

Impact of Infrapatellar Fat Pad Morphology and MRI Signal Intensity on Its Movement in Patients with Knee Osteoarthritis

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INTRODUCTION: Knee osteoarthritis (KOA) is one of the most common inflammatory diseases and it is an irreversible degenerative disease, in which the principal complaint is pain during loading, such as walking. The infrapatellar fat pad (IPFP) might be related to KOA because the IPFP changes to fibrosis after inflammation which was observed as high intensity on Magnetic Resonance Imaging (MRI). The IPFP exists in the anterior component of the knee joint and it should change its shape during knee motion. The fibrotic IPFP after inflammation might be difficult to change its shape during knee motion in patients with KOA. We reported the movement of the IPFP was smaller in the patients with KOA than in young healthy individuals from 30° to 0° knee flexion using 3D models created by MRI. However, there has been no investigation of the relationship between high intensity in the IPFP on MRI and the IPFP movement which was calculated using 3D models in patients with KOA. The purpose of this study is to compare the IPFP movement in the high-intensity group and the low-intensity group of the IPFP in patients with KOA. The hypothesis is that the IPFP movement with high intensity on MRI is smaller than that without high intensity.

METHODS: After obtaining approval from the local ethics committee, we recruited patients with KOA and young healthy individuals to serve as controls. Selection criteria for the KOA group were: 1) age 40 to 79 years at the time of recruitment, 2) Kellgren–Laurence (K/L) grade of 1 to 4, and 3) no history of surgery or fracture in either lower limb. Selection criteria for a healthy group were: 1) age 20 to 25 years, 2) healthy knees, 3) normal range of motion, and 4) no history of surgery or fracture of either lower limb. Common exclusion criteria for both groups were: 1) problems with communication, 2) difficulty in understanding the research, 3) pregnancy, 4) medical risks, or 5) rheumatoid arthritis. All participants agreed to participate in this study. Fourteen patients with KOA (2 males, 12 females), averaged 65.67 ± 6.69 years of age, and eight healthy individuals (4 males, 4 females) averaged 22.0 ± 2.0 years. Movement of the IPFP was quantified for both groups using 3D models of the tibia and IPFP from MRI scans taken at 0° and 30° knee flexion (Fig.1). Outcomes were (1) movement of the IPFP, (2) volume change of the IPFP. MRI of the knee was taken using a 0.3T APERTO (Hitachi Medical Corporation) at 0° and 30° knee flexion in the supine position (The imaging sequence was 3-dimensional T1 sagittal images with a slice pitch of 1 mm spanning 250 mm across the knee (TR:3700, TE:90)). 3D coordinate system (X, Y and X axis) was embedded in the tibia using commercial 3D-Aligner software (GLAB Corp). Knee positions corresponding to the six degrees-of-freedom of the tibia were calculated with reference to the femoral 3D coordinate system, as described in a previous study. Movement of the IPFP was calculated as outlined below. For movement of the IPFP, we calculated the antero-posterior position of the anterior surface point of the IPFP using a coordinate system and the value got by the IPFP position at 30° subtracted from the IPFP position at 0°. For volume change of the IPFP, the IPFP model was divided into eight portions by three planes (sagittal, horizontal and coronal planes) and the divided IPFP models in each hyperoctant at 30° were subtracted from the divided IPFP models at 0° to determine the volume changes in each hyperoctant. We defined that when high intensity in the IPFP was recognized in more than one MRI slice, the IPFP was allocated to the high-intensity group. A non-paired t-test was used to compare each parameter in both groups. The significance level was set at alpha = 0.05.

RESULTS SECTION: Eight patients with KOA had high intensity in the IPFP on MRI and six subjects were without high intensity. The IPFP movement (high-intensity:2.68 mm, low-intensity group:3.20 mm) showed no significant difference between the two groups (p=0.365) (Table.1). However, the IPFP movement in both groups was significantly smaller than in young healthy individuals (IPFP movement:5.23mm, vs. high-intensity group: p=0.041, vs. low-intensity group: p=0.045). The volume change of the IPFP suggested that it moved anteriorly from 30° to 0° knee flexion in the young healthy individuals. However, anterior movement was not observed to move anteriorly movement in either KOA group.

DISCUSSION: This study suggested that the IPFP movement in patients with KOA might be limited from 30° to 0° knee flexion regardless of whether their IPFP showed high intensity, compared with young healthy individuals. This means that patients with KOA might have limited IPFP movement even if they didn't show high intensity in the IPFP on MRI. Treatment to improve IPFP movement in patients with KOA should be considered, even if no high intensity is observed on MRI in the IPFP. A limitation of this study was that it compared the patients with KOA only with young healthy individuals. Therefore, we could not discuss the effect of aging on the IPFP movement. We should investigate the IPFP movement in patients with KOA and elderly individuals without KOA in the future.

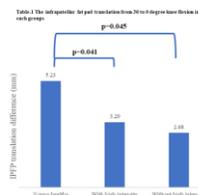
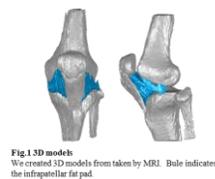
SIGNIFICANCE/CLINICAL RELEVANCE: (1-2 sentences): The IPFP movement in patients with KOA might be limited regardless of imaging findings, such as high intensity in the IPFP on MRI.

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ACKNOWLEDGEMENTS: Include acknowledgements here. (Acknowledgements are Optional)

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