Cartilage Imaging in the Workplace – Dominic Kennedy

Cartilage imaging has long been used to assess the structure of the cartilage as part of routine musculoskeletal MRI protocols. Standard MRI imaging of articular cartilage typically uses 2D SE/FSE proton density weighted type imaging together with 2D GRE sequences to delineate any cartilage abnormalities. 3D techniques are starting to be used more frequently as their scan times decrease and their ability to be reformatted with isotropic resolution leads to improved detection of articular cartilage lesions. Imaging of the collagen network and proteoglycan content using T2/T1 mapping (dGEMRIC) is also being used to provide physiological information about the cartilage. The routine MRI exam can be used to show both the structural and physiological integrity of the articular cartilage as well as providing information about the progression of degeneration of this cartilage.

Conventional MRI imaging showing the structural integrity of cartilage routinely uses 2D multi-slice proton density, T1 or T2 weighted scans with or without fat suppression in multiple planes. The resolution of the images has improved dramatically with the advent of higher field strength magnets, dedicated multi-array coils allowing for <3mm thick slices to be acquired routinely for 2D imaging. In-plane resolution of < 0.5mm allows excellent depiction of lesions in the imaging plane, but oblique structures can be difficult to interpret. Multiple planes are required to be imaged due to the partial volume artifacts that could occur as the slice thickness is >1mm. Currently 2D scan times are typically 2-3 minutes per sequence. 3D imaging with isotropic datasets eliminates this partial volume issue, as the slice thickness is <1mm and the in-plane resolution <1mm. Problems with 3D pulse sequences have been long scan times and lack of reliable contrast between cartilage and fluid (7). Scan times have decreased significantly in recent times due to increased signal to noise ratio by using higher field strength magnets and dedicated coils allowing use of higher parallel factors. Using a 3D FSE technique has been shown to be equal to a combination of 2D FSE in multiple planes (10).

Physiological assessment of the articular cartilage using dGEMRIC can be part of the routine MRI imaging protocol. dGEMRIC utilises the principle that the glycosaminoglycan in the cartilage and Gd-DTPA both contain negatively charged ions, and when the glycosaminoglycan in the cartilage is low (cartilage abnormality), the Gd-DTPA can enter the cartilage and be seen using T1 mapping allowing quantitative assessment. (7) The Gd-DTPA can be either injected intravenously (0.4ml/kg)(30-100min delayed scan) or intra-articular (2mM)(15min post injection delayed scan) (6). Patients exercise the joint post injection prior to imaging to improve uptake of the Gd-DTPA. Mapping values have shown to be similar regardless of the IV vs. IA technique used for GAD administration. (6) We currently use the IA technique for administration of the Gd-DTPA for our hip imaging as we perform an arthrogram as part of the standard imaging protocol. The patients walk for 15 minutes post injection, and are then scanned with the 3D sequence. The T1 mapping sequence takes an extra 5 minutes and is added to the standard hip protocol sequences. Images are post
processed and then reviewed by a radiologist by manually taking ROI values of the articular cartilage in all three planes.

Imaging cartilage, looking at both the structural and physiological integrity, can be achieved in your normal routine imaging time slots. It is important that we provide an accurate assessment of the cartilage, as this is an integral determinant of treatment and also its success. Determining the chondral damage at an early stage is vital, as diffuse chondral damage is typically associated with the worst outcomes (11) as well as allowing the patient the chance to change activities and minimise potential future debilitating outcomes.


