The fifth decade is a tipping point for disease-related alignment changes involving the lower extremities and the spine

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INTRODUCTION: In previous cohort studies, the relationship between adult spinal deformities (ASD) and knee osteoarthritis (KOA) was reported [1,2)] and 12.2% of people had both low back and knee pain [3)]. It is not clear whether those phenomena occur due to aging in each spine and knee, or whether they are compensating changes [4)]. There are also few reports of a relationship with alignments of the hip, and pelvis [5)]. Therefore, the relationship between the age-related knee alignment changes using CAPK classification [6)] and the spine-pelvis alignment using Schwab adult spinal deformity classification was examined in a cohort study.

METHODS: The subjects were healthy 62 women, in their 40s and 80s, who participated in the resident examination twice voluntarily. Using the standing lower limb AP and lateral X-rays in 1st screening and 5 years later (the 2nd screening), 15 parameters of pelvic and lower limb alignments were measured. Parameters included SVA, SS, PT, PI, LL, and PA in sagittal spine alignment, and FTA, HKA, %MA, JOL, mLDFA, mLDFA, mMPTA, mLDTA, and KL-grade in knees. Spine sagittal alignment was evaluated by PI-LL, global alignment, and pelvic tilt according to Schwab classification. Knee alignment was divided into I - IX groups according to the CPAK classification. The inter-examiner error was 0.98, and 0.05 was considered as a significant level. SPSS software was used for statistical analysis and the significance level was less than 5%.

RESULTS: (1) CAPK classification group I was 15.3%, II was 16.9%, IV was 15.4%, and V was 30.6% in the 1st screenings. Group I was 23.6%, II was 16.4%, IV was 22.4%, and V was 18.0% in the 2nd screening. (Figure 1) (2) No statistical correlation between X-ray parameters and age was observed at 1st screening and 2nd screening. The people who changed to varus in the 2nd screening had a smaller SS and a larger PT indicating pelvic tilted posteriorly at 1st screening. (3) Comparing each parameter by age group, HKA increased in the 50s, 70s, and 70s compared to the 40s. A statistical correlation was found between SVA and HKA in the 40s (r=0.593、P<0.01). A statistical correlation was found between SVA and %MA in the 70s (r=0.761, p<0.01). (Figure 2) KL grade was higher by age group, but there was no statistical difference. (4) No statistical correlation between the sagittal alignment according to Schwab classification and the varus alignments group (I, IV, VII), neutral (II, V, VIII), or valgus (III, VI, IX) aliment group of CAPK classification at 2nd screening. However, %MA was significantly smaller (knee varus) in the posterior tilt ++ group (30 degrees < PT; high posterior pelvic tilt) (p = 0.026). (figure3)
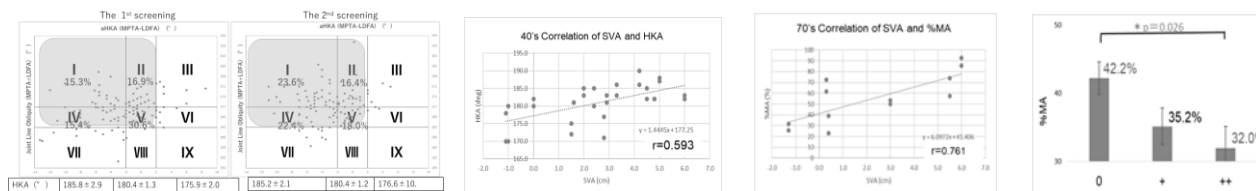

Figure 1: CAPK classification   Figure 2: Correlation of SVA and HKA or %MA.   Figure 3: Schwab pelvic tilt and %MA

DISCUSSION: Although age-related changes and alignment changes in the knees and spine appeared, they did not necessarily result in high-grade OA, nor did they develop pathological ASD. In this study, the most people who changed in the 2nd screening were in the varus and the apex distal. People with the change to varus alignment had a smaller SS and a larger PT indicating pelvic tilted posteriorly. Also, the small %MA suggested knee varus showed an anterior trunk tilt in the 70s and the small %MA had a bigger pelvic tilt. There are compensatory mechanisms in the lumber and knees[7)]. There is also a report that there is an association between the Schwab classification and the KL grade[8)], although different from our results.
Knee alignment (HKA) showed a significant difference between the 40s age and later. Knee varus alignment correlated to spine sagittal alignment in the 40s and 70s. These suggest that the 50s - 60s may be the turning term of the disease-related lower extremity varus.

SIGNIFICANCE/CLINICAL RELEVANCE: The knee alignments changed to the varus and the apex distal with aging. These varus changes in more than the 50s were correlated with the change of pelvic tilt posteriorly. Although age-related changes and alignment changes in the knees and hips appeared, they did not necessarily result in high-grade OA, nor did they develop pathological ASD. The 50s - 60s may be the turning term of the disease-related lower extremity varus.

REFERENCES: (1)Yoshimura N et al. JBMM. 2009,(2) Barry C et al. Euro Spine J. 2013, (3)Shimizu M et al Scientific reports.2020,(4) Bao H. et al. Eur Spine J 2018, (5) Katsumi R, et al. J Knee Surg 2022,(6) MacDessi S. et al. The Bone & Joint Journal, 2021, (7)Eur Spine J. 2013 Nov;22 Suppl 6(Suppl 6): S834-41(8) Cho HJ, Clini.Ortho.Res , 2015