New Horizon of Fast MSK Imaging

SY26-1

Conventional approaches (3D isotropic FSE)

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The 3D isotropic image can be used to make multi-planar reformatted images and can shorten the total acquisition time by obviating the need to acquire the same sequence in different planes. Several 3D fast-field echo imaging methods have been used in the evaluation of the knee joint with multi-planar reconstruction, but insufficient soft tissue contrast leads to limitations in the detection of ligament injury. 3D isotropic fast spin-echo T2-weighted MR (volume isotropic turbo spin echo acquisition [VISTA]) enables thin-section data acquisition without inter-slice gap and multi-planar image reformation that may be helpful for the analysis of complex structures (12). The VISTA sequences are obtained utilizing a fast spin echo (FSE) 3D non-selective method, which uses short, non-volume selective FSE to refocus pulses and slow shorter echo spacing to prevent chemical shift artifact. 3D FSE produced high-quality isotropic images with similar contrast to 2D FSE. The diagnostic performance of 3D FSE with multi-planar reformation for internal derangements of the knee is comparable to that of conventional sequences consisting of 2D FSE.

Keywords : MR, Nterior cruciate ligament, Sequence-3D fast spin-echo imaging

New Horizon of Fast MSK Imaging

SY26-2

New Horizon of Fast MSK Imaging : Fingerprinting

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MRF (Magnetic Resonance Fingerprinting) has been introduced as a fast method for quantitative MRI. It takes advantage of the unique signal evolution of transient state imaging by utilizing fast data acquisition, incoherent error, and dictionary matching. The method has shown applications not only for brain imaging but for MSK. Here, we introduce the basic concepts for MRF and key issues that make MRF a potentially useful application. Also, MRF in the context of MSK Is discussed. In particular, high resolution MRF and fat/water MRF are discussed. For high resolution MRF, the limit of data acquisition and how it impacts the signal-to-noise ratio of data will be investigated. For fat/water MRF, we present an unique signal evolution pattern to separate the signals coming from fat and water. Practical issues with these MSK oriented applications are discussed and potential solutions are presented.

Keywords : Magnetic Resonance Fingerprinting

New Horizon of Fast MSK Imaging

SY26-3

Compressed Sensing in musculoskeletal MRI

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In this work, we present the basic principles of compressed sensing and its applications to musculoskeletal MRI. To this end, we present how to achieve optimal acquisition for compressed sensing, how to reconstruct MSK images, how to separate fat and water images in a single acquisition, how to reconstruct compressed sensing processed MSK images directly from k-space, and how feasible it is to perform 3D MSK imaging in a clinically feasible imaging time using compressed sensing.

Keywords : MSK, MRI, Compressed sensing

New Horizon of Fast MSK Imaging

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New horizon of fast MSK imaging, Clinical application in MSK Field

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The recent advancement in fast imaging technology can markedly reduce the imaging acquisition time. Specific advancements include gradient echo imaging, echo planar imaging, and parallel imaging. These techniques have proven to be extremely useful in recent times. Several ongoing applications and evaluations such as synthetic magnetic resonance image (MRI) and compressive sensing (CS) MR imaging show promise for fast imaging sequences.

Synthetic MR imaging is a novel method that generates T1-weighted, T2-weighted, proton density-weighted, and short tau inversion recovery (STIR) images based on MR quantification (relaxation time and proton density) with B1 inhomogeneity correction within a single scan. This synthetic MRI technique can be applied in musculoskeletal imaging. The advantage offered by synthetic MRI is the clinical feasibility of simultaneous TR- and TE-tunable multi-contrast imaging with single image acquisition. Because multiple synthetic imaging sequences can be generated from single quantitative acquisition, it demonstrates time-saving potential as compared with the time taken in conventional MRI acquisition. Synthetic potential time-saving MRI was recently introduced to enable rapid acquisition and accurate quantification of MR images, which make it possible to reformat various synthetic images by adjusting scanning parameters such as repetition time (TR) and the echo time (TE).

Compressive sensing (CS) has been developed and has been applied to accelerate MRI acquisition in the past decade. CS was founded on the premise of reconstructing an image from an incompletely filled *k-space*, i.e. undersampled *k-space*, as the number of segments in *k-space* is a direct determinant of image acquisition time. Using different algorithms, medical images can be successfully compressed while preserving diagnostic efficacy. The application of CS has been initiated in isotropic three-dimensional (3D) volumetric MRI, which requires a relatively longer scanning time and is susceptible to motion-related artifacts during the scan.

In conclusion, the use of synthetic MRI and CS MRI shows potential in the field of musculoskeletal imaging for quantitative imaging with adequate image quality and comparable diagnostic performance. The synthetic MRI and CS MRI could play an important role in achieving a better patient experience.

Keywords : MRI, fast imaging, compressed sensing, synthetic MRI