

The effect of opening wedge high tibial osteotomy on patellar cartilage using dGEMRIC score as an indicator of cartilage health

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INTRODUCTION Opening-wedge high tibial osteotomy (OWO), a procedure used to treat medial tibiofemoral (TF) osteoarthritis (OA) for knees with varus malalignment, shifts load from the medial component to the lateral compartment of the TF joint. This procedure changes the kinematics of both the TF and the patellofemoral (PF) joints¹; however, the effect of this change on PF cartilage health is not known. It has been found that low glycosaminoglycan (GAG) content is associated with early osteoarthritis (OA)². The purpose of this study is to examine changes in patellar cartilage GAG content after OWO using delayed gadolinium-enhanced MRI of cartilage (dGEMRIC) T1 scores.

METHODS Fourteen (14) male subjects (mean age 48.3, SD 7.2) undergoing OWO participated in this study. All subjects gave informed consent and ethics board approval was granted. During surgery, titanium hardware was used to allow for follow-up scans. Each subject was scanned at three time points: within a month before surgery, 6 months after surgery, and 12 months after surgery using a 3T Philips Achieva scanner. Some subjects were unable to complete one or more of the follow up scans, and one subject's baseline scan was omitted due to data corruption. In total: at baseline, n = 13, at 6 months, n = 9, and at 12 months, n = 8. A standard dGEMRIC procedure was used: subjects were given double dose of Gd-DTPA²⁻ intravenously, and walked for 10 minutes. Two hours after injection, eight single slice inversion recovery scans were performed on the subject (TSE factor 9; TR 2200ms; TI 1800, 1200, 700, 400, 200, 150, 100, 50ms; FOV 100mm; matrix 256x256; slice thickness 3mm). For each set of eight scans, images were manually aligned to the highest inversion time image, and the dGEMRIC T1 values were calculated per pixel (MATLAB). The patellar cartilage area was segmented (MATLAB), and a linear mixed model was used to compare mean dGEMRIC scores over time (STATA).

RESULTS No statistically significant change was found in dGEMRIC score between the baseline (665ms) scan and the 6 month post-op (649ms) scan (p=0.4), or between the baseline scan and the 12 month post-op (700ms) scan (p=0.1). However, a statistically significant increase of 50ms was found in dGEMRIC score between 6 months and 12 months post-op (p=0.03) (Fig. 1, Fig. 2).

DISCUSSION Despite known kinematic changes in the PF joint with OWO, we found a positive significant difference in patellar dGEMRIC score from 6 to 12 months post-op. The dGEMRIC scores were within with the range of 400-900ms mean dGEMRIC T1 value found in another study at 3T³; a change of 50ms in dGEMRIC score is 10% of this range. While this change is small, one study showed that the development of radiographic OA by 6 years follow-up has been associated with a 71ms lower dGEMRIC score value in the TF joint at baseline⁴ (at 1.5T, with a smaller of T1 values expected³). Although only one imaging slice was evaluated, our results may indicate that the change in kinematics caused by OWO does not adversely affect patellar cartilage health.

REFERENCES

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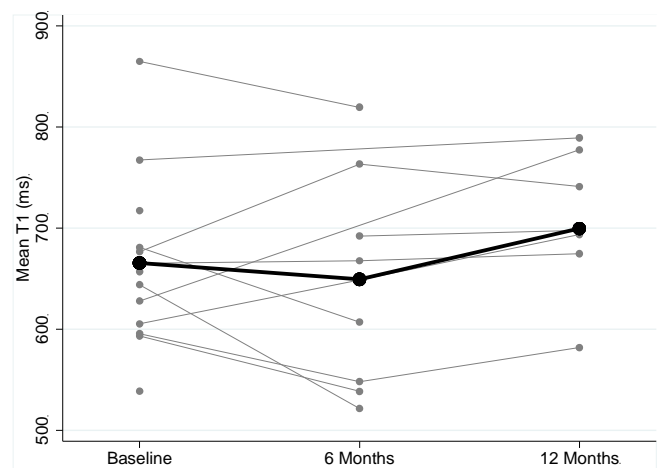


Figure 1: Patellar mean dGEMRIC score from baseline to 12 months post-op for all subjects. The mean linear mixed model results at each time point are shown in bold.

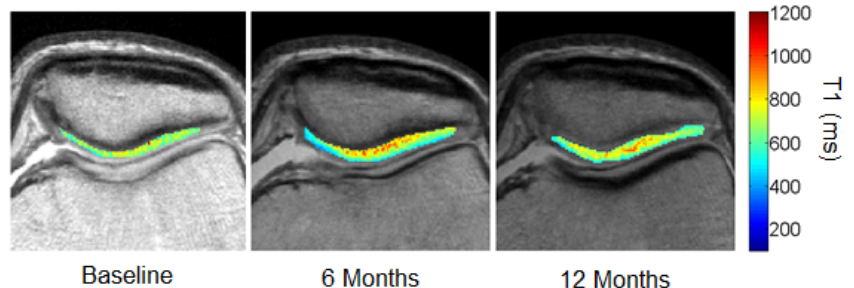


Figure 2: Segmented patellar T1 maps for one subject from baseline to 12 months