MR CARTILAGE IMAGING IN KNEE JOINT OSTEOARTHRITIS

Thesis

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LIST OF ABBREVIATIONS

2D	two dimensional
3D	three dimensional
ACL	anterior cruciate ligament
ADC	apparent diffusion coefficient
B_0	main magnetic field
b-FFE	balanced fast field echo
BLOKS	Boston Leeds osteoarthritis of the knee score
BML	bone marrow lesions
COMP	cartilage oligomeric matrix protein
DEFT	driven equilibrium Fourier transform
DESS	dual echo steady-state
DRIVE	FSE with driven equilibrium pulses
DTI	diffusion tensor imaging
DWI	diffusion weighted imaging
ETL	echo train length
FCL	fibular collateral ligament
FEMR	fluctuating equilibrium MRI
FFE	fast field echo
FIESTA	fast imaging employing steady stateacquisition
FISP	fast imaging with steady state precession
FLASH	fast low angle shot
FOV	field of view
FSE	fast spin echo
GRE	gradient recalled echo
IDEAL	iterative decomposition of water and fat with echo asymmetry and least-squares estimation
IM	Intermediate weighted sequence
ISK	index of severity for osteoarthritis of the knee
KL	Kellgren-Lawrence
KOSS	knee osteoarthritis scoring system
LFTC	lateral femoro-tibial compartment
MCL	medial collateral ligament
MFTC	medial femoro-tibial compartment
MOAKS	MRI osteoarthritis knee score

ms	milli second
MT	magnetization transfer
No	Number
OA	Osteoarthritis
P	probability of error
PCL	posterior cruciate ligament
PD	proton density
PFC	patello-femoral compartment
PSIF	time reversed FISP
r	Spearman correlation coefficient
ROI	region of interest
SPACE	sampling perfection with application-optimized contrast using different flip-angle evolutions
SPGR	spoiled gradient recalled echo
SS	sub-spinous
SSFP	steady state free precession
T	Tesla
T1	Spin lattice relaxation time
T2	Spin spin relaxation time
T1-FFE	T1-weighted fast field echo
TE	echo times
TR	repetition times
UTE	Ultrashort echo time
WOMAC	Western Ontario and McMaster University osteoarthritis index
WORMS	whole-organ magnetic resonance imaging scoring

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INTRODUCTION AND AIM OF THE WORK

INTRODUCTION

Hyaline cartilage is an important intra-articular tissue that may be involved in degenerative change of knee joint. Damaged cartilage rarely heals spontaneously, and its subsequent degeneration in association with degeneration of other articular tissues may lead to knee osteoarthritis (OA), which is a cartilaginous and a whole-organ disease ***(Felson, 2006)***.

OA is the most frequent form of arthritis, with major implications for individual and public health care without effective treatment available ***(Roemer et al., 2011)***. It is an important health concern, as joint disease is the single largest cause of disability in elderly people ***(Hardingham and Bayliss, 1990)***. Symptomatic OA causes substantial physical and psychosocial disability ***(Hunter, 2011)***.

From a rheumatologist's perspective, cartilage imaging is most significant in the setting of OA ***(Hunter, 2011)***. The field of imaging in OA and cartilage has evolved rapidly, and, despite the continued lack of effective therapies, there is hope that imaging might be in a position to help drive a therapeutic breakthrough ***(Roemer et al., 2011)***.

Many imaging methods are available to assess articular cartilage. Conventional radiography can be used to detect gross loss of cartilage, evident as narrowing of the distance between the two adjacent bones of a joint ***(Boegard et al., 1998)***, but it does not image cartilage directly. Secondary changes such as osteophyte formation can be seen, but conventional radiography is insensitive to early chondral damage ***(Gold et al., 2009)***. Arthrography, alone or combined with conventional radiography or CT, is mildly invasive and provides information limited to contour of cartilage surface ***(Coumas and Palmer, 1998)***. Conventional MRI sequences do not provide a comprehensive assessment of cartilage, lacking either in spatial resolution or specific information about cartilage physiology ***(Gold et al., 2009)***.

The field of joint imaging and particularly MR imaging, has evolved rapidly owing to technical advances and application of these to field of clinical research. Cartilage imaging certainly is at the forefront of these developments ***(Roemer et al., 2011)***.

Recently, MR imaging has become the most important modality for assessment of pathologic changes in knee cartilage, in both clinical and research environments. One of the major advantages of MR imaging is that it allows the manipulation of contrast to highlight different tissue types. The new surgical and pharmacologic options available to treat damaged cartilage, and the need to monitor effects of treatment, have led to development of various MR imaging techniques that allow morphologic assessment of cartilage, quantification of its volume, and evaluation of its biochemical composition ***(Gold et al., 2009)***.

Pharmacologic agents proposed to preserve hyaline cartilage or to treat damage to cartilage include dietary supplements. Their effectiveness for slowing or halting progression of cartilaginous degeneration, decreasing knee pain, and improving joint function is debated ***(Black et al., 2009)***. Mechanism of activity of these agents remains obscure, but continuing research into these and other potentially chondroprotective agents will require techniques to monitor both the morphologic status and the composition of hyaline cartilage ***(Crema et al., 2011)***.

Various reparative and reconstructive surgical techniques are available to treat traumatic and degenerative cartilaginous damage ***(Gudas et al., 2005 & Knutsen et al., 2007)***.

Even though clinical outcome of clinical and surgical treatments is the most important outcome parameter in trials, morphologic and compositional quality of cartilage can provide valuable information about progression of degeneration or durability of repair tissue. MR imaging, method of choice for detecting morphologic and compositional alterations in knee cartilage, is therefore useful for monitoring effects of therapies for OA and cartilage injury. Current MR imaging techniques to assess morphologic status of cartilage include conventional spin-echo (SE) and gradient-recalled echo (GRE) sequences, fast SE sequences, and more advanced isotropic three-dimensional (3D) SE and GRE sequences Compositional assessment techniques include T2 mapping, delayed gadolinium-enhanced MR imaging of cartilage (dGEMRIC), T1ρ imaging, sodium imaging, and diffusion-weighted imaging. These techniques allow detection of morphologic defects in articular cartilage of the knee and are commonly used in research for semiquantitative and quantitative assessments of cartilage. These techniques may be used in various combinations and at various magnetic field strengths in clinical and research settings to improve characterization of changes in cartilage ***(Crema et al., 2011)***.

AIM OF THE WORK:

This study aims to describe articular cartilage changes as assessed by MR cartilage imaging in knee joint osteoarthritis.