dGEMRIC in an OA population : Effect of Age and BMI

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Background

Since both age and obesity are known risk-factors for osteoarthritis (OA), it is reasonable to expect that increases in age and body mass index (BMI) would lead to biochemical degradation in weight-bearing cartilage. The dGEMRIC technique can quantitatively assess the biochemical status of cartilage by examining relative distribution of glycosaminoglycan (GAG) throughout the tissue. The purpose of this study to compare age and BMI to the dGEMRIC index in a population of volunteers with clinically diagnosed OA.

Methods

dGEMRIC images, volunteer age and body mass index (BMI) were compared in 25 volunteers with clinically diagnosed knee osteoarthritis. Standard AP radiographs were collected in a semi-flexed position and read in batches by a single blinded reader who assigned Kellgren and Lawrenece (K/L) and Joint Space Grade scores to each of the knees. dGEMRIC imaging was performed at 1.5T. Volunteers were given double dose IV injections of Magnevist (Berlex, Wayne, NJ), and asked to walk for 10min. Images were acquired approximately 90 min after the injection with either a 2D (n=11) or a 3D (n=14) T1-mapping sequence. Single slice sagittal 2D dGEMRIC images were acquired using an FSE IR sequence with 5 inversion delays ranging from 50-1650ms, TR/TE = 1800/14ms. 2D image resolution was 275um in-plane, 3mm thick. 3D dGEMRIC images were acquired using an IR prepared SPGR sequence with 62.5kHz bandwidth, 20 flip angle, five inversion delays ranging 10-1650ms, and variable TR ranging 300-1950ms. The 3D slab was oriented sagittally and 32 slices 3mm thick were acquired with 364x364um in-plane resolution. T1(Gd) maps were generated with a pixel-by-pixel 3-parameter fit routine using Matlab (TheMathWorks, Natick, MA). The "dGEMRIC Index", was averaged across the central zones of the femoral condyle and tibial plateau sagittal views. Two sagittal sections from each of 25 knees were considered. The sections were chosen from the center of the medial and lateral condyles. In two knees, cartilage was only present on one of the two condyles imaged, giving a total of 48 dGEMRIC indices included in the present analysis. Linear regression statistics were used to determine significance of trend line slopes where p the value represents the likelihood that the slope is equal to zero.

Results

No correlation was found between dGEMRIC index and age in either the 'uninvolved' (radiographically unnarrowed) compartments Figure 1 (left), or in the 'involved' compartments (radiographically narrowed) Figure 1(right). A correlation between dGEMRIC in OA volunteers with higher BMI was observed, Figure 2. In both the radiographically uninvolved and involved compartments, lower dGEMRIC was strongly associated with higher BMI ($p < 0.006$, $p<0.005$, respectively) with slopes of –9.03 (R^2=0.247) and –4.69 (R^2=0.36), in the uninvolved (right) and involved (left) compartments, respectively.

Figure 1

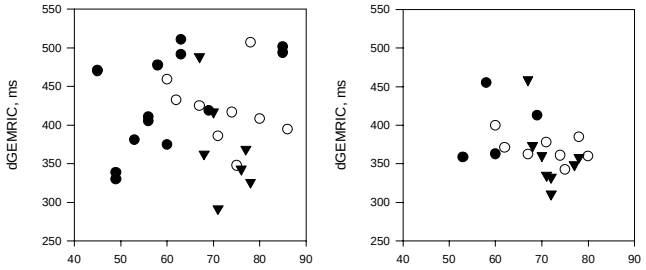

Figure 1 - No correlation is seen between dGEMRIC index and age in an OA population in the uninvolved (left graph) and involved (right) compartment of the knee. Closed circles = K/L 2, open circles = K/L 3, closed triangles = K/L 4.

Figure 2

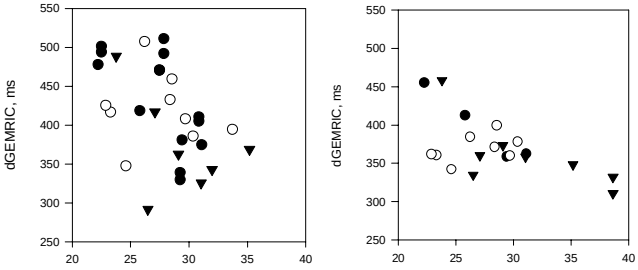

Figure 2 – Negative correlation is seen between dGEMRIC index and BMI in an OA population in the uninvolved (left graph) and involved (right graph) compartment of the knee.

Discussion/Conclusions

No correlation was found between dGEMRIC and age in this OA population. A negative correlation was observed between dGEMRIC and BMI, but the reason for this finding cannot be definitely determined. *In vitro* studies of cartilage explants have shown that excessive mechanical loading leads to GAG loss [1] so it is reasonable to hypothesize that years of excessive loading *in vivo* also leads to GAG loss. Another possibility is that cartilage of volunteers with high BMI may receive a higher dosage of contrast than volunteers with the same weight but lower BMI since contrast dosage is determined by weight, and since fatty tissue may not take up as much Gd-DTPA as lean mass. However, the fact that the correlation of the dGEMRIC index with BMI was much stronger in one compartment of the knee than the contralateral compartment, suggests that dosing was not an over-riding effect.

References

[1] Grodzinsky *et al*. Arthritis & Rheumatism. 2003 48(5)1292-1301.