REGIONAL RELATIONS WITHIN THE MEDIAL MENISCUS OF THE KNEE JOINT - ASSESSED WITH DGEMRIC

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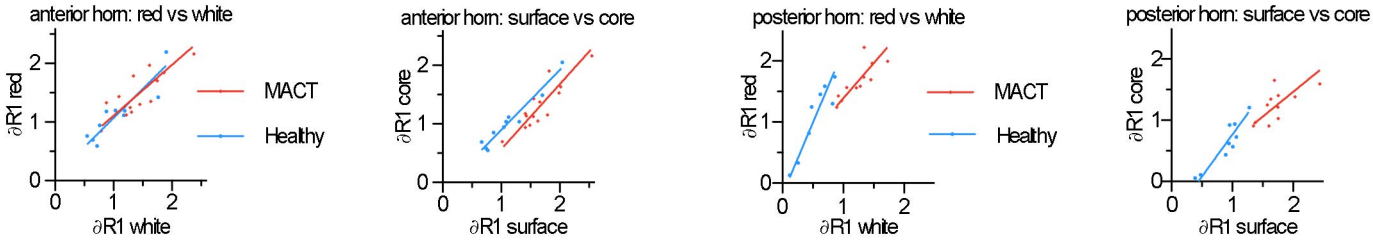
Introduction:
Delayed Gadolinium-enhanced magnetic resonance imaging of cartilage (dGEMRIC) is a well established method for quantitative evaluation of glycosaminoglycan (GAG) content of articular cartilage. dGEMRIC is based on the distribution of intravenously applied ionic gadopentate dimeglumine (Gd-DTPA^{2-}) in tissue. The distribution of Gd-DTPA^{2-} in articular cartilage is inversely related to the tissue concentration of proteoglycan, particularly GAG (1). Beside articular cartilage the menisci of the knee joint also serve an important role in distributing and attenuating load across this joint. The menisci are fibrocartilaginous with a lower proteoglycan content than hyaline cartilage (2). The aim of this study was to use a standard dGEMRIC protocol to search for different regional relations in the medial menisci of healthy volunteers versus patients after cartilage repair surgery.

Material and methods:
Fourteen patients one year after a matrix-associated autologous chondrocyte transplantation (MACT) on the medial femoral condyle of the femur and ten healthy volunteers (Volunteers) without any history or signs and symptoms of knee osteoarthritis were enrolled. Participants with tears or degeneration of either the anterior or posterior horn of their medial menisci on standard morphologic MR imaging were excluded. The dGEMRIC examinations were performed on a 3T MRI unit with the use of a pre- and postcontrast variable flip angle 3D GRE sequence for T1 mapping. We evaluated the horns of the medial meniscus with distinct regions of interest (ROIs) firstly for the white (centrally two-thirds) and red (peripherally one-third) zone, and secondly for the articular surface area (approximately one pixel wide) and the core area (remaining part). For all ROIs the relaxation rate R1 = 1/T1 (in 1/sec) both with and without contrast enhancement was calculated, and the delta relaxation rate (∂R1) by subtracting the latter from the former. The arithmetic means of ∂R1 of each region of each participant were calculated for further evaluation. Statistical analysis was performed with Model II linear regression and analysis of covariance (ANCOVA) whether the regression lines are different between the Volunteers and after MACT. A p value ≤ .05 was considered significant.

Results:
The results of the linear regression are given as [slope ± standard deviation, 95% confidence intervals of slope] and shown in the graphs below, the results of ANCOVA are given as p value . Anterior horn red versus white zone: Volunteers [0.9925 ± 0.17, 0.6005 – 1.385], MACT [0.8671±0.1836, 0.4672 – 1.267], p = 0.43 for slopes and p = 0.58 for intercepts. Anterior horn surface versus core area: Volunteers [1.023 ± 0.08852, 0.8193 – 1.228], MACT [1.111 ± 0.1712, 0.7383 ± 1.484], p = 0.89 for slopes and p = 0.005 for intercepts. Posterior horn red versus white zone: Volunteers [2.358 ± 0.3822, 1.423 - 3.293], MACT [1.151 ± 0.2834, 0.5098 - 1.792], p = 0.007 for slopes. Posterior horn surface versus core area: Volunteers [1.370 ± 0.2154, 0.8605 - 1.879], MACT [0.8096 ± 0.3011, 0.1285 - 1.491], p = 0.045 for slopes. Since the p value for the slopes of the posterior horn is statistically significant for both comparisons, it is statistically not possible to test the intercepts.



Discussion:
Our results indicate that the relation of the surface to the core area is statistically significant different between MACT and Volunteers for both the anterior and the posterior horn of the medial meniscus. The relation of the white with the red zone differs statistically significant between MACT and Volunteers for the posterior horn only. Assuming a similar rationale for the use of dGEMRIC for fibrocartilage as for articular cartilage we suggest that relative differences in GAG content account for our results. This is most probably due to an adaption to different loading patterns of the meniscus in patients after MACT versus healthy volunteers.

References:
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