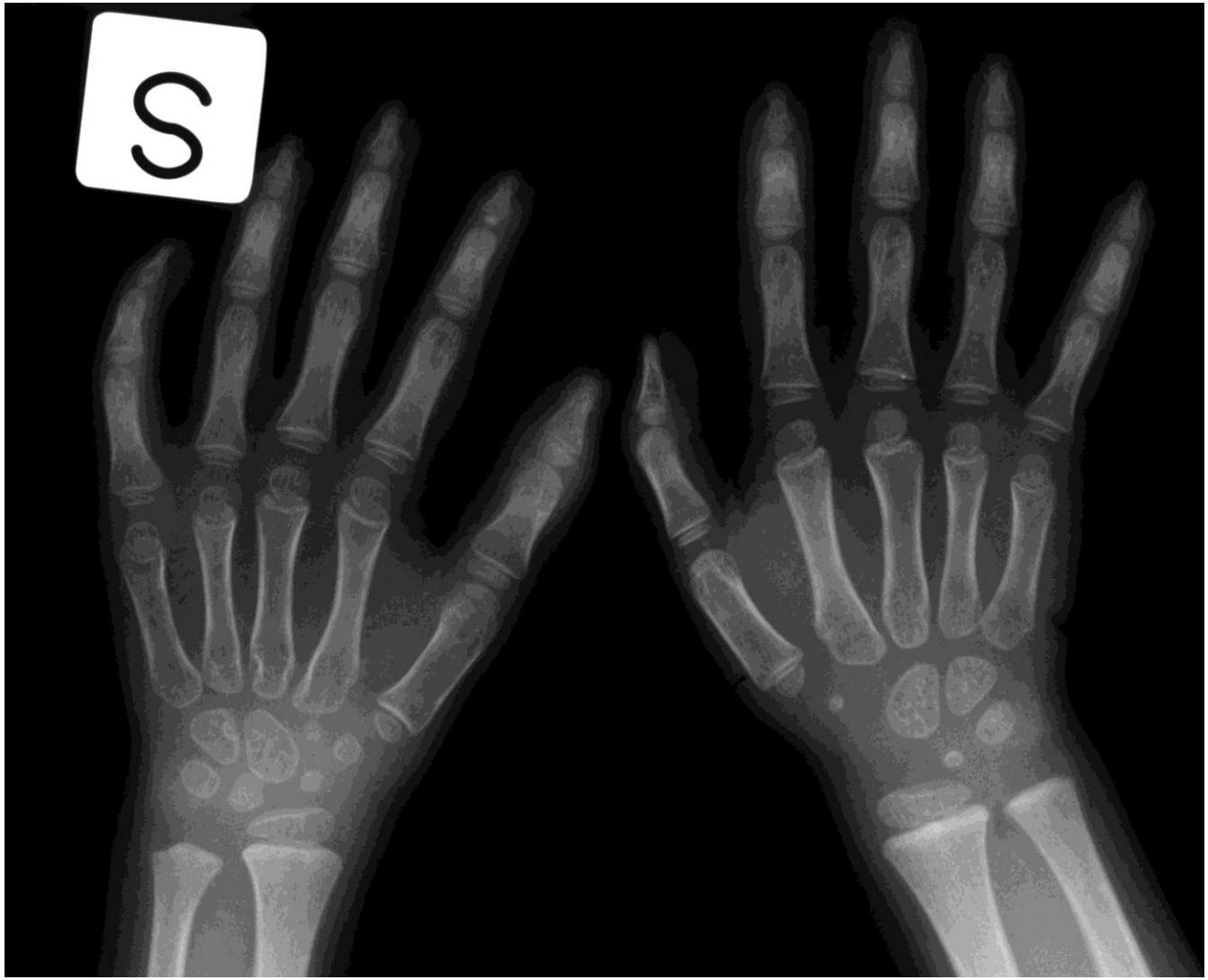
1994, 2 years

1995, 3 years

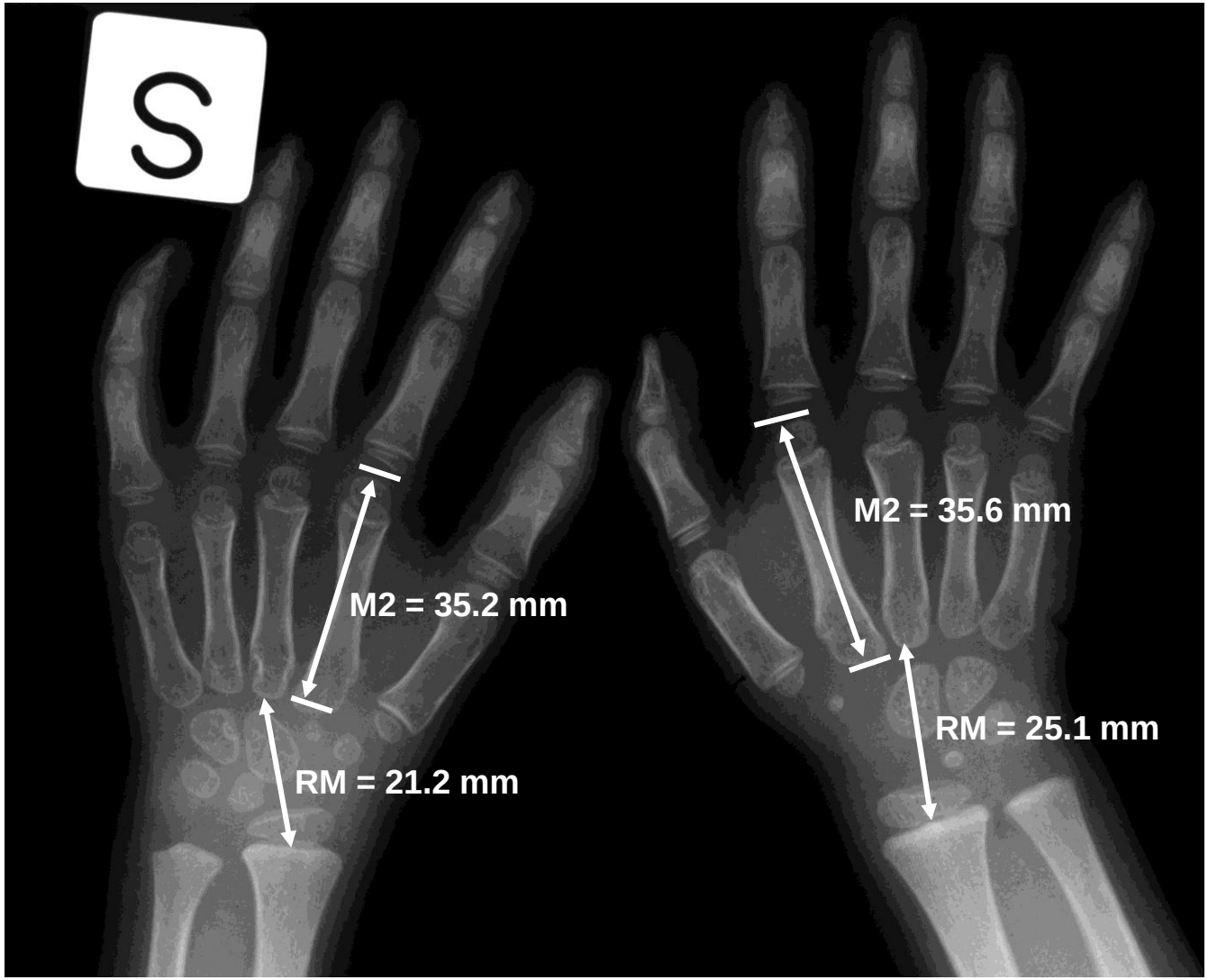
1996, 4 years

Advancement in bone age

A patient with unilateral wrist disease…

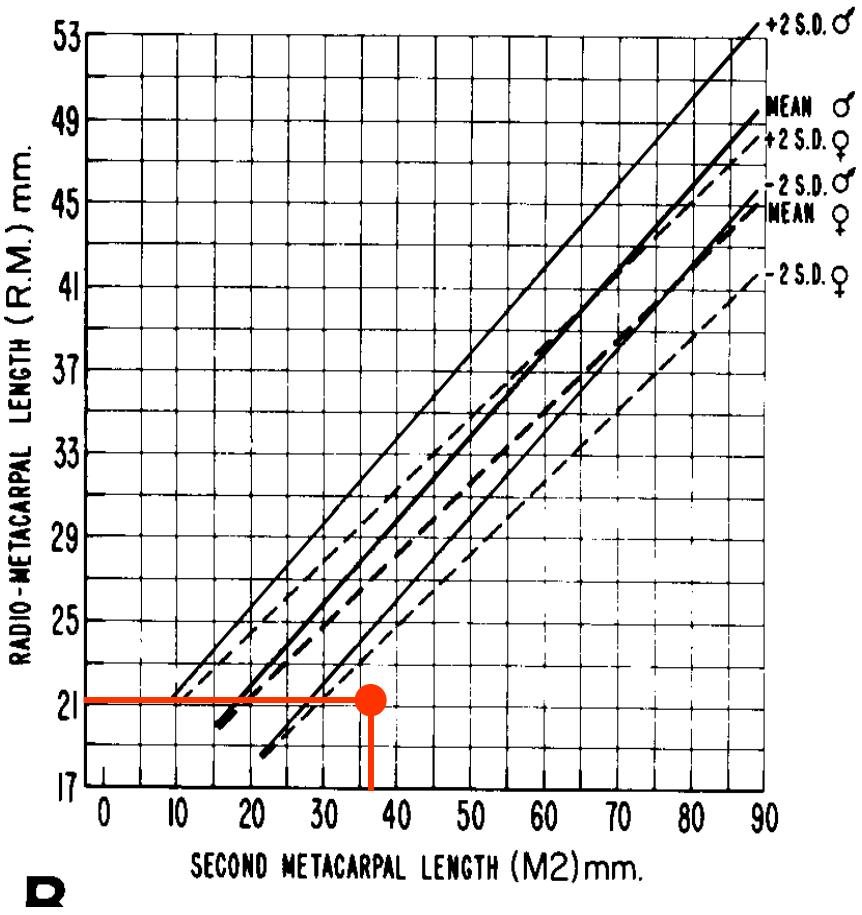


Measurement of Poznanski score

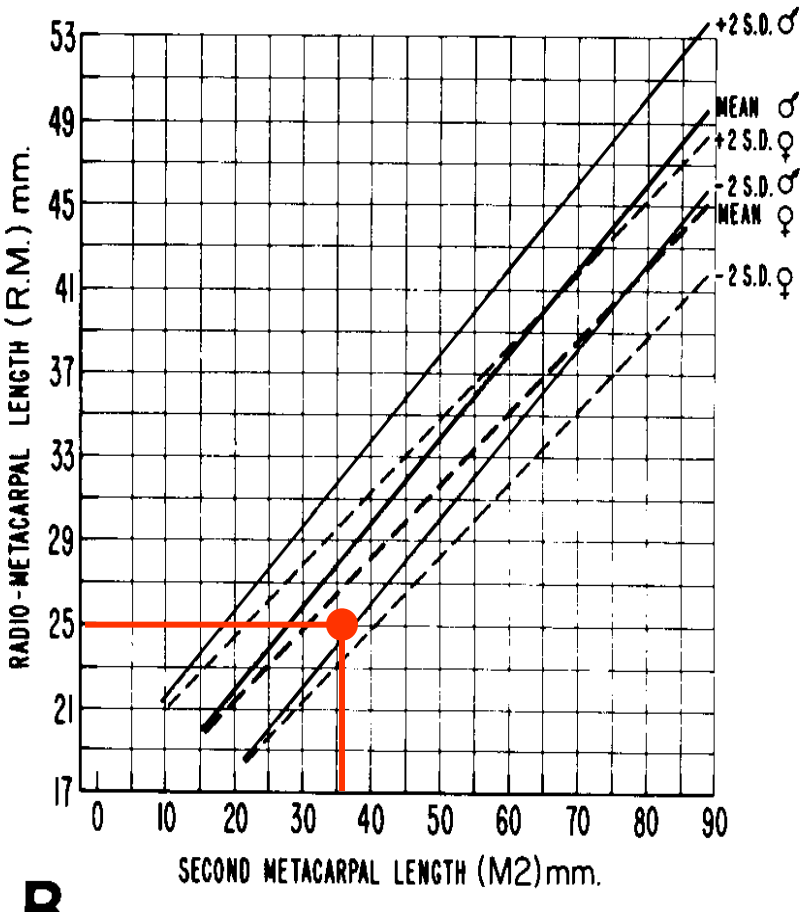


Normative chart for Poznanski score

Left wrist



Right wrist



Calculation of Poznanski score

LEFT WRIST:

Expected RM = 14.1 + (0.348 x M2) = 14.1 + (0.348 x 35.2 mm) = 26.3 mm SD=1.65 mm

Poznanski score = (Observed RM – Expected RM)/SD

= (21.2– 26.3)/1.65 = -5.1/1.65 = **-3.09 units**

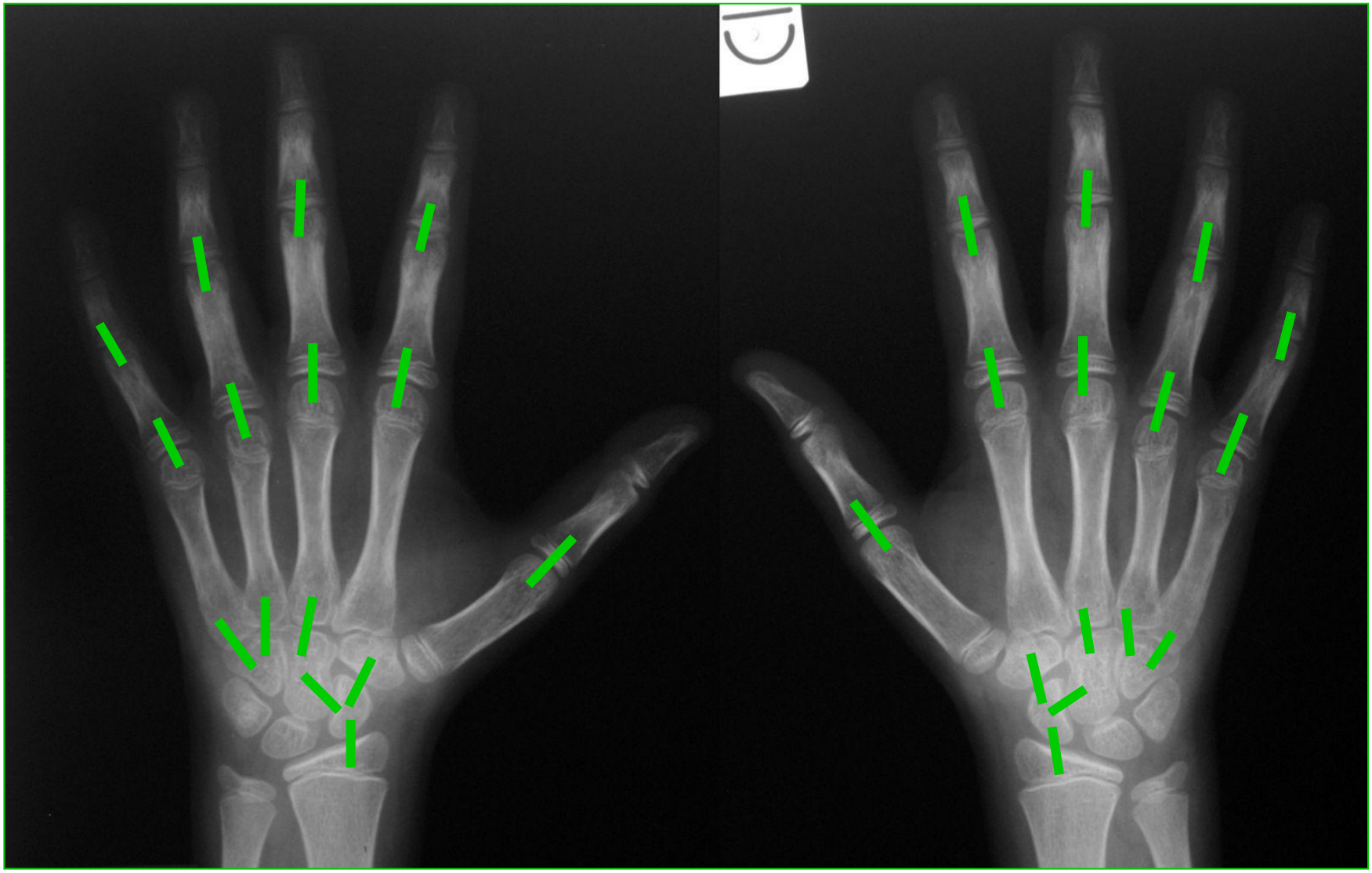
RIGHT WRIST:

Expected RM = 14.1 + (0.348 x M2) = 14.1 + (0.348 x 35.6 mm) = 26.5 mm SD=1.65 mm

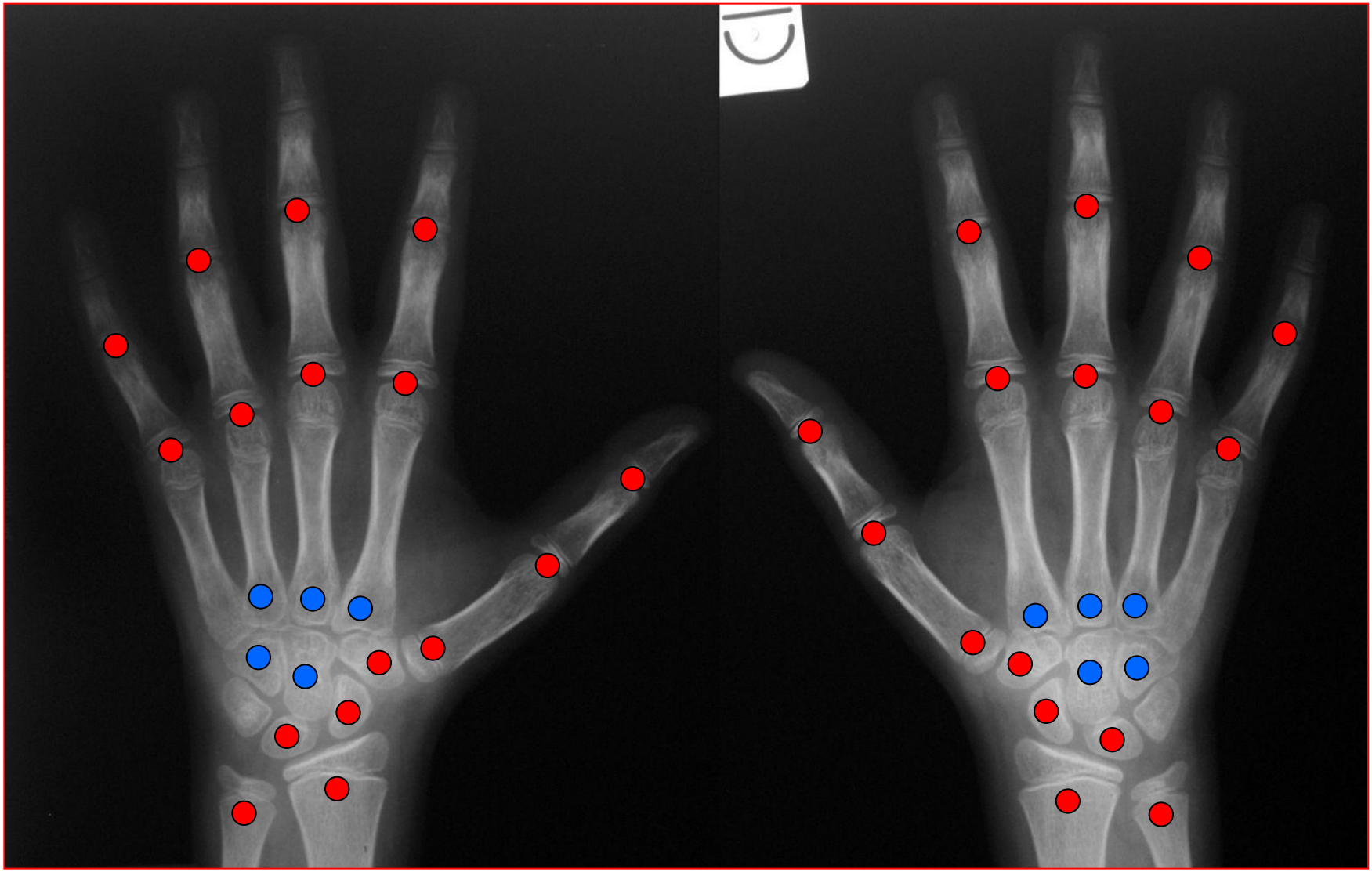
Poznanski score = (Observed RM – Expected RM)/SD

= (25.1– 26.5)/1.65 = -1.4/1.65 = **-0.84 units**

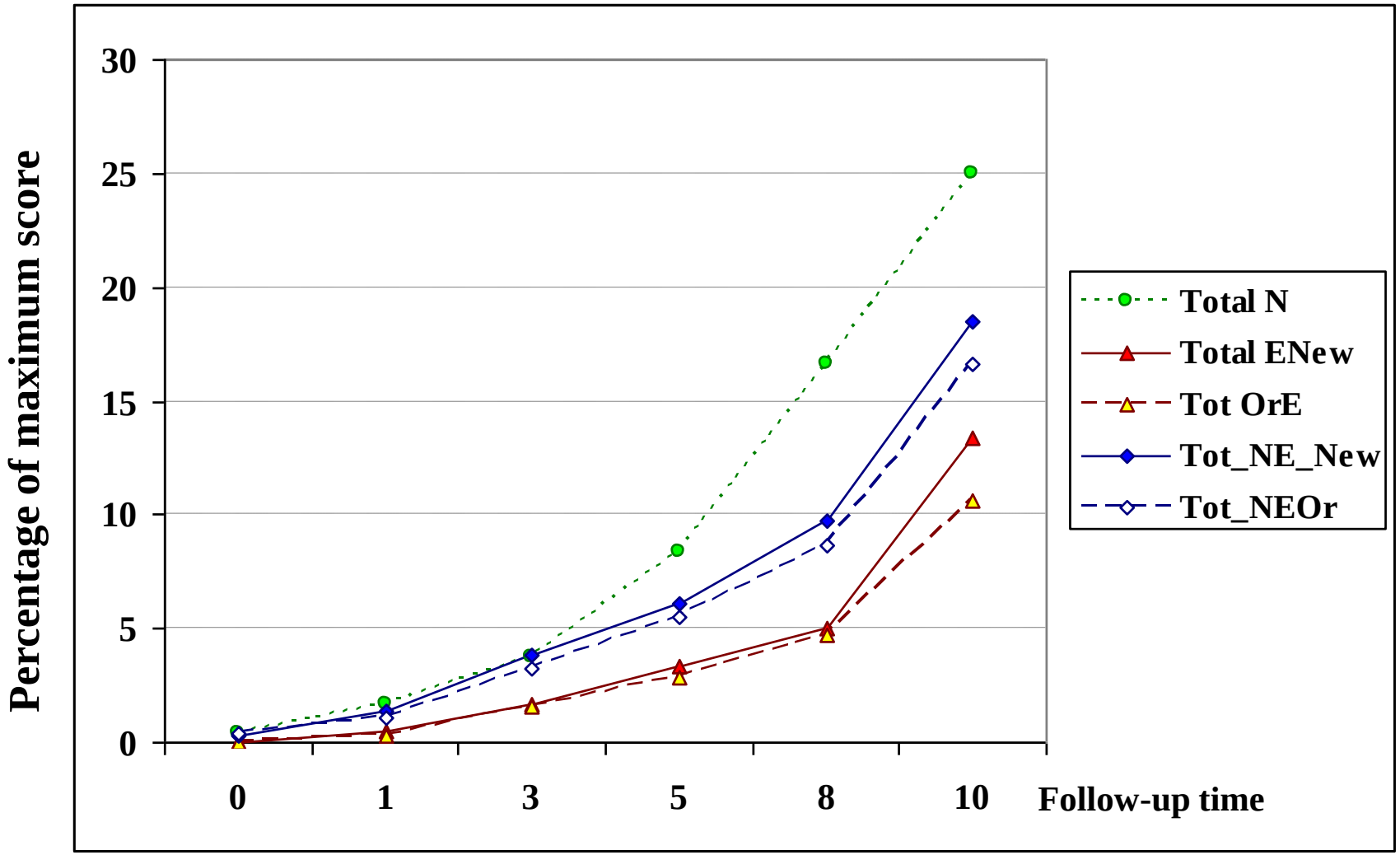
Adapted SH – JSN score



Adapted SH – Erosion score



Time course of radiographic joint damage in JIA



Ravelli A et al. A&R 2007;56:3087-95

Magnetic resonance imaging (MRI)

Advantages and limitations of MRI

Advantages

- Demonstration of soft tissue inflammation
- Early detection of bone erosions
- Direct visualization of cartilage
- Visualization of bone marrow edema
- Suitable for assessment of axial skeleton and TMJ
- Lack of exposure to ionizing radiations

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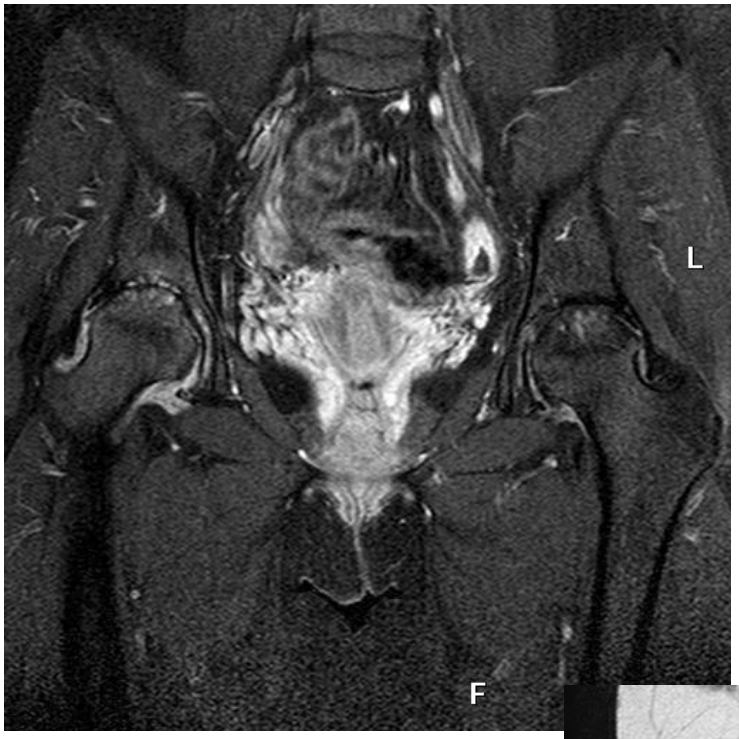
Limitations

- High cost
- Long examination time
- General anesthesia required in younger children
- Possible allergic contrast reactions
- Evaluation limited to one target joint
- Variable availability worldwide

Hip MRI

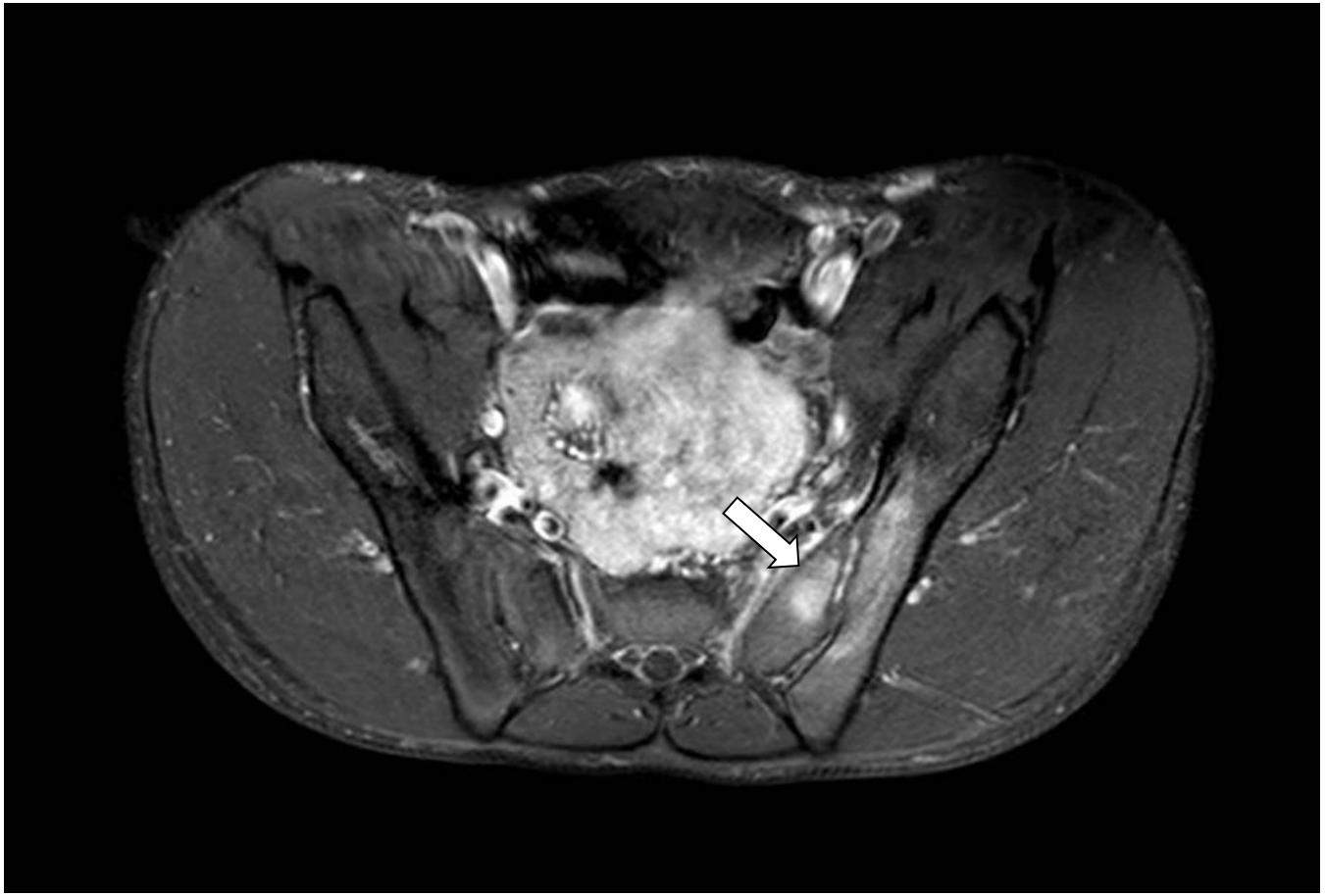


Active synovitis

Bone marrow edema

Erosion

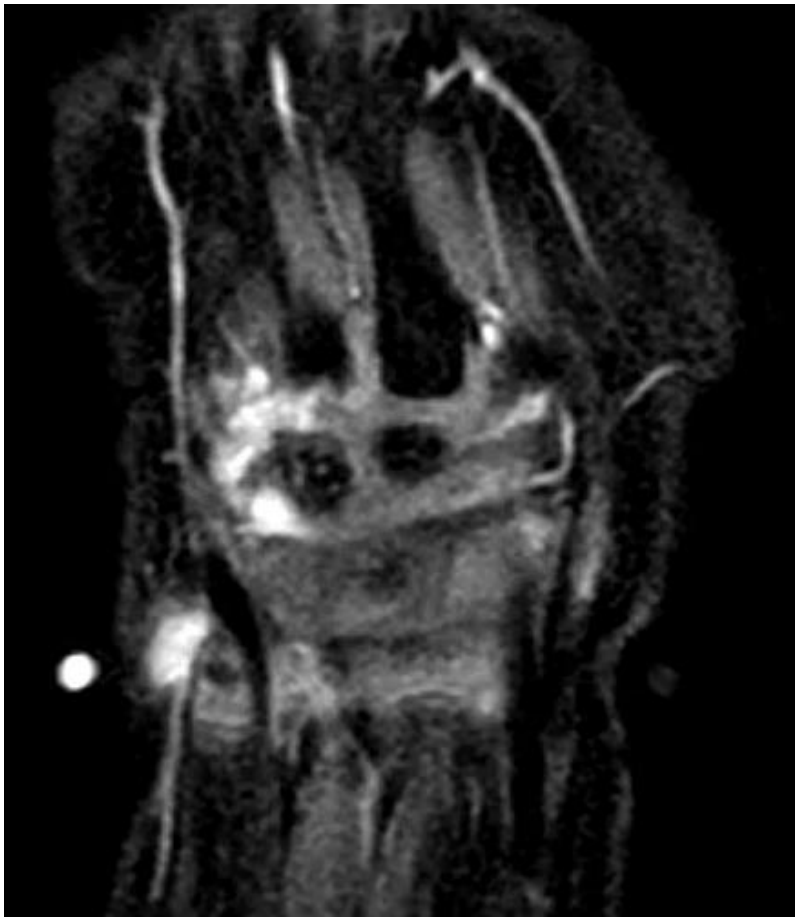
Sacro-iliac joint MRI



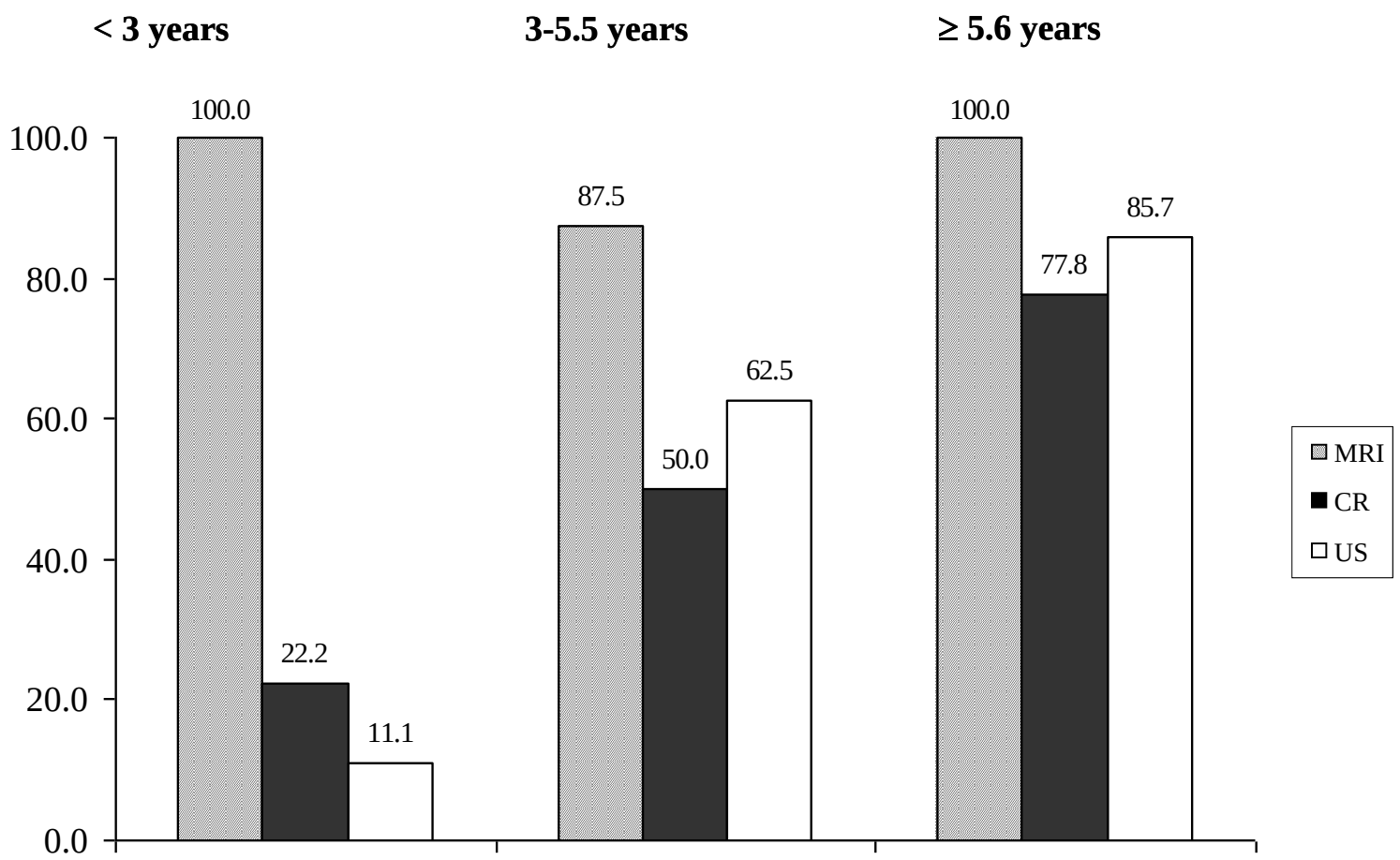
Course of MRI-detected synovitis during etanercept therapy

Baseline

After 1 year

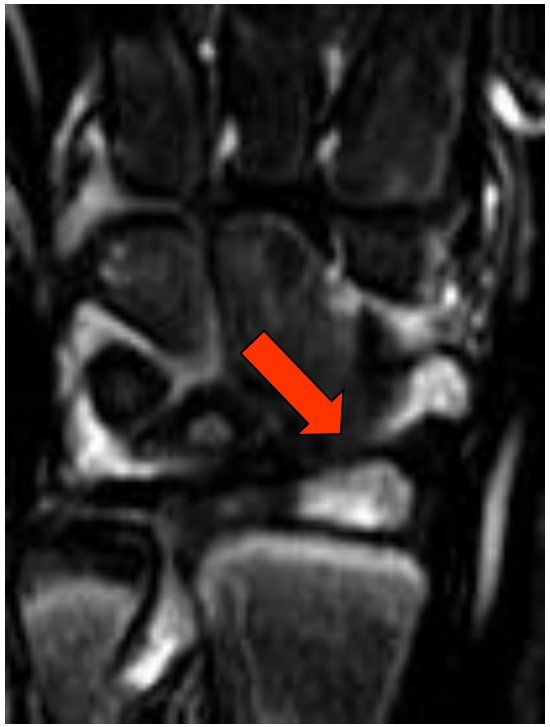


Frequency of bone erosions by disease duration



Malattia C et al. A&R 2008;59:1764-72

Baseline (T2w)

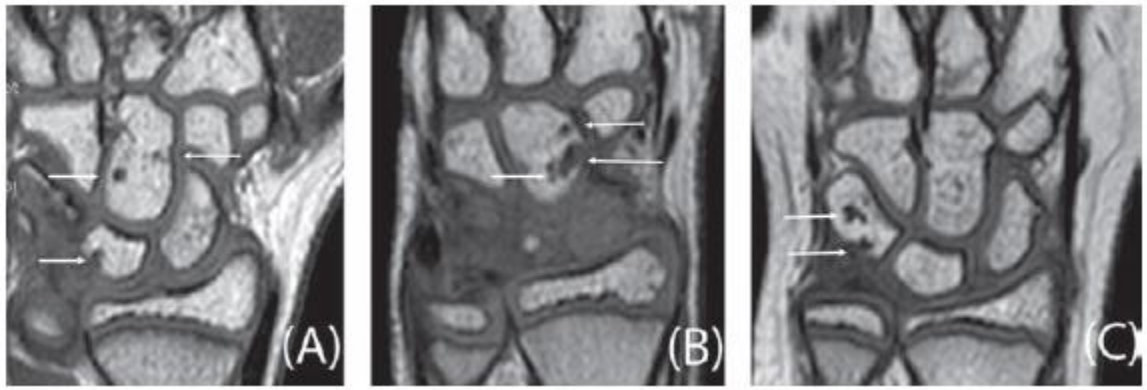


Baseline (T1w)

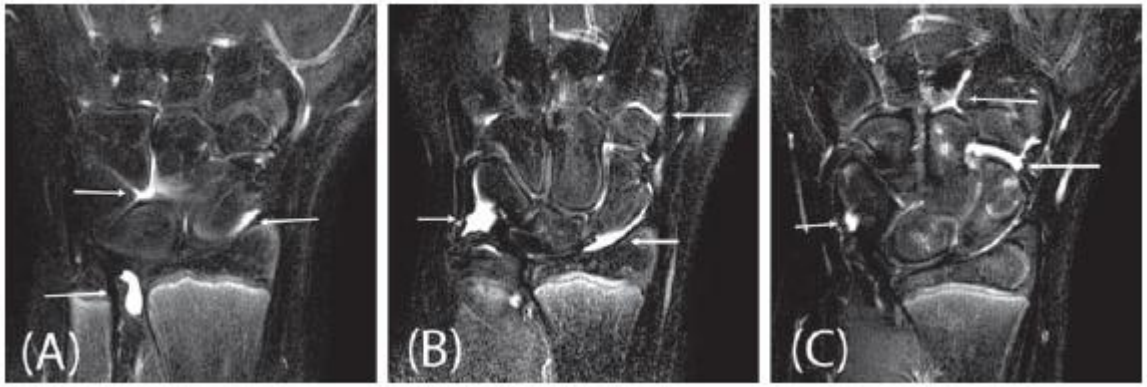
After 1 year

Bone edema → progression to an erosion into the distal epyphysis of the radius

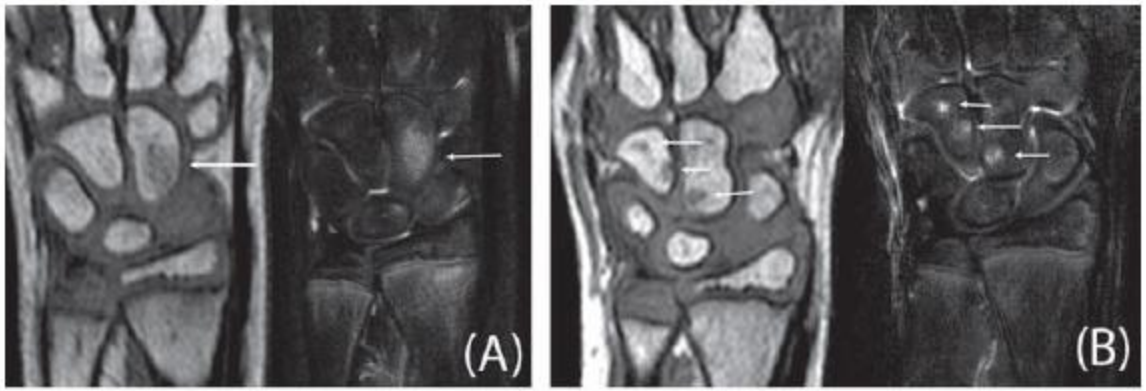
Wrist MRI in healthy children



Bony depressions



Intra-articular fluid



Bone marrow edema

Müller LS et al. Ann Rheum Dis 2011;70-605-10

Ultrasound

Advantages and limitations of ultrasound

Advantages

- Noninvasiveness
- Ability to scan multiple joints
- Easy repeatability
- High patient acceptability
- Relatively cheap
- Demonstration of soft tissue inflammation
- Visualization of cartilage
- Potential aid for guiding intra-articular injections
- Lack of exposure to ionizing radiations

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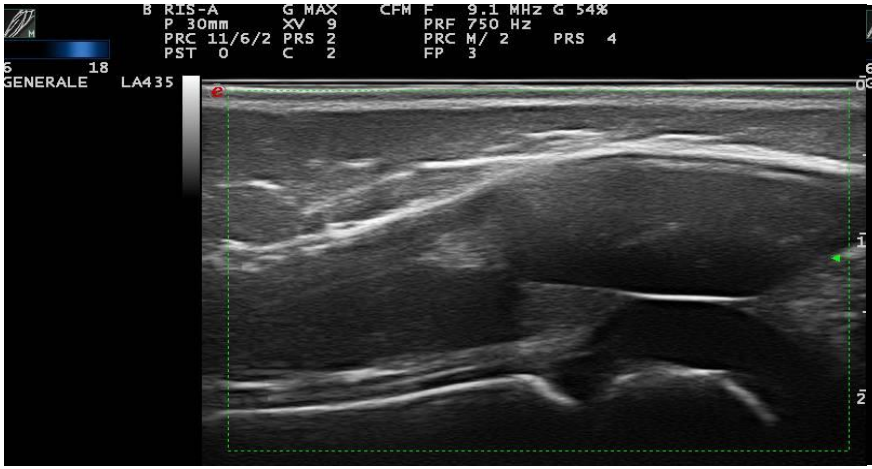
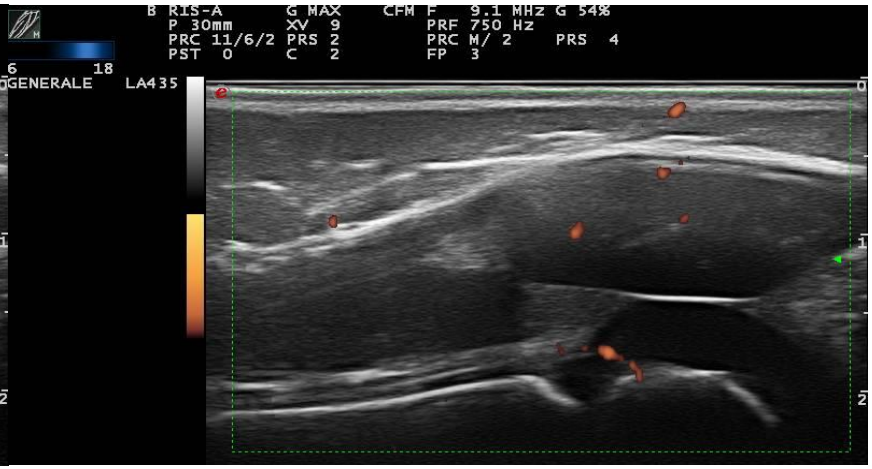
Limitations

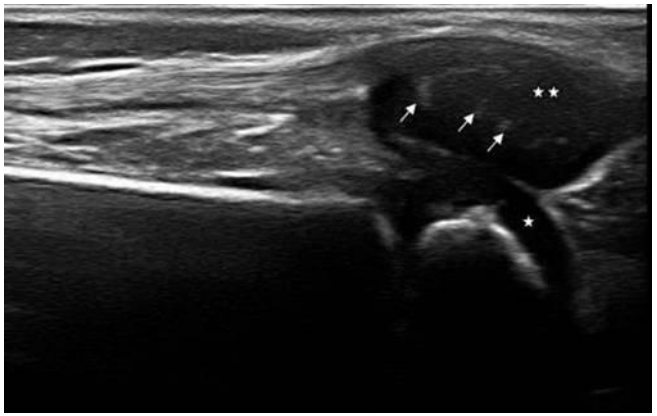
- Operator dependency
- Reliability dependent on equipment used
- Limited value in the assessment of axial skeleton and TMJ
- Inability to assess the whole joint space
- Difficult to carry out in case of joint pain
- Difficult to standardize and centralize for clinical trials

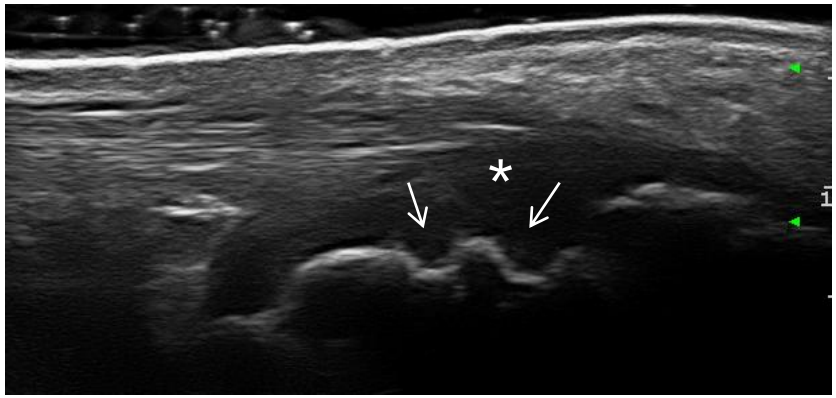
Challenges with use of US in children with JIA

- High ratio cartilage/bone in the immature skeleton
- Physiologically enhanced blood flow
- Changes in US anatomy during growth
- Irregular appearance of some ossification centers

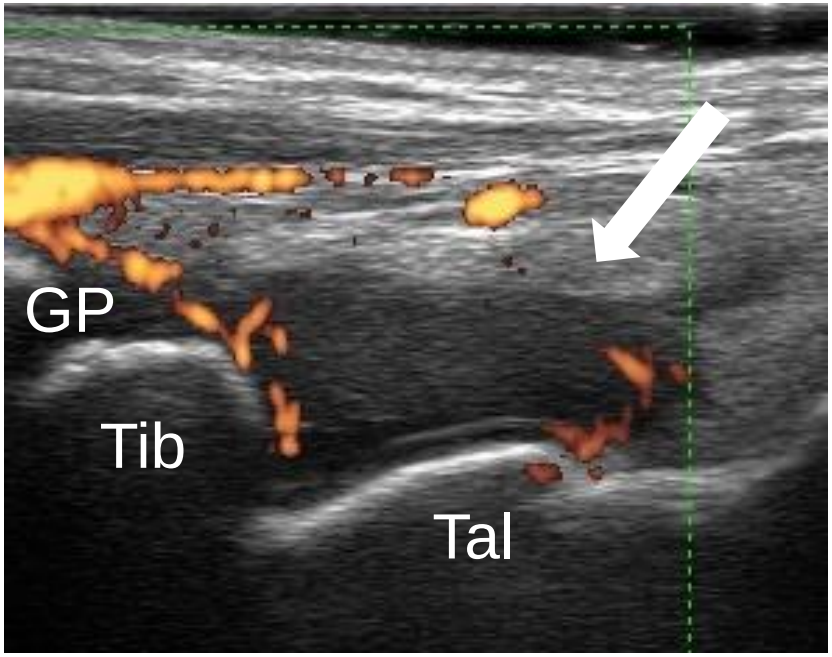


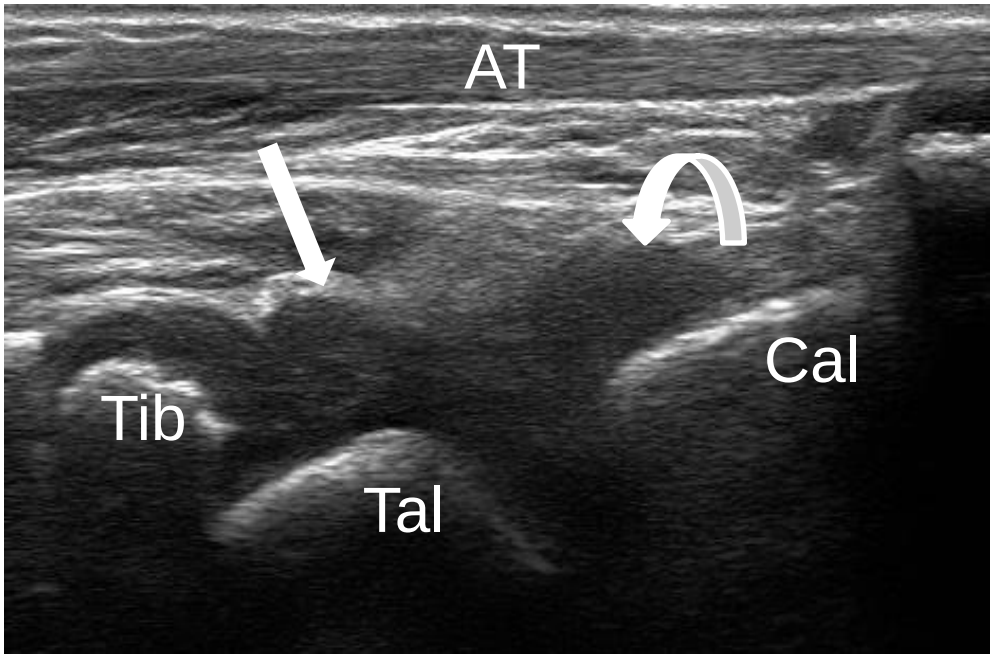




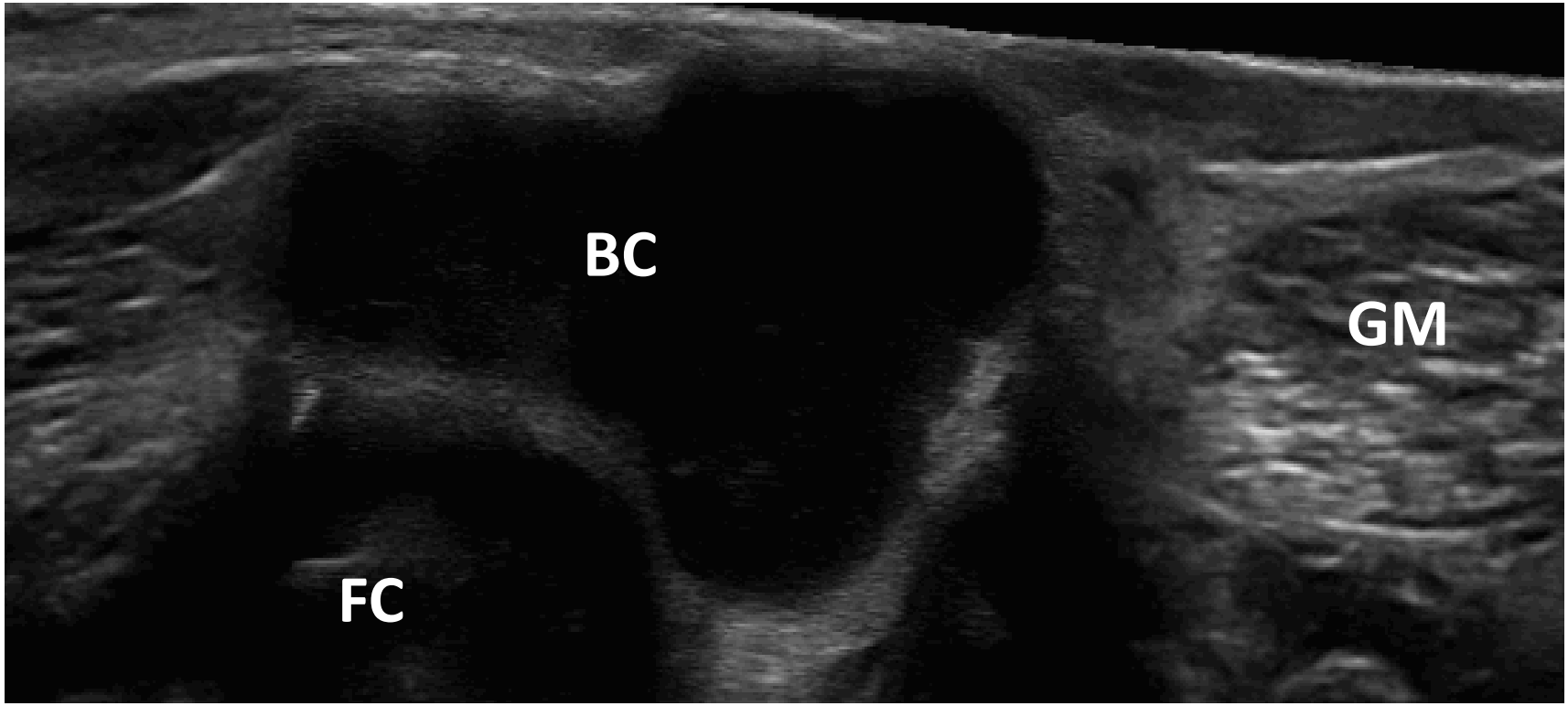


Ankle synovitis



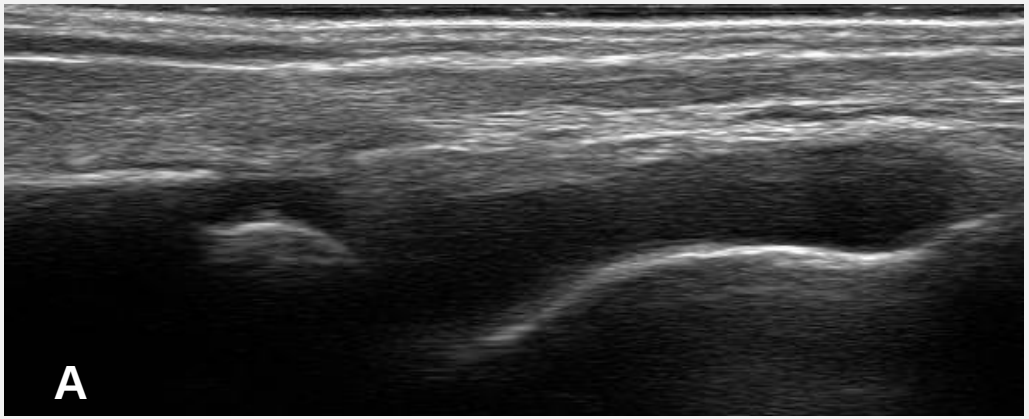


Backer’s cyst

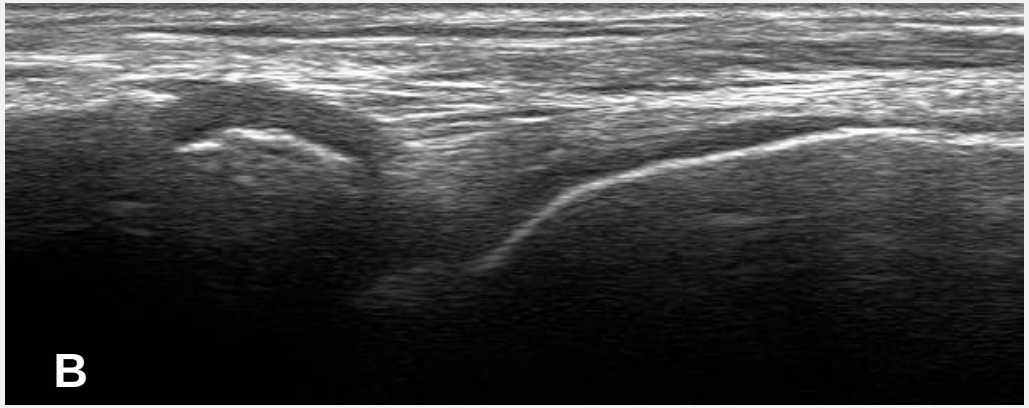


US assessment of therapeutic response

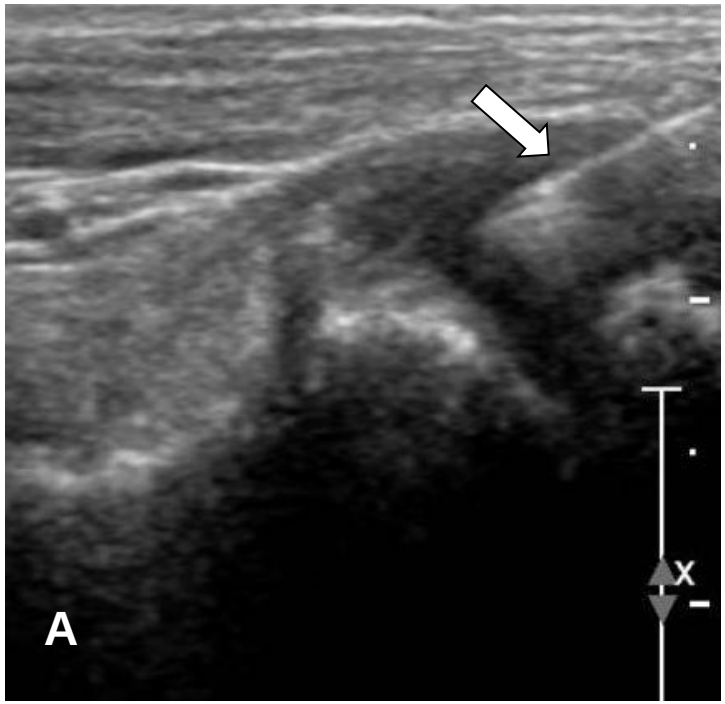
Before IACI

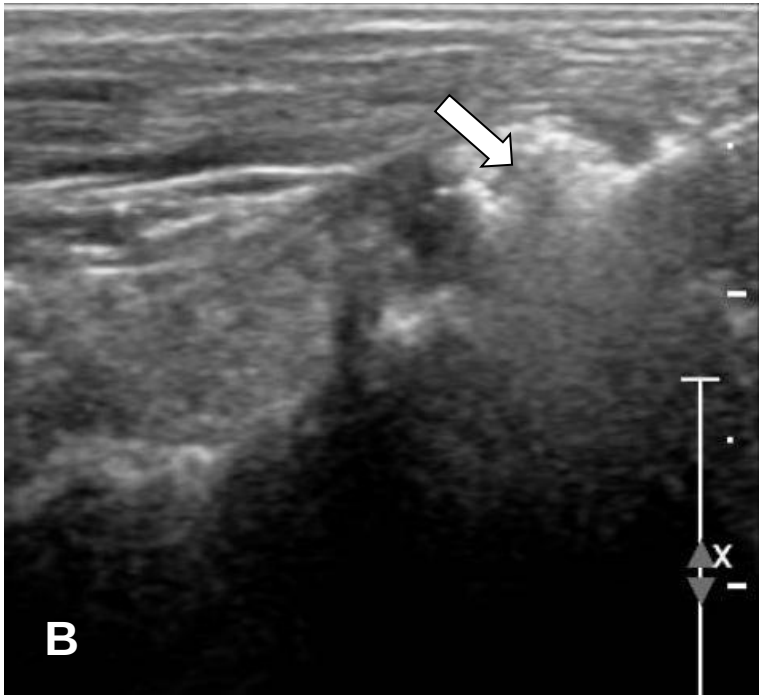


After IACI

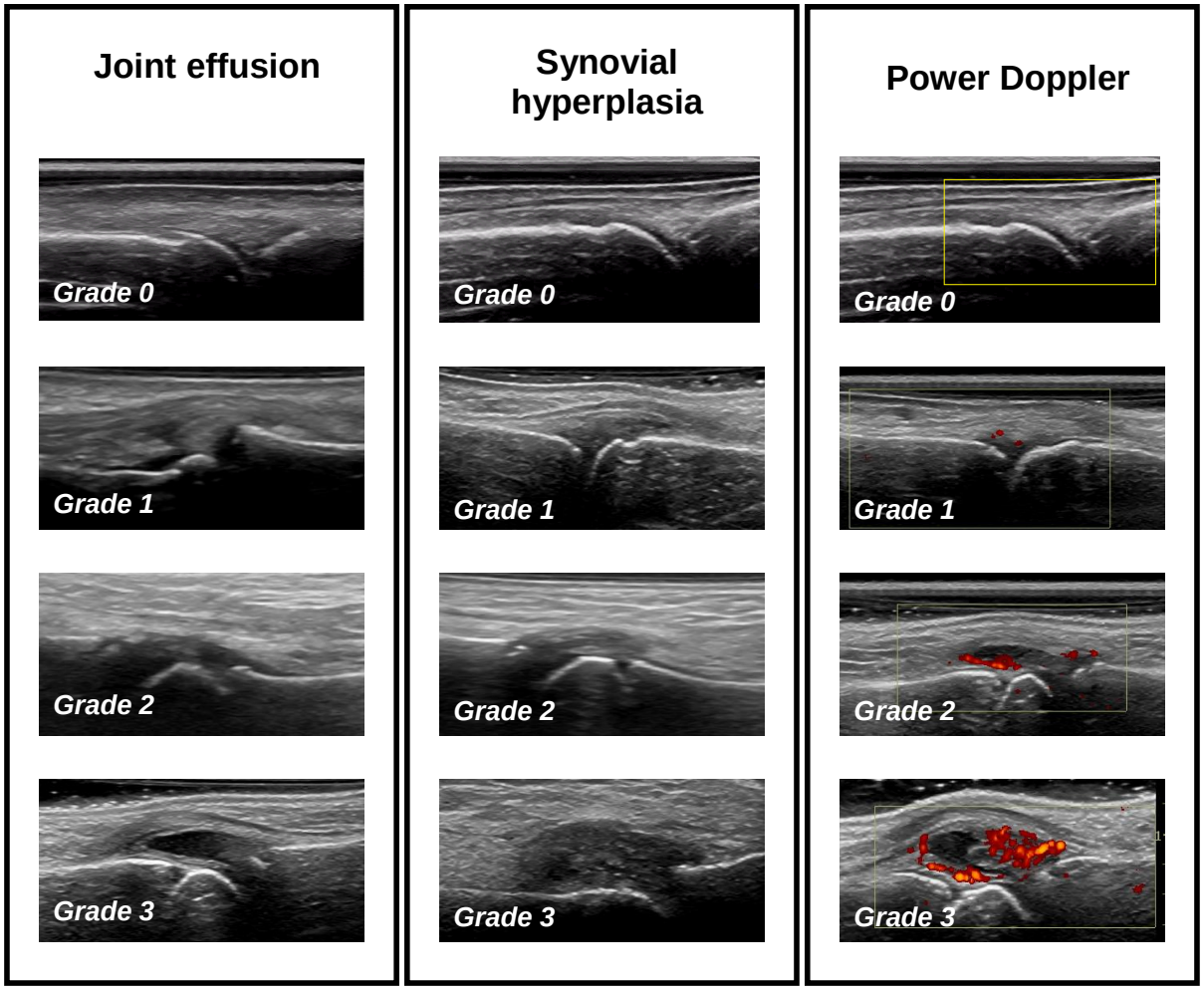


Ultrasound-driven injection





Scoring of US features



Subclinical synovitis in JIA

Detection of Active Disease in Juvenile Idiopathic Arthritis: Sensitivity and Specificity of the Physical Examination vs Ultrasound

GINGER L. JANOW, VIKASH PANGHAAL, ANGELA TRINH, DAVID BADGER, TERRY L. LEVIN, and NORMAN T. ILOWITE

Comparison of Clinical and Ultrasonographic Evaluations for Peripheral Synovitis in Juvenile Idiopathic Arthritis

Rheumatology 2010;49:123–127
doi:10.1093/rheumatology/kep339
Advance Access publication 20 November 2009

Sylvain Breton, MD,* Sandrine Jousse-Joulin, MD,† Claire Cangemi, MD,* Loic de Parscau PhD,‡ Danielle Colin, MD,* Luc Bressolette, PhD,§ Alain Saraux, PhD,† and Valérie Devauchelle-Pensec, PhD†

RHEUMATOLOGY

Original article

The detection of subclinical synovitis by ultrasound in oligoarticular juvenile idiopathic arthritis: a pilot study

Kirsty E. Haslam[1], Liza J. McCann[2], Susan Wyatt[1] and Richard J. Wakefield[3]

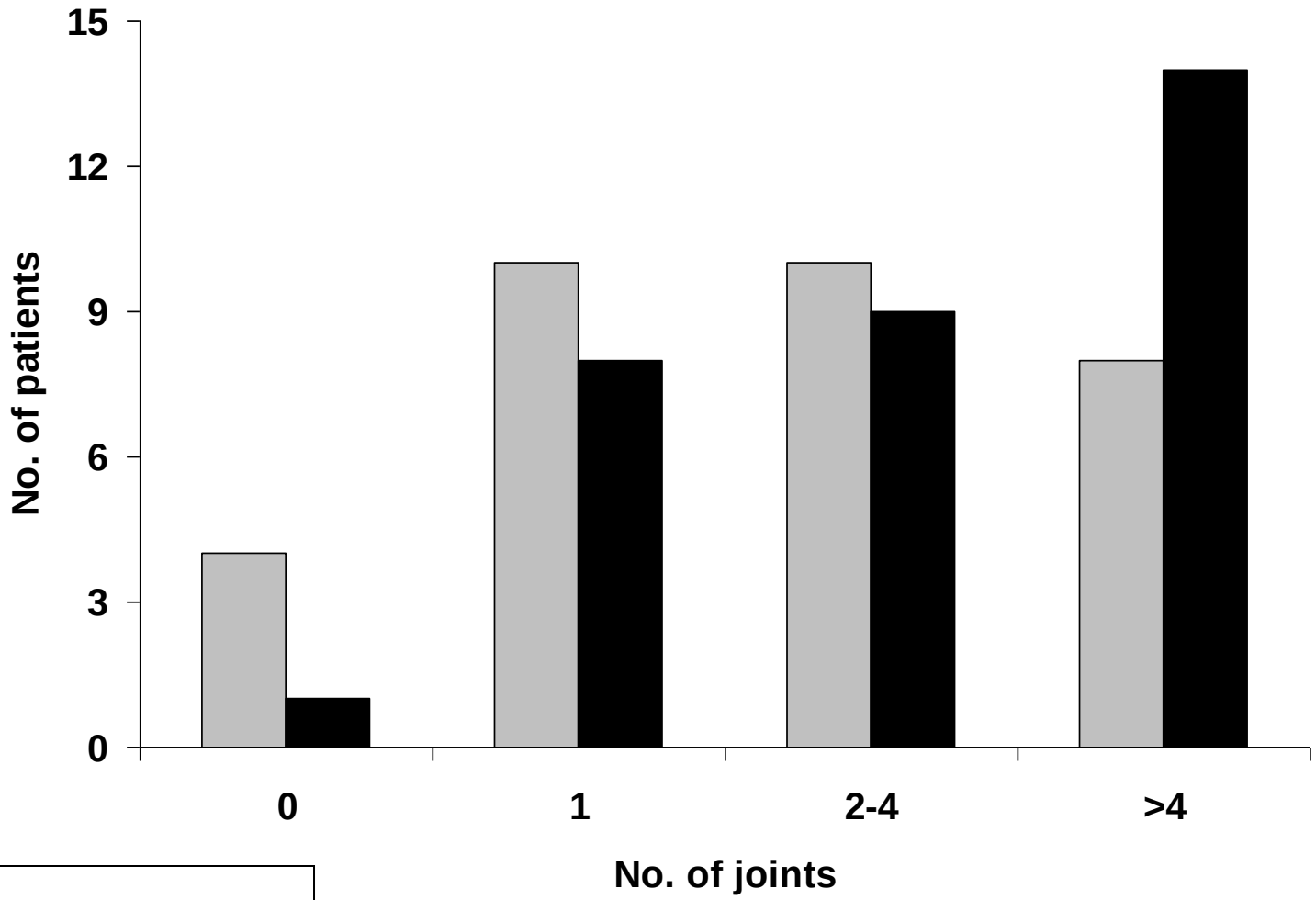
Ankle Disease in Juvenile Idiopathic Arthritis: Ultrasound Findings in Clinically Swollen Ankles

MADELEINE E. ROONEY, CATHERINE McALLISTER, and JAMES F.T. BURNS

Prospective Evaluation of Clinical and Ultrasound Findings in Ankle Disease in Juvenile Idiopathic Arthritis: Importance of Ankle Ultrasound

LAURA PASCOLI, STEPHEN WRIGHT, CATHERINE McALLISTER, and MADELEINE ROONEY

Clinical vs. US assessment



Magni-Manzoni S et al. A&R 2009; 61:1497-504

Arthritis Care & Research
Vol. 63, No. 7, July 2011, pp 1013–1019
DOI 10.1002/acr.20478

ORIGINAL ARTICLE

Ultrasound Findings on Patients With Juvenile Idiopathic Arthritis in Clinical Remission

MONICA REBOLLO-POLO,[1] KHALDOUN KOUJOK,[1] CAROLINE WEISSER,[1] ROMAN JURENCAK,[1] ALESSANDRA BRUNS,[2] AND JOHANNES ROTH[1]

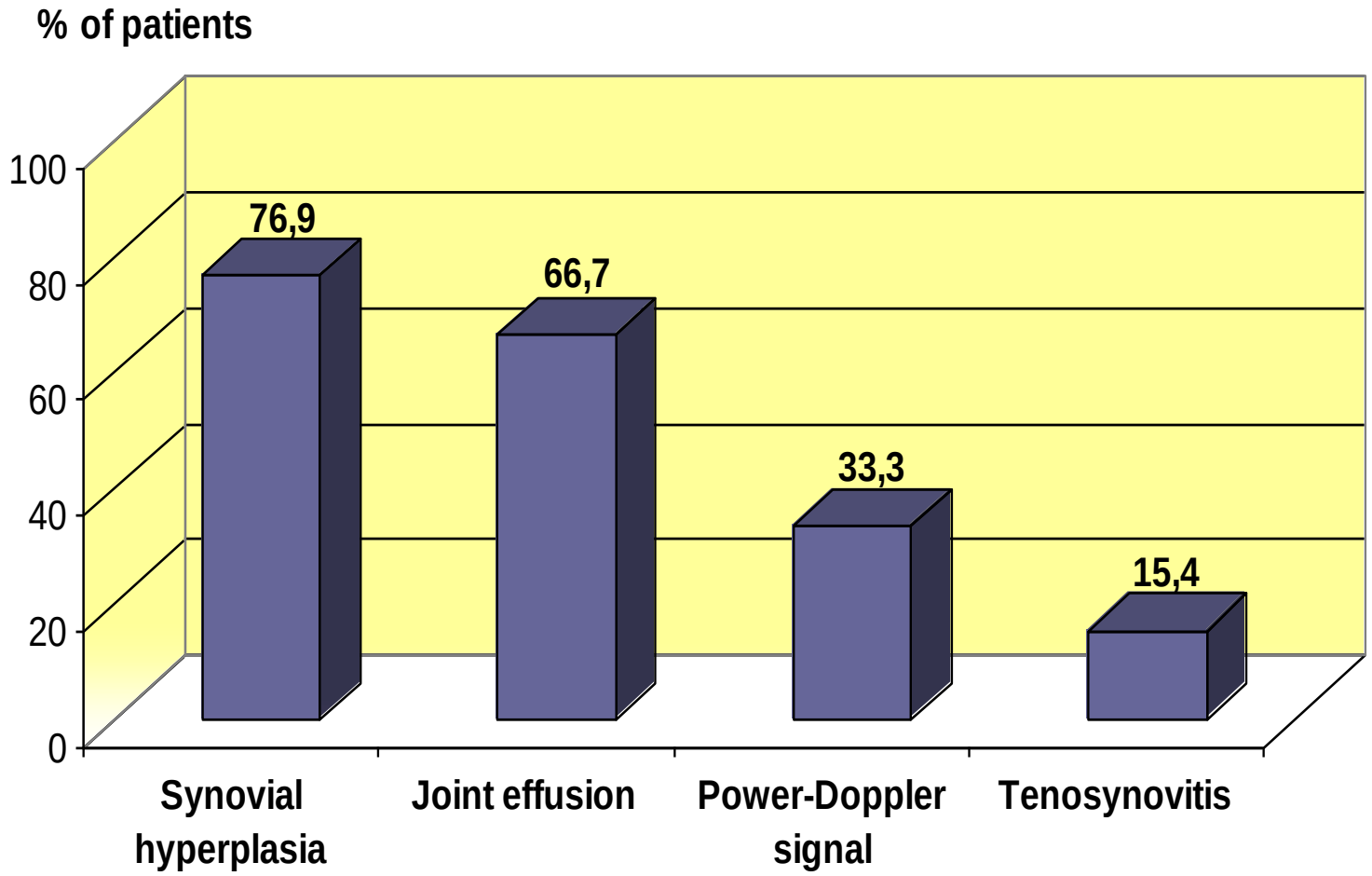
Arthritis Care & Research
Vol. 64, No. 12, December 2012, pp 1846–1854
DOI 10.1002/acr.21774

ORIGINAL ARTICLE

Do Patients With Juvenile Idiopathic Arthritis in Clinical Remission Have Evidence of Persistent Inflammation on 3T Magnetic Resonance Imaging?

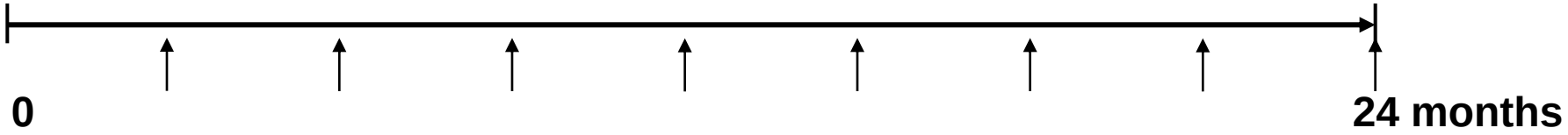
AMANDA BROWN,[1] RAPHAEL HIRSCH,[2] TAL LAOR,[3] MICHAEL J. HANNON,[4] MARC C. LEVESQUE,[4] TERENCE STARZ,[4] KIMBERLY FRANCIS,[2] AND C. KENT KWOH[5]

Frequency of baseline US abnormalities in 39 children with JIA and clinically-defined inactive disease



Magni-Manzoni S, Scirè CA, Ravelli A, *et al. Ann Rheum Dis* (2012)

Assessment of disease course over time



1) Persistently Inactive Disease at 24 months

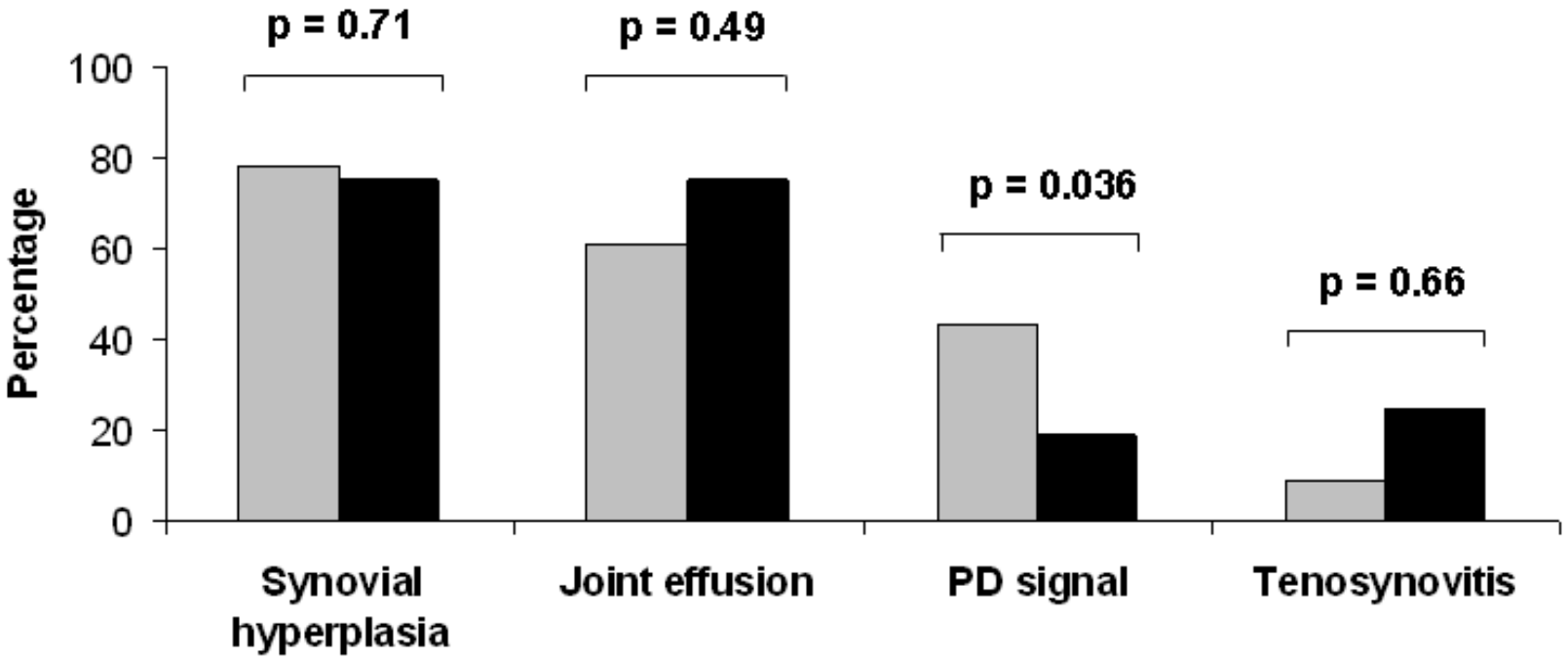
No. of patients	**24 (61.5%)**

2) Relapse of synovitis

No. of patients	**15 (38.5%)**
Median follow-up, months	**10.6 (6.3-13.7)**

Magni-Manzoni S, Scirè CA, Ravelli A, *et al. Ann Rheum Dis* (2012).

Comparison of US features at baseline between children with sustained ID and children with synovitis flare



Patients with persistent ID

Patients with synovitis flare

Magni-Manzoni S, Scirè CA, Ravelli A, *et al. Ann Rheum Dis* (2012)

EXTENDED REPORT

Ultrasound-detected synovial abnormalities are frequent in clinically inactive juvenile idiopathic arthritis, but do not predict a flare of synovitis

Silvia Magni-Manzoni,[1] Carlo Alberto Scirè,[1] Angelo Ravelli,[2,3] Catherine Klersy,[1] Silvia Rossi,[1] Valentina Muratore,[1] Chiara Visconti,[1] Stefano Lanni,[1] Pietro Merli,[1] Carlomaurizio Montecucco,[1,4]

Ann Rheum Dis 2013;**72**:223–228.

Future directions

- Conventional radiography will remain the most reliable modality for the demonstration of structural bone damage in children with JIA for some time to come
- MRI and US hold great promise in identifying bone and cartilage changes much earlier than conventional radiography
- More information is needed to establish whether the apparent changes in bone surface and the bone marrow edema seen on MRI in children with JIA are pathologic or part of normal development
- Further investigations of the clinical meaning of US-detected features of synovitis in children are necessary

Editorial

The Time Has Come to Include Assessment of Radiographic Progression in Juvenile Idiopathic Arthritis Clinical Trials

The Journal of Rheumatology 2008; 35:4

REVIEWS

Advances and challenges in imaging in juvenile idiopathic arthritis

Silvia Magni-Manzoni, Clara Malattia, Stefano Lanni and Angelo Ravelli

Nat. Rev. Rheumatol. **8**, 329–336 (2012)

Review

doi:10.1093/rheumatology/kes287

Towards a role of ultrasound in children with juvenile idiopathic arthritis

Stefano Lanni[1,2], Mark Wood[3], Angelo Ravelli[4,5], Silvia Magni Manzoni[1], Paul Emery[2] and Richard J. Wakefield[2]

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Review

doi:10.1093/rheumatology/kes287

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Thank you

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