

MRI of the Lower Extremity"
Case-based Teaching Course, Wed., 22 April
Ankle and Foot
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OPTIMIZED MRI PROTOCOLS FOR THE ANKLE AND FOOT

1) ANKLE / HINDFOOT

- Coil selection
 - Phased array “ski-boot” coil
 - Quadrature “chimney” extremity coil
 - Standard knee coil
- Imaging strategy
 - High spatial and contrast resolution assessment of articular cartilage in the ankle and subtalar joints
 - Demonstration of bone marrow oedema
 - Frequency selective fat suppression
 - STIR
 - IDEAL
 - Adequate depiction of ligaments and synovial fluid / synovitis
 - Demonstration of tendons
 - Scan planes to compensate for curved course of peronei
 - Minimise magic angle effect with use of a heavily T2 weighted sequence
 - Coverage should include
 - Achilles insertion
 - Plantar fascia
 - Peroneus longus insertion base 1st metatarsal
 - Peroneus brevis insertion base 5th metatarsal
 - Optional additional sequences
 - Long axis PD fat sat sequence through midfoot if ? midfoot arthrosis in addition to ? pathology in hindfoot
 - MR arthrography has been advocated as a means of improving sensitivity for detection of synovitis, scar tissue and fibrous bands that may predispose to soft tissue impingement. The authors clinical experience has been that a high spatial and contrast resolution approach is sufficient to demonstrate these pathologies
 - Intravenous contrast has been advocated as a means of rendering more conspicuous for synovitis that may cause impingement symptoms and also as a means of differentiating inert tendon sheath effusions from an active tenosynovitis
- Case studies

2) ACHILLES

- a) Study tailored for Achilles tendonopathy & insertional Achilles path**
- Use standard ankle coil, ankle neutral (avoid plantar flexion)
 - Axial sequences through Achilles tendon
 - Fat sat T2

- Fat sat T1 gradient echo (most sensitive routine sequence for tendinopathy)
 - Thin slice sagittal sequences through Achilles tendon, angled perpendicular to tendon off axial images
 - T1
 - Fat sat T2
 - Fat sat T1 gradient echo (most sensitive routine sequence for tendinopathy)
 - Optional sequences
 - Coronal T2 2mm
 - UTSE sequence for Achilles insertion
 - Case study
- b) Study tailored for acute Achilles tendon tear**
 - Often require more coverage than can be achieved with standard ankle coil
 - Scans must get above level of injury
 - Coil options
 - Use ankle coil and move up calf if required
 - Spine coil
 - Head coil
 - Long flex coil
 - Use a combination of PD, T2 and fat sat PD sequencing in 3 planes
 - Fat sat T1 gradient echo sequencing unhelpful in this setting
 - Case study

3) MID-FOOT

- Coil selection
 - Standard ankle coil
 - Knee coil, foot flat
 - Less pt comfort but may offer higher SNR
 - Flex coil
- Long axis PD and PD fat sat
 - Angle off short axis for ROI eg Lisfranc vs lat midfoot
- Sagittal PD fat sat +/- sag PD
- Short axis PD fat +/- short axis PD
 - Use short axis PD for ? tib ant path, post op setting or ? DPN
- Coverage
 - Transverse tarsal jt to mid metatarsal shaft
- Case study

4) FOREFOOT

- Central forefoot and great toe are separate anatomic regions, with differing orientation, requiring separate differing, tailored imaging technique
- a) Central Forefoot**
 - Indications
 - ? mortons neuroma or 2nd MTP joint capsulitis
 - Coil selection
 - Wrist coil – older” non-moulded” coils usually accommodate forefoot and afford high SNR. Newer moulded coils often unsuitable.

- Flex coil – preferably phased array construct
 - Knee coil – esp if 8 channel phased array & pt able to position foot flat
 - Ankle coil – esp if newer ski boot 8 channel phased array
 - Pulse sequences
 - Short axis T1 & T2 perpendicular to P1 2nd / 3rd toes
 - Sagittal PD & PD fat sat optimised for visualisation of common plantar interdigital nerves and plantar plates
 - Long axis PD fat sat
 - Case study
- a) Great Toe**
- Indications
 - ? turf toe, ? 1st MTPJ chondral injury
 - Coil selection
 - Wrist coil – older” non-moulded” coils usually accommodate forefoot and afford high SNR. Newer moulded coils often unsuitable.
 - Flex coil – preferably phased array construct
 - Knee coil – esp if 8 channel phased array & pt able to position foot flat
 - Ankle coil – esp if newer ski boot 8 channel phased array
 - Pulse sequences
 - Short axis PD & PD fat sat
 - Long axis PD fat sat angled to intersesamoid plane off short axis
 - Sagittal T1, PD & PD fat sat perpendicular to intersesamoid plane
 - Case study

METAL ARTEFACT REDUCTION IMAGING STRATEGY

- Fast /turbo spin echo PD sequences with:
 - Longer echo train (12-20_
 - Larger receiver bandwidth
 - Shorter TE (approx 20msec)
 - Lower angle refocussing pulse
- STIR sequences
- Case study

NEWER SEQUENCES

- 3D PD FSE / TSE
 - Potential for isotropic data set that can be reconstructed in any plane
- IDEAL (Iterative Decomposition of water / fat using Echo Asymmetry and Least Squares estimation)
 - 3 point Dixon technique that allow use of parallel imaging
 - Homogeneous fat suppression in ankle and foot with better SNR than STIR sequencing
- UTE imaging of Achilles entheses
- Quantitative imaging of articular cartilage
 - T2 mapping
 - DGEMRIC

- T1 rho
- Fat sat T1 gradient echo for cartilage thickness / volumes