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27TH & 28TH JUNE 2016

THE NATIONAL FOOTBALL CENTRE, ST GEORGE'S PARK

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PROFESSOR OF TRAUMA & ORTHOPAEDIC SURGERY

UNIVERSITY OF WARWICK

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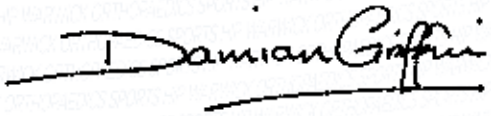
Dear Colleague,

The Sports Hip Conference will run again in 2018 as part of our portfolio of Sports Injury conferences. Some of you may have already attended the Sports Foot & Ankle, Sports Shoulder and and Sports Knee conferences. The dates for the next events will shortly be published on our website
www.sports-surgery.org

The key feature of these Sports Injury conferences is that we explore the latest ideas and most difficult problems in a relatively small group, guided by an expert international faculty.

Please do let us know if you have any thoughts about the meeting or any suggestions as to how we might develop it in the future.

With very best wishes.



PROFESSOR DAMIAN GRIFFIN
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UNIVERSITY OF WARWICK

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Ara Kassarjian



Ara Kassarjian is a consultant musculoskeletal radiologist at Corades, LLC in Boston, Massachusetts, USA and Madrid, Spain as well as being a staff physician for the Madrid Open tennis tournament.

Ara earned his medical degree at the McGill University Faculty of Medicine in Montreal, Quebec, Canada. He completed his residency training in diagnostic radiology at the Boston University Medical Center. This was followed by a fellowship in musculoskeletal imaging at the Massachusetts General Hospital/Harvard Medical School.

Ara was an Assistant Professor of Radiology at Harvard Medical School and the Director of Musculoskeletal MRI and CT at Massachusetts General Hospital until 2006 at which point he established Corades. He has since focused on the care of elite and professional athletes.

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Session 2

DEEP GLUTEAL AND PERITROCHANTERIC SPACES

Imaging gluteal tears, deep gluteal space and ischiofemoral space

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CONTACT THE AUTHOR

MR of peritrochanteric lesions, ischiofemoral impingement and deep gluteal syndrome

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Medical Service
Madrid Open Tennis
Madrid, Spain

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Objectives

- Peritrochanteric lesions
- Ischiofemoral impingement
- Deep gluteal syndrome

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Normal anatomy-axial

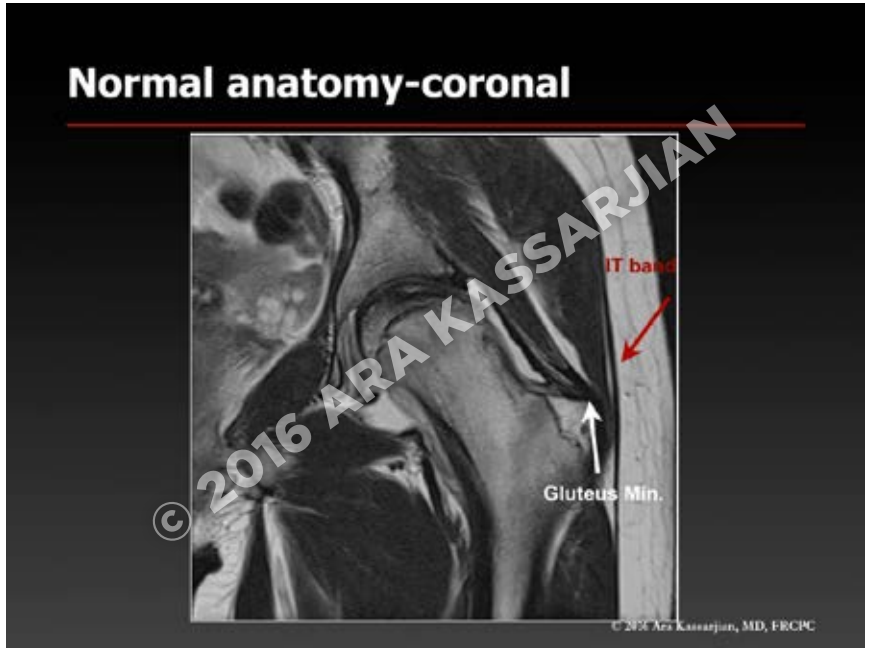


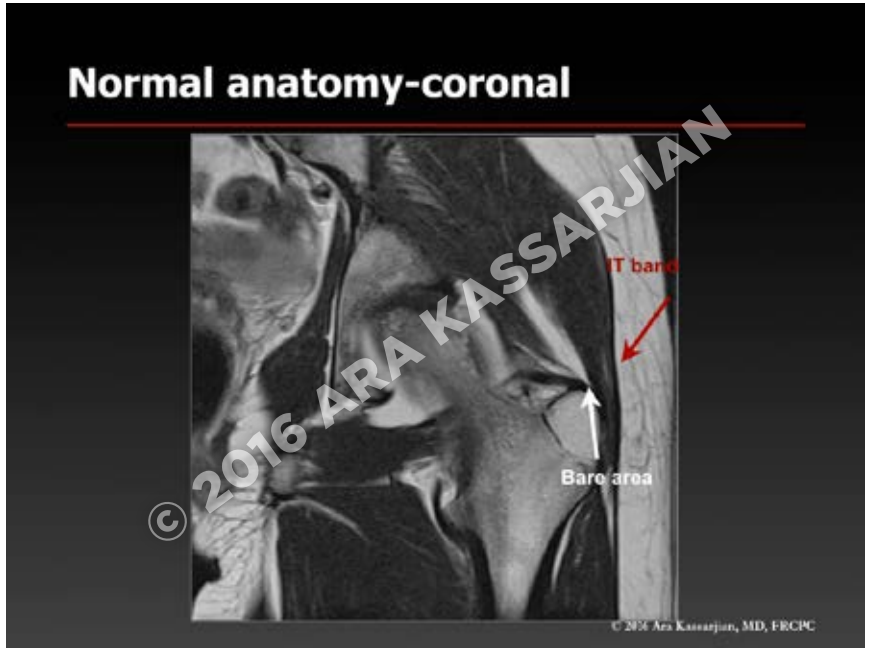
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Normal anatomy-axial

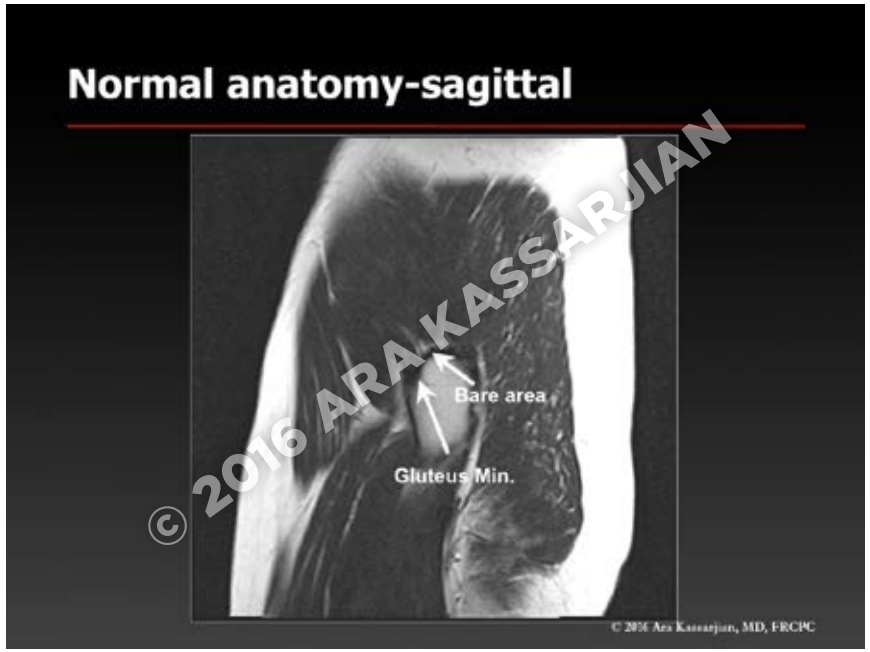


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Normal anatomy-coronal
IT band
Gluteus Min.
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Normal anatomy-coronal
IT band
Bare area
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Normal anatomy-coronal
IT band
Gluteus Med.
Trochanteric bursa
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Normal anatomy-sagittal
Bare area
Gluteus Min.
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Normal anatomy-sagittal



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Normal anatomy-sagittal

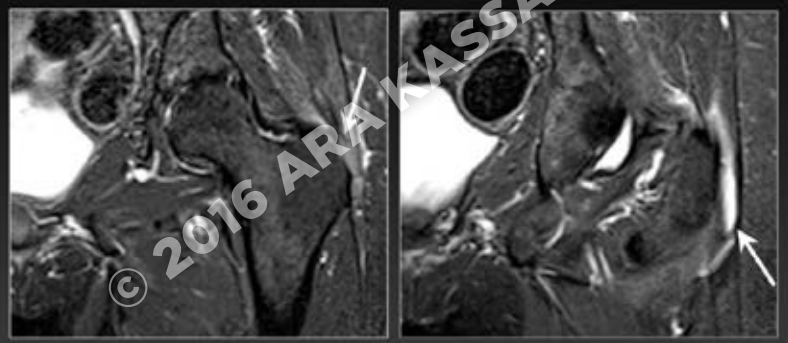


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Tendon and bursal pathology

- Gluteus medius tendonopathy
- Fluid in greater trochanteric bursa

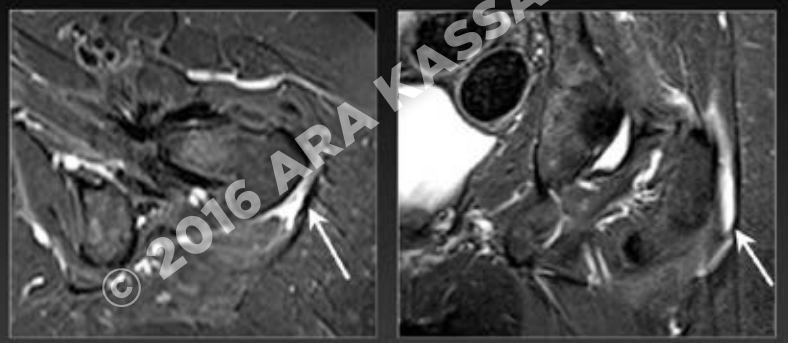


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Tendon and bursal pathology

- Gluteus medius tendonopathy
- Fluid in greater trochanteric bursa

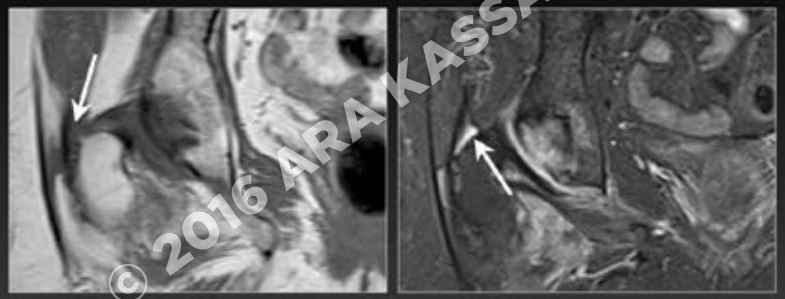


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Tendon and bursal pathology

- Gluteus medius tendonopathy
- Fluid in sub-gluteus medius bursa



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Tendon and bursal pathology

- Gluteus medius partial tear
- Fluid in sub-gluteus medius bursa



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Tendon and bursal pathology

- Gluteus minimus tendonopathy with partial tear

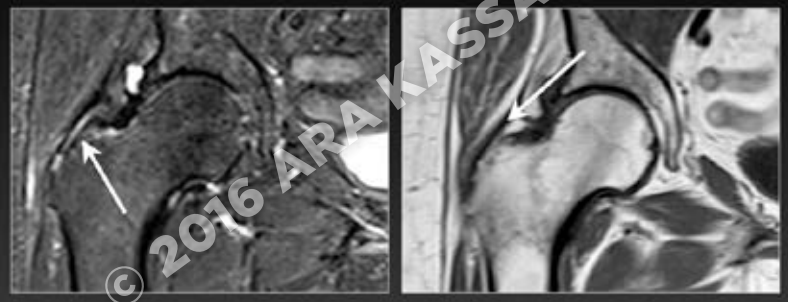


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Tendon and bursal pathology

- Sub-gluteus minimus bursal fluid with attenuated tendon



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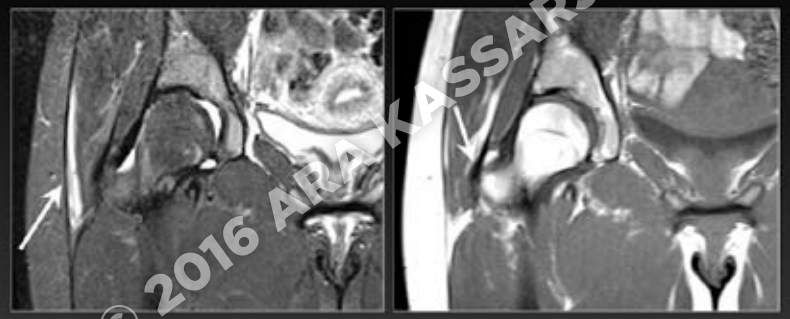
Iliotibial band friction



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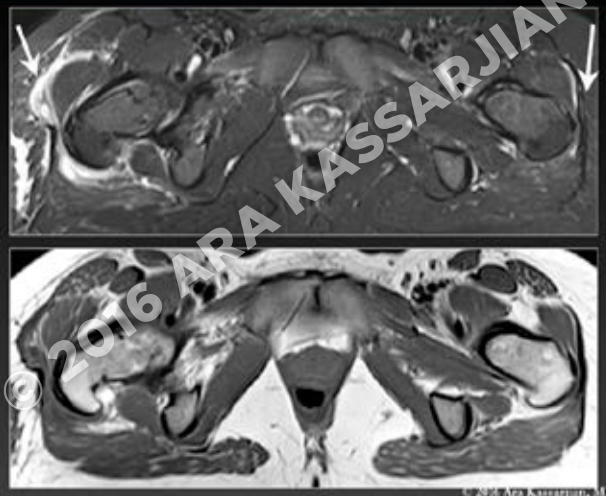
Iliotibial band friction



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Iliotibial band tear



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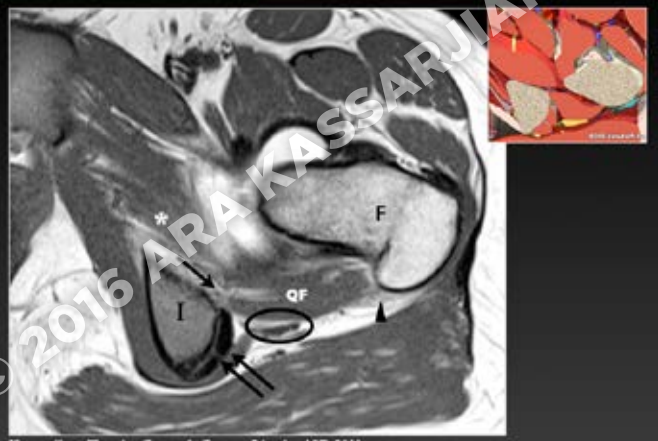
Ischiofemoral impingement

- Quadratus femoris
  - Anatomy
  - Pathology

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Quadratus femoris anatomy-axial



From: Kassarjian, Tomás, Cerezal, Canga, Llopis. AJR 2011

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Quadratus femoris anatomy-sagittal



From: Kassarjian, Tomás, Cerezal, Canga, Llopis. AJR 2011

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Ischiofemoral impingement

- MR features first described in 2008
  - Kassarjian A. AJR Am J Roentgenol. 2008 Jun;190(6):W379
  - Patti, et al. Skeletal Rad 2008 Oct;37(10):939-41
- Muscle belly impinged between the lesser trochanter and the ischial tuberosity or hamstrings
- More common in women
- Etiology?

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Ischiofemoral impingement

- Muscle belly impinged between the lesser trochanter and the ischial tuberosity



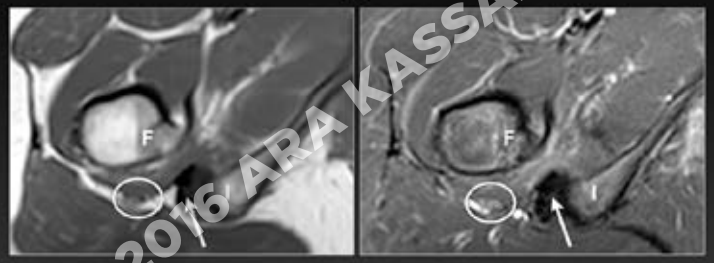
From: Kassarjian, Tomás, Cerezal, Canga, Llopis. AJR 2011

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Ischiofemoral impingement

- Muscle belly impinged between the lesser trochanter and hamstrings



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Ischiofemoral impingement



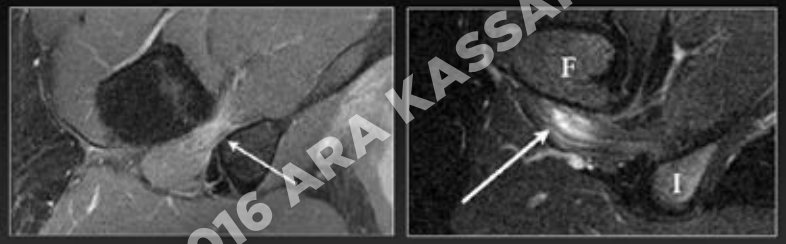
Impingement

From: Kassarjian, Tomás, Cerezal, Canga, Llopis. AJR 2011

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Ischiofemoral impingement



Impingement

Strain

From: Kassarjian, Tomás, Cerezal, Canga, Llopis. AJR 2011

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Ischiofemoral impingement

- Normal distance between lesser trochanter and ischial tuberosity?
- Varies with degree of hip rotation, flexion, etc
  - Narrower with external rotation
  - ?Image through arc of motion (Singer Am J Orthop 2014)
- Recent update meta-analysis (Singer Skel Rad 2015):
  - IFS space <15 mm
    - 77% sens, 81% spec, 78% acc
  - QF space <10 mm
    - 78% sens, 74% spec, 74% acc

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Ischiofemoral impingement

- Other measurements:
  - Pelvic inclination/lumbar lordosis
  - Femoral torsion
  - Coxa valga, coxa breva
  - Ischial angle
  - Inter-tuberous distance
  - Shape/size/angle of lesser trochanters

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Ischiofemoral impingement

More studies needed re: osseous anatomy, hip biomechanics, related lesions, clinical relevance, treatment

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Deep gluteal syndrome - clinical

- Non-discogenic pain in buttock +/- radiation along posterior thigh
- Exacerbated by long periods of sitting



Martin et.al. Arthroscopy 2011

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Deep gluteal syndrome - clinical

- Pain on deep palpation along course of sciatic nerve +/- Tinnel sign
- Positive Pace and Lasègue signs
- Positive piriformis test



Martin et.al. Arthroscopy 2011

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Deep gluteal syndrome - etiology

- Causes: common factor is mass effect on, or scarring of, sciatic nerve

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Deep gluteal syndrome - etiology

- Causes: common factor is mass effect on, or scarring of, sciatic nerve
- Readily visible causes at imaging:
  - hematoma
  - tumor
  - abscess
  - penetrating injuries
  - prior surgery

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Deep gluteal syndrome - etiology

- Causes: common factor is mass effect on, or scarring of, sciatic nerve
- More subtle causes:
  - anatomic abnormalities of piriformis and its relation to the sciatic nerve
  - scarring related to prior hamstring injuries
  - quadratus femoris and ischiofemoral abnormalities
  - vascular abnormalities

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Deep gluteal syndrome - imaging

- Imaging findings often very subtle or negative
- Carefully assess sciatic and other nerves:
  - course
  - signal intensity
  - preservation of fasciculation
  - surrounding fat and vessels

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Deep gluteal syndrome - imaging

- Wide FOV: Left hamstring abnormality



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Deep gluteal syndrome - imaging

- Evidence of prior left hamstring tendon and sacrotuberous ligament injuries



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Deep gluteal syndrome - imaging



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Deep gluteal syndrome - imaging



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Deep gluteal syndrome - imaging



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Deep gluteal syndrome - imaging



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Deep gluteal syndrome

- Post-traumatic scarring of/along sciatic nerve
- Results in decreased nerve excursion with hip motion

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Deep gluteal syndrome-treatment

- Conservative:
  - Physiotherapy/rehabilitation
  - Anti-inflammatories
- Minimally invasive:
  - Image guided injections
- Surgical:
  - Tenotomy (e.g. piriformis, obt. internus, semimembranosis, etc.)
  - Lysis of adhesions



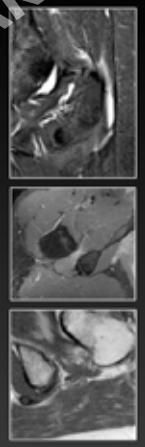
Courtesy: L. Pérez Carro, MD, Santander

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Take home points

- Peritrochanteric lesions are common
  - tendons, bursae, IT band
  - correlate imaging with symptoms
  - asymptomatic gluteus medius abnormalities common
- Ischiofemoral impingement
  - look at space and mass effect
- Deep gluteal syndrome
  - subtle findings



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Thank you



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Session 4

HIP CARTILAGE

MRA, dGEMRIC, T2, T2*, Na and 7T mapping: What works?

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Imaging of hip cartilage: 2016 update

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Disclosures

- Consultant: Arthrosurface

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- Vasco Mascarenhas, MD, Lisbon, Portugal

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Objectives

- MR imaging of hip cartilage
  - Scanner
  - Coils
  - Sequences
- Advanced imaging techniques
  - Current evidence
- How I do it

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MR imaging technique

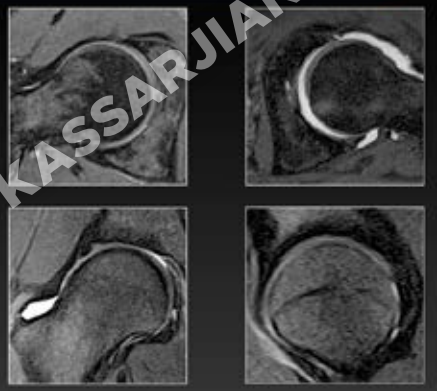
- Scanner
  - 1.5 T or 3 T
- Coils
  - No dedicated hip coils on the market
- Sequences
  - Most common error in hip imaging is poor sequence design

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MR imaging technique

- Sequence design
  - Most common error in hip imaging is poor sequence design

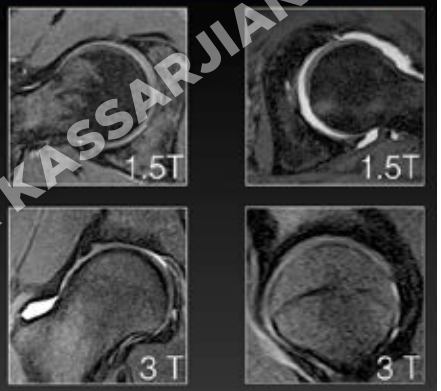


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MR imaging technique

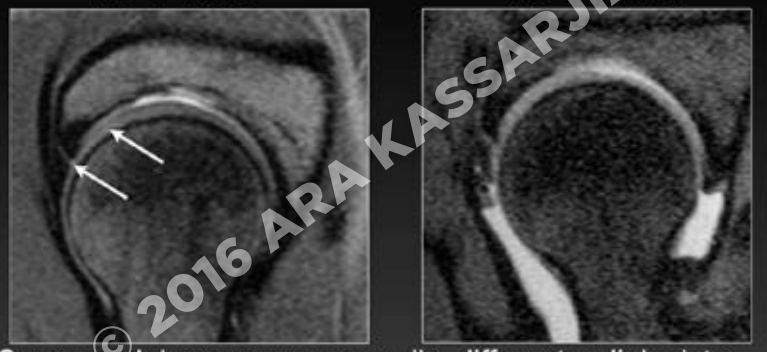
- Sequence design
  - Most common error in hip imaging is poor sequence design



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MR imaging technique



Same model scanner, same coils, different radiologists

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MR imaging technique

- Optimized
  - This is about as good as it gets



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Advanced imaging

- T2 mapping
  - H20 content
  - Structure
  - Organization



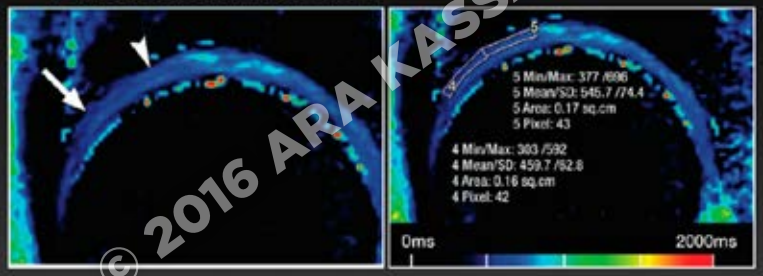
Images Courtesy of Dr. Atsuya Watanabe

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Advanced imaging

- dGEMRIC
  - GAG concentration



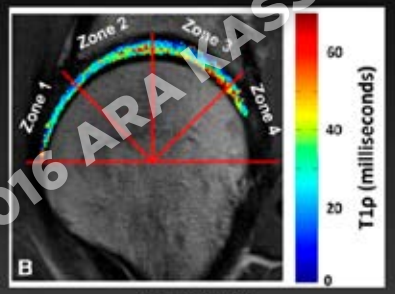
Sutter Radiology 2012

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Advanced imaging

- T1 rho
  - GAG concentration



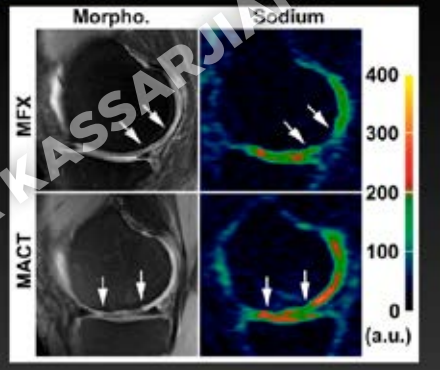
Rahkra CORR 2015

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Advanced imaging

- Sodium imaging
  - proteoglycan loss
  - biochemical
  - experimental



Zbyn Cur Radiol Rep 2014

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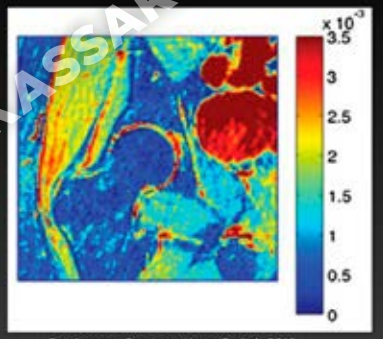
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Advanced imaging

- Diffusion tensor imaging
  - Fiber organization



Filidoro et al. Mag Res Med 2005



Petchprapa. Seminars Musc. Radiol. 2013

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Advanced imaging

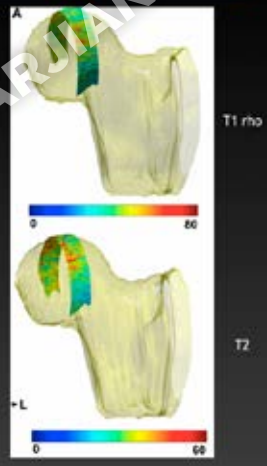
- Limitations
  - Regional variations**
  - Reproducibility*
  - Post-exercise change
  - Imaging times
  - Software
  - Field Strength (DTI, T1rho)

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Advanced imaging

- Limitations
  - Regional variations**
    - T1 rho and T2 variations
      - Subburaj. Magn Reson Imaging 2013
      - Ferro. Arthroscopy 2015
      - Ho. Cartilage 2014
      - Rakhra CORR 2015



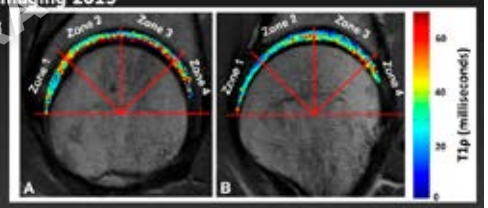
Subburaj. Magn Reson Imaging 2013

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Advanced imaging

- Limitations
  - Regional variations**
    - T1 rho and T2 variations
      - Subburaj. Magn Reson Imaging 2013
      - Ferro. Arthroscopy 2015
      - Ho. Cartilage 2014
      - Rakhra CORR 2015



Rahkra CORR 2015

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Advanced imaging

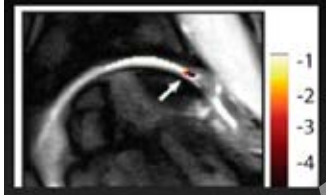
- Limitations
  - Reproducibility/inter- and intra-rater variability
    - Fair to good, poor in some zones
      - Ho Cartilage 2014
  - Very sensitive to field inhomogeneities, especially at 3T
    - Silversson. Magn Reson Med 2012

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Advanced imaging

- How good is it?



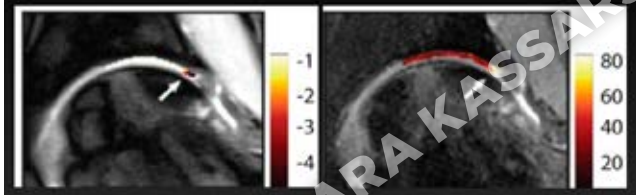
dGEMRIC

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Advanced imaging

- How good is it?



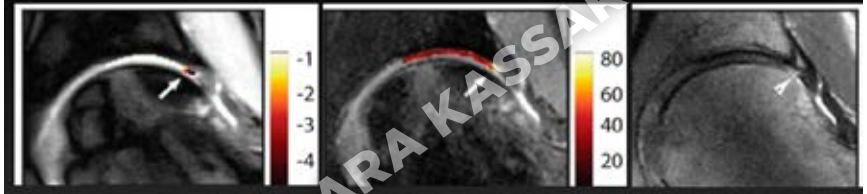
dGEMRIC T2 mapping

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Advanced imaging

- How good is it?



Petchprapa. Seminers Musc. Radiol. 2013

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Advanced imaging

- How good is it?
- Do we really need it?



Petchprapa. Seminers Musc. Radiol. 2013

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Advanced imaging

- How good is it?
- Do we really need it?



Courtesy Kai Vilanova, MD, Girona

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Advanced imaging

- How good is it?
- Do we really need it?



Courtesy Kai Vilanova, MD, Girona

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Advanced imaging

- How good is it?
- What do we do with this information?



PD Fat Sat | T2 mapping | dGEMRIC

Courtesy Kai Vilanova, MD, Girona

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Advanced imaging

- Acquisition times

TABLE 1 | Selected imaging parameters of previously reported studies of dGEMRIC, T1ρ, T2, and T2* assessment of hip joint cartilage.

	Zilkens et al. (35, 44)	Subburaj et al. (54)	Sutter et al. (70)	Bittersohl et al. (80)
MRI technique	dGEMRIC	T1ρ mapping	T2 mapping	T2* mapping
Imaging parameters				
Field strength (T)	3	3	3	3
Repetition time, TR (ms)	15	n/a	1500	38
Echo time, TE (ms)	2.24	0, 15, 30, 45	10.3–103	4.62, 9.41, 15.28, 21.15, 27.02, 32.89
Flip angle (°)	5, 25	n/a	n/a	25
Number of excitation	1	n/a	1	1
Field of view (mm)	192	140	150	192
Slice thickness (mm)	0.6	4	4	0.6
In-plane resolution (mm)	0.6 × 0.6	0.5 × 0.5	1 × 1	0.6 × 0.6
Slice gap (mm)	0.12	None	None	0.2
Bandwidth (Hz/pixel)	260	62.5 × 40	315 × 40	650
Acquisition time (min)	14.01	13.40	17.41	13.29

n/a, not specified

Bittersohl. Frontiers in Surgery 2015

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Advanced imaging

- The hard data

	SENS	SPEC	ACC
dGEMRIC (3T)	69-83	60-70	69-75
MRI (1.5T)	58-83	50-100	64-79
MR arthro (1.5T)	71-92	25-100	75-82
MR arthro (1.5T)	56-88	25-100	65-75
MR (3T)	59-65	100	
MR arthro (3T)	71-81	82-91	

Lattanzi Osteoarthr Cart 2014 (dGEMRIC)
Mintz Arthroscopy 2005 (MRI)
Sutter AJR 2014 (MR arthro)
Magee. Br J Radiol 2015

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Advanced imaging

- The hard data

	Cartilage		Labrum	
	SENS	SPEC	SENS	SPEC
Inidrect MR arthro (3T)	39-59	79-86	86-95	95
Direct MR arthro (3T) Literature	71-92	50-100	70–100	70-100

Petchprapa. Skel Radiol 2015

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Experience matters

- 2 MSK radiologists with 2 and 10 years of experience

	MRI	MR arthro
2 years experience	58% sens. 64% acc.	71% sens. 75% acc.
10 years experience	83% sens. 79% acc.	92% sens. 82% acc.

Sutter et al. AJR 2014

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Experience matters

- 2 MSK radiologists with 5 and 12 years of experience

3T MR arthro **traction**	Sens	Spec	Accuracy
5 years experience	85	78	83
12 years experience	88	96	91

Schmaranzer Eur Rad 2015

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How high can we go?

- Higher field strength
  - 7T



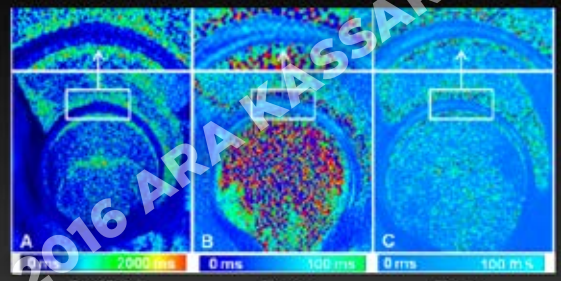
Cheng. JMRI. June 2015

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How high can we go?

- Higher field strength
  - 7T



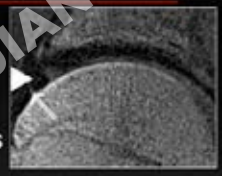
Lazik, et al. Eur Rad 2015

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How high should we go?

- Higher field strength
  - More artifacts
    - chemical shift, field inhomogeneities
  - Higher SAR (specific absorption rate)
    - Safety, energy deposition in patient
      - 1.5T to 3T = 4x increase in SAR
    - Tissue heating
    - European regulations

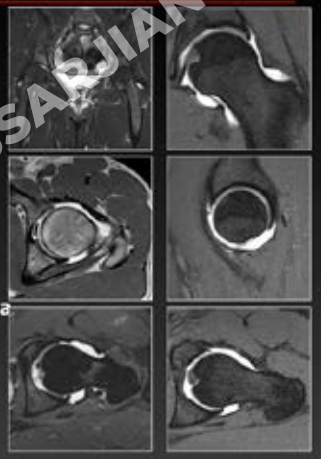


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How I do it

- Direct MR arthrography
- Coronal STIR pelvis
- 3 plane T1 with fat suppression
  - Cartilage and labrum
- T1 without fat suppression
  - Marrow, muscle atrophy
- 1-2 plane PD with fat suppression
  - Edema: marrow, cartilage, muscle edema
  - Cysts, bursae
- Radial imaging (if available)

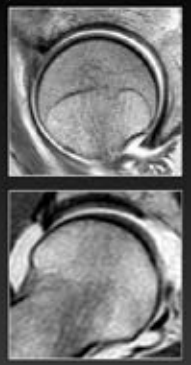


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Conclusions

- Successful hip cartilage imaging requires:
  - High field magnet (1.5T or 3T)
  - Optimized sequences
  - Intra-articular contrast (probably)
  - Experience
- Even when optimized, it is still challenging
- Advanced techniques experimental



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Thank you



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