

Association between femoral neck-shaft angle 2 years after ACL injury with medial tibiofemoral osteoarthritis 5 years after anterior cruciate ligament injury

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Background:

The relationship between hip anatomy, knee alignment and osteoarthritis (OA) after anterior cruciate ligament (ACL) injury is unknown.

Purpose:

To investigate if knee alignment and hip geometry assessed 2 years after ACL injury is associated with compartment-specific OA of the injured knee 5 years after the ACL injury.

Figure 1: Full-limb radiographs were obtained of the injured leg with the radiographed leg in weight-bearing and in slight knee flexion. The HKA was assessed by drawing a line from the center of the femoral head to the center of the tibial spines. An additional line was drawn from the center of the trochlea of talus to the center of the tibial spines. The HKA angle was defined as the medial angle at the intersection of the two lines. The NSA was defined as the angle between the femoral neck axis and the femoral long axis. The femoral neck axis was defined as the line between the center of the femoral head and the femoral neck center. The FNL was defined as the distance from the femoral head to the intersection between the femoral neck axis and the femoral long axis. The FO was defined as the distance in the transverse plane from the center of the femoral head to a line bisecting the long axis of the femur. HKA: hip-knee-ankle angle; NSA: neck-shaft angle; FO: femoral offset; FNL: femoral neck length. The figure is showing only the proximal part of a full-limb radiograph of the left leg.



Results

In patients who had developed *medial tibiofemoral* OA at the 5-year follow-up, the HKA angle at the 2-year follow-up was 176.4°, compared to 178.7° in patients who had not developed medial tibiofemoral OA at the 5-year follow-up. The mean difference was -2.3° (95% CI -4.2° to -0.4°, p=0.02). In patients who had developed *medial tibiofemoral* OA at the 5-year follow-up, the NSA at the 2-year follow-up was 124.7° compared to 129.3° in patients who had not developed medial tibiofemoral OA at the 5-year follow-up. The mean difference was -4.6° (95% CI -7.9° to -1.1°, p=0.001). The HKA and NSA at the 2-year follow-up were not associated with lateral tibiofemoral OA nor patellofemoral OA. The FO and the FNL were not associated with OA in any of the compartments (Table 1).

In the adjusted model (adjusting for age, sex, body mass index, randomization, partial medial and lateral meniscectomy) only the NSA at 2 years after the ACL injury was associated with medial tibiofemoral OA at the 5-year follow-up (p=0.02).

Methods:

Adults aged 18-35 with an ACL injury within 4 weeks prior to examination were recruited for the Knee Anterior Cruciate Ligament, Nonsurgical versus Surgical Treatment (KANON) trial (ISRCTN84752559). In total 121 participants were included in the study. Patients were followed-up at 2 and 5 years, 115 patients underwent radiographs. At the 2-year follow-up, full-limb radiographs were obtained of the injured leg. The hip-knee-ankle angle, neck-shaft angle, femoral offset and femoral neck length were assessed from these radiographs (Figure 1). At the 5-year follow-up, weight-bearing tibiofemoral radiographs were acquired. Radiographs were graded according to the OARSI atlas and OA was defined as joint space narrowing grade 2 and above, or grade 2 or more marginal osteophyte grades in the same compartment or a combination of grade 1 scores from the categories above. Statistically continuous variables were reported as mean (SD) and differences between groups were tested with the Student's t-test.

	Medial Tibiofemoral compartment Radiographic OA		P value
	Yes n=9	No n=106	
HKA	176.4 (2.9)	178.7 (2.8)	0.02
NSA	124.7 (2.8)	129.3 (5.0)	0.001
FO	45.1 (4.8)	43.6 (6.8)	0.51
FNL	54.4 (5.0)	55.8 (6.7)	0.52
	Lateral Tibiofemoral compartment Radiographic OA		P value
	Yes n=7	No n=108	
HKA	178.2 (2.9)	178.5 (2.9)	0.80
NSA	128.6 (6.7)	129.0 (4.9)	0.86
FO	43.5 (9.1)	43.7 (6.5)	0.93
FNL	54.8 (8.4)	55.8 (6.4)	0.70
	Patellofemoral compartment Radiographic OA		P value
	Yes n=22	No n=93	
HKA	178.2 (3.5)	178.5 (2.7)	0.63
NSA	128.1 (3.6)	129.1 (5.3)	0.27
FO	42.6 (6.7)	43.9 (6.6)	0.38
FNL	53.6 (7.3)	56.2 (6.3)	0.09

Table 1. Compartmental OA at 5 years after ACL injury in relationship to hip anatomy and knee alignment at 2 years after the ACL injury. Data is presented as mean (SD), differences between groups were tested with the Student's t-test. HKA=hip-knee-ankle angle, NSA=neck-shaft angle, FO=femoral offset, FNL=femoral neck length.

Conclusion

A smaller NSA 2 years after ACL injury is associated with medial tibiofemoral OA 5 years after the ACL injury. These findings infer that coxa vara increased the adduction moment at the knee and increased medial tibiofemoral loads during gait, which could increase the risk of medial tibiofemoral OA after ACL injury.