MSK Clinical and Research Applications of T1rho Imaging

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The primary clinical and research applications for T1rho are focused on quantitative imaging of hyaline cartilage, meniscus and intervertebral disc. A number of clinical studies have been performed studying the role of T1rho in osteoarthritis and early degenerative disease of the knee, hip and spine (1-11).

T1rho of the hyaline cartilage

Measuring T1rho of the hyaline cartilage in knee joints differences were found between normal controls and patients with osteoarthritis. It could be demonstrated that in particular patients with early osteoarthritis had increased T1rho values compared to normal controls (4). Focal areas of increased T1rho were found in patients without morphological changes in standard MRI and were confirmed as abnormal cartilage on arthroscopy (5), suggesting that T1rho identifies focal cartilage degeneration earlier than conventional MRI. In an additional study physically active subjects without clinical symptoms were studied and increased T1rho was found of the global cartilage matrix if focal cartilage defects were present (10). The authors concluded that T1rho could be a parameter suited to identify active healthy subjects at higher risk for developing cartilage defects.

T1rho of the menisci

A small number of studies has focused on measuring T1rho of the meniscus (6, 11). It was found that meniscal T1rho correlated significantly ($p<0.05$) with clinical findings of osteoarthritis; T1rho in subjects with early findings of osteoarthritis was increased compared to normal controls. An additional study found an increase of T1rho in healthy subjects after running a marathon, which persisted for a period of 3 months suggesting changes of the cartilage matrix induced by marathon running.

T1rho of the intervertebral disc

Recent in vitro studies have reported correlations between T1rho and glycosaminoglycan content (12), and have demonstrated a relationship between T1rho and disc mechanical properties (13), suggesting that T1 rho may be sensitive to early biochemical changes in disc degeneration. In vivo studies have demonstrated differences in mean T1rho values between the nucleus and the annulus, and have shown a correlation between T1rho and degenerative grade in an asymptomatic population at 1.5 Tesla (14), thus demonstrating the feasibility of quantifying T1rho in human subjects.

Conclusion

Findings of previous clinical studies suggest that T1rho is a promising biomarker to quantify early degenerative disease of spine and joints and may identify subjects at risk for osteoarthritis. T1rho can be implemented for imaging of knee and hip cartilage,

menisci and the intervertebral disc. To better understand the significance of T1rho, however, longitudinal studies are required and currently conducted.

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