Advanced MR Techniques with MSK Application

UTE : Cartilage and Fibrocartilage - Structure & Function

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Background

Healthy joints, such as the knee, hip and ankle, are essential for carrying out everyday activities such as walking, climbing stairs and rising from a chair. However, such activities are difficult if not impossible for the 27 million Americans who suffer from osteoarthritis (1), a degenerative joint disease for which there is no known cure. MRI is being increasingly used to study and evaluate joint tissues in clinical studies of osteoarthritis (2-4); however, there are certain important joint tissues that are difficult to visualize using traditional MRI scans. These tissues, such as tendons, ligaments, meniscus and the deep layers of cartilage, have highly organized collagen ultra-structures and therefore short T2 relaxation times. Most clinical scanners use echo times of 8-20 ms; however, these tissues have T2 relaxation times ranging from less than 1 ms (5), in tendons, to 12 ms in the meniscus (4). Thus, short T2 tissues have limited or no signal on traditional MR images. With ultrashort echo time (UTE) sequences, echo times as short 8 μs are possible (6). This greatly improves our ability to visualize short T2 tissues and also allows us to quantify properties such as T2, T2* and T1ρ relaxation (7-9). Measuring these quantities is particularly important because traditional MR techniques have shown that T2 and T1ρ are sensitive to degenerative changes in cartilage and meniscus (10,11). If we can identify and track early degenerative changes in short T2 tissues with these metrics it may be possible to develop and evaluate disease modifying treatments for osteoarthritis. UTE MRI therefore has great potential for improving our understanding of short T2 joint tissues and the role they play in osteoarthritis and other degenerative joint diseases.

Learning Objectives:

By the end of this session participants will be able to:

1. Describe the structure and function of tendons, ligaments, meniscus and cartilage in healthy and degenerated joints.
2. Describe the basics of UTE imaging.
3. Describe how UTE has been used morphologic and quantitative imaging of short T2 tissues in healthy and degenerated joints.
References

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cartilage: in vivo assessment of early degenerative changes in symptomatic osteoarthritic