Clinical Relevance of Imaging in Osteoarthritis: The Radiologist’s Perspective

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Imaging: why is it relevant?

- Imaging is a powerful tool in OA assessment
- Morphology of different joint structures
- Function/composition of some structures
- Imaging improved the understanding of natural history and symptoms in OA
Imaging - Overview

- Radiography
- Ultrasound
- Magnetic Resonance Imaging
- CT/CT-Arthrography
- Nuclear Medicine
- Others
Radiography

- First line diagnostic imaging tool in a clinical setting
- Most of the time sufficient for clinical diagnostic purposes (OA); strongly associated with knee pain*
- X-ray detected joint space narrowing: only accepted imaging endpoint in clinical phase III trials (EMEA/FDA)
- **Important for inclusion into clinical trials and subject stratification**

*Neogi T et al. BMJ 2009;339:b2844
Ultrasound

- Visualization of soft tissue structures in multiple planes
- Real time, mobile scanners, dynamic exam
- No radiation, inexpensive
- No contrast agent needed for synovial assessment
- Good soft-tissue contrast
- Most of the time sufficient for clinical diagnostic purposes (OA)

Ultrasound

- User-dependent
- Physical properties of sound limit its application
  - no visualization of subchondral bone and deep intra-articular structures!
- Low negative predictive value for cartilage assessment*
- Not yet validated as an outcome tool in OA**
- Documentation difficult (screenshots)

*Saarakkala S et al. Osteoarthritis Cartilage 2012 Feb 1 [Epub ahead of print]
Magnetic Resonance Imaging

- Tomographic technique; no radiation
- Multiplanar capability
- Superior tissue contrast
- High spatial resolution
- Clinically relevant for differential diagnosis*
- Direct visualization of all joint structures: whole-joint assessment

*Roemer FW et al. Osteoarthritis Cartilage 2009;17:1115-31
Semiquantitative MRI Scoring Systems

- **WORMS = Whole-Organ Magnetic Resonance Imaging Score**
  Peterfy CG et al. Osteoarthritis Cartilage 2004;12:177-190

- **KOSS = Knee Osteoarthritis Scoring System**
  Kornaat PR et al. Skeletal Radiol 2005;34:95-102

- **BLOKS = Boston Leeds Osteoarthritis Knee Score**

- **SQ Synovitis Assessment Score**

- **MOAKS = MRI Osteoarthritis Knee Score**
  Hunter DJ et al. Osteoarthritis Cartilage 2011;19:990-1002

- **HOAMS = Hip Osteoarthritis MRI Score**

- **OHOA-MRI = Oslo Hand Osteoarthritis MRI Score**
  Haugen IK et al. Ann Rheum Dis 2011;70:1033-8

*needs further validation
Semiquantitative MRI: Cartilage

- Sensitive to detect change over time
- Different baseline SQ grades = different risks of progression
- SQ grades extensively used as the outcome when testing different predictors
- Useful in identifying associations with clinically relevant lesions (BMLs)

Crema MD et al. Osteoarthritis Cartilage 2010;18(Suppl 2):S12
Semiquantitative MRI
Whole-organ Assessment

- Direct assessment of other important articular structures:
  - Meniscus
  - Subchondral bone (BMLs and cysts)
  - Synovium (synovitis)
  - Synovial cavity (effusion)
  - Ligaments
  - Periarticular structures (bursae)
  - Loose bodies
Quantitative MRI

- Cartilage (+++); sensitive to change
- May be applied in other joint structures (menisci, bone, synovium)
- Less observer dependent (more objective)
- Needs specialized software; time-consuming
- Less sensitive than SQ to small focal changes

Buck RJ et al. Osteoarthritis Cartilage 2011;19:302-8
Compositional MRI

- Detect alterations in cartilage matrix before surface damage (collagen/water;GAG)
- Special techniques required; some applicable on clinical scanners
- Needs segmentation (time-consuming)
- Prediction of incidence/progression of structural damage in OA: no strong evidence!

Link TM. Radiol Clin N Am 2009;47:617-32
Crema MD et al. Radiographics 2011;31:37-62
Compositional MRI

- T2 mapping
- dGEMRIC
- T1rho
- Sodium MR
- Diffusion
Whole-organ MRI Assessment

- **Clinically relevant lesions in OA** (BMLs, synovitis, effusion)
- **Relevant lesions regarding progression of structural damage** (BMLs, meniscal damage, meniscal extrusion, effusion, cruciate tears)
- **Relevant non-MRI factors** (BMI, malalignment)
- **Natural history and intervention**
Relevance of MRI Features in Progression of Structural Damage

- Multiple studies have used cartilage loss as the outcome in longitudinal studies of knee OA
- Using quantitative and semiquantitative measurements, MRI based predictors are:
  - meniscal damage and extrusion \(^{1-7}\)
  - bone marrow lesions \(^{8-13}\)
  - pre-existing (focal) cartilage damage \(^{14-16}\)
  - subchondral bone area/attrition \(^{17,18}\)
  - ACL disruption \(^4\)
  - effusion \(^{12,19,20}\)

Summary

• Multiple imaging tools available
• To date, MRI is the most important
• Associations between imaging findings and symptoms/fast progression/TKR
• Current therapeutic approaches have lapsed behind capabilities of MR imaging
Thank you!