Apex distal joint line obliquity (JLO) leads to greater progression of knee osteoarthritis compared to a neutral and proximal JLO in coronal plane alignment of the knee classification: A longitudinal study from the TOEI study

Kazuki Nomoto[1], Mitsuru Hanada[2], Kensuke Hotta[2], Yuki Murakami, Yukihiro Matsuyama[2]
[1]Hamamatsu University Hospital, [2]Hamamatsu University School of Medicine

INTRODUCTION:

Knee osteoarthritis (OA) is a complex degenerative disease that involves advancing age, hereditary disease, and post traumatic changes. The number of patients with knee osteoarthritis is increasing. Several mechanical factors have been identified as having a significant influence on knee OA. The geometry of an articular surface, which is a determinant of altered joint biomechanics, may be an important risk factor for knee OA.

Recently, the coronal plane alignment of the knee (CPAK) classification system proposes nine phenotypes according to arithmetic hip-knee-ankle angle (aHKA) and Joint line obliquity (JLO) for predicting the pre-arthritic alignment of the knee. The aHKA and JLO are composed of anatomical joint line measures of the lateral distal femur angle (LDFA) and medial proximal tibial angle (MPTA). No study that longitudinally examines which types of aHKA and JLO progress to knee OA has been reported. This longitudinal study aimed to evaluate which types of aHKA and JLO progress to knee OA.

METHODS:

A total of 248 patients (79 men and 169 women) participated in the first survey in 2012 and the fifth survey in 2020 in Toei Town in Aichi Prefecture, Japan (Fig. 1). Patients with at least one knee with Kellgren-Lawrence (KL) grade 0–1 in 2012 were included in the study. Alignment parameters, including the aHKA, JLO, hip-knee-ankle angle (HKA), LDFA, MPTA, and joint line convergence angle (JLCA), were measured (Fig. 2). Changes in distribution of CPAK classifications were investigated. The rate of knee OA progression was compared between varus aHKA and other types of aHKA (neutral and valgus). Additionally, the progression rate was compared between apex distal JLO and other types of JLO (neutral and apex proximal). Knee OA progression was defined as advancement from KL grade 0–1 to a KL grade 2-4.

RESULTS:

The study included 180 patients (329 knees) (Fig. 1). The distributions of all CPAK phenotypes were similar between 2012 and 2020 (Fig. 3,4). 56 out of 148 varus aHKA (27.3%) and 37 out of 124 other types of aHKA (29.8%) had knee OA progression. The rate of knee OA progression in the varus aHKA was not significantly different compared to other types of aHKA (χ^2 (1) = 0.2; P=0.36; φ= -0.03). 83 out of 268 apex distal JLO (31.0%) and 10 out of 61 other types JLO (29.8%) had knee OA progression. Apex distal JLO had a higher rate of knee OA progression than other types of JLO (χ^2 (1) = 5.2; P<0.05; φ= 0.126). There were no significant differences in age, gender, and BMI between the group with progression of knee OA and the group without progression concerning the apex distal JLO. (Table 1) The longitudinal changes of each parameter in both groups were shown (Table 2).

DISCUSSION AND CONCLUSION:

The most important finding of this study was the progression of knee OA showed significant differences between apex distal JLO and other types of JLO. To our knowledge, this is the first longitudinal study to examine which types of JLO progress to knee OA.

MacDessi et al. reported that LDFA and MPTA were unaffected by cartilage wear in patients with OA. Additionally, aHKA and JLO, which were calculated using MPTA and LDFA, remained unchanged with the progression of OA. They concluded that the CPAK classification can be used for both patients with arthritis and healthy individuals. Therefore, patients with apex distal JLO before OA progression can be identified as being at risk for knee OA progression. According to previous reports, 52.8-75.4% of individuals in other countries had apex distal JLO, whereas 89.2% of individuals in Japanese had apex distal JLO. In this study, 81.4% of individuals had apex distal JLO. These results may indicate that Japanese patients had a stronger medial inclination and a bone morphology that predisposes them to a higher rate of knee OA progression.

In conclusion, apex distal JLO had a higher rate of knee OA progression compared to other types of JLO. From the perspective of bone morphology, patients with apex distal JLO were at risk for knee OA progression and Japanese individuals are more susceptible to the progression of knee OA.