

dGEMRIC of the First Carpometacarpal (1CMC) Joint: Initial Results

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Introduction

The first carpometacarpal (1CMC) joint, at the base of the thumb, is a frequent site for osteoarthritic (OA) changes [1]. The dGEMRIC (delayed Gadolinium Enhanced MRI of Cartilage) technique offers a non-invasive method to evaluate cartilage biochemical status, and potentially identify arthritic changes early in the disease process. In the dGEMRIC technique cartilage T1 in the presence of Gd-DTPA²⁻ (T1(Gd)) is used as an index of glycosaminoglycan distribution in the tissue. While it has previously been applied in the knee and hip joint, the finger joint represents a particular challenge due to the high resolution needed to depict the thin cartilage in that region. The aim of this study is to examine the feasibility and obtain pilot results of dGEMRIC evaluation of 1CMC joint cartilage.

Methods

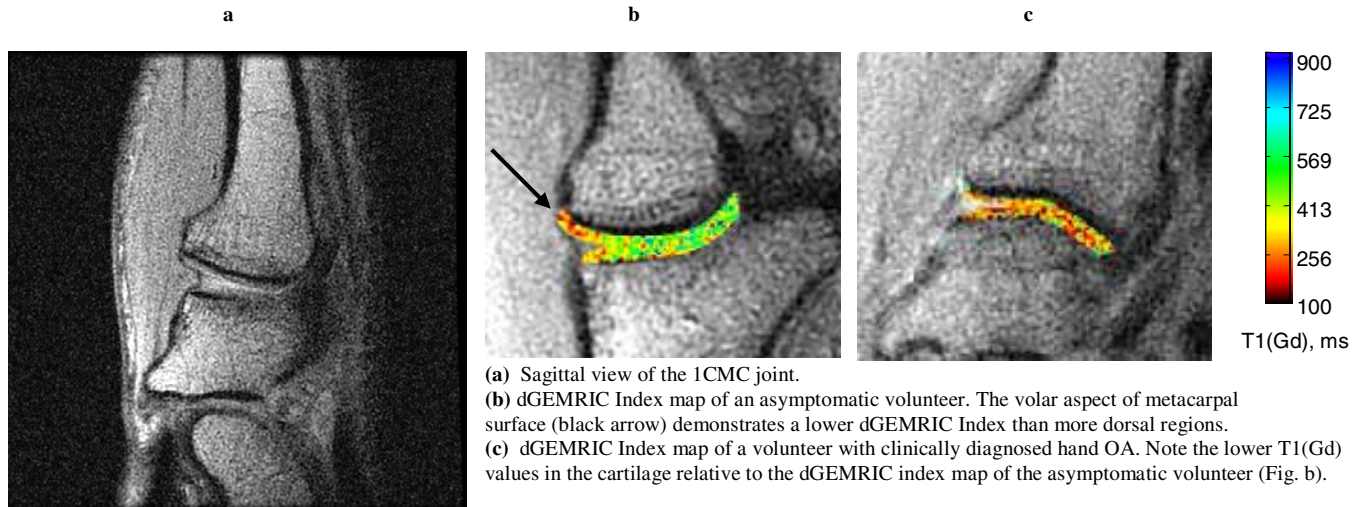
The right hands of 5 subjects (3 asymptomatic, 1 with 1CMC joint pain, 1 with clinically diagnosed hand OA) were examined using the standard dGEMRIC protocol [2]. All studies were approved by the institutional review board, and all subjects gave their informed consent. Volunteers were injected intravenously with 0.2 mM/kg Magnevist (Berlex Imaging, Wayne, NJ, USA) and asked to squeeze a squeeze ball for 5 minutes following injection. Ninety minutes after injection, volunteers were imaged with a 1.5T GE Signa TwinSpeed MRI (GE Healthcare, Waukesha, WI, USA) using a commercially available 1" surface coil (eCoil, Medrad, Indianola, PA, USA). Single slice sagittal inversion recovery prepared fast spin echo images were acquired with a 6 cm field of view and 195-235 μ m in-plane x 1.0 - 1.5 mm thick resolution. In order to achieve the high in plane resolution, the "Zoom" gradient (40 mT/m max gradient strength, 150 mT/m/ms slew rate) of the TwinSpeed MRI was used for all imaging. The inversion recovery image series was acquired with 5 T1 delay times ranging between 50-1650 ms, constant TR of approximately 1800 ms (TR value varied across subjects: 1767 -1900 ms), 20 kHz BW, ETL of 5, and 2NEX. The scan time was 15 min per slice. T1 maps were generated using custom coded software and cartilage was manually segmented. Regions of interest were analyzed on the trapezium and metacarpal surfaces of the 1CMC joint.

Results

Across all subjects, 1CMC joint dGEMRIC values ranged from 287-454 ms (mean \pm std: 372 \pm 52 ms). The lowest dGEMRIC indices were observed in the subject with clinically diagnosed hand OA. In all 5 subjects, the same regional variation in the dGEMRIC index was apparent: the volar aspect of the metacarpal surface demonstrated lower dGEMRIC indices than more dorsal regions. Averaged across subjects, the volar aspect was found to have 23% lower T1(Gd) than more dorsal cartilage (mean \pm std: 310 \pm 35 ms volar aspect vs 400 \pm 57 ms dorsal regions). Signal intensity across the images varied with coil placement resulting in low signal and difficulty in resolving cartilage/bone/synovium boundaries in the extreme dorsal aspects of some images.

Discussion

dGEMRIC evaluation of 1CMC joint cartilage is feasible using commonly available hardware and imaging sequences. dGEMRIC indices measured in 1CMC cartilage were shown to be in the same general range as dGEMRIC values previously measured in the knee and hip [3,4] with the lowest values observed in a subject with hand OA. Regional variations observed in this pilot study, consistent with prior reports suggesting that OA begins in the volar aspect of the joint [5], are intriguing and deserve further investigation in a larger cohort of subjects. For future dGEMRIC examinations, scan time may be reduced by employing a coil with better SNR, thus allowing larger portions of the 1CMC joint to be probed in a single imaging session.



References

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