

Secondary Gait Changes in Patients With Medial Compartment Knee Osteoarthritis

Increased Load at the Ankle, Knee, and Hip During Walking

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Table 1. Characteristics of patients with medial compartmental knee osteoarthritis (OA) and matched control subjects*

Variable	Patients	Control subjects	<i>P</i> vs. control subjects†	<i>P</i> , less vs. more severe knee OA†
Less severe knee OA (n = 19)				
Sex, no. female/no. male	13/6	13/6		0.110
Age, years	65.2 ± 12.5 (36–82)	61.7 ± 12.3 (39–86)	0.392	0.950
Height, cm	164.9 ± 8.8 (147–178)	165.1 ± 7.4 (150–176)	0.929	0.007
Mass, kg	73.3 ± 10.7 (54–95)	71.4 ± 10.1 (54–93)	0.562	0.017
BMI, kg/m ²	26.9 ± 3.1 (22–34)	26.1 ± 2.6 (22–33)	0.511	0.476
Knee pain (VAS scale 0–100)	13.6 ± 8.8 (2.5–32.1)	–		0.153
Medial tibiofemoral JSN grade (scale 0–3)	0.3 ± 0.3 (0.0–1.0)	–		<0.001
Lateral tibiofemoral JSN grade (scale 0–3)	0.0 ± 0.1 (0.0–0.5)	–		0.002
Patellofemoral JSN grade (scale 0–3)	0.6 ± 0.6 (0.0–1.8)	–		0.595
Self-selected walking speed, meters/second	1.26 ± 0.23 (0.79–1.69)	1.16 ± 0.15 (0.82–1.40)	0.197	0.854
More severe knee OA (n = 23)				
Sex, no. female/male	10/13	10/13		
Age, years	65.0 ± 8.0 (49–80)	63.7 ± 9.2 (49–84)	0.311	
Height, cm	172.9 ± 9.1 (156–190)	172.8 ± 7.7 (155–185)	0.923	
Mass, kg	83.0 ± 14.0 (60–106)	80.9 ± 13.6 (60–105)	0.359	
BMI, kg/m ²	27.8 ± 4.8 (20–37)	27.1 ± 4.0 (22–37)	0.194	
Knee pain (VAS scale 0–100)	17.4 ± 7.6 (5.6–33.3)	–		
Medial tibiofemoral JSN grade (scale 0–3)	1.7 ± 0.7 (0.0–3.0)	–		
Lateral tibiofemoral JSN grade (scale 0–3)	0.1 ± 0.3 (0.0–0.5)	–		
Patellofemoral JSN grade (scale 0–3)	0.5 ± 0.6 (0.0–1.5)	–		
Self-selected walking speed, meters/second	1.25 ± 0.22 (0.91–1.68)	1.23 ± 0.21 (0.84–1.66)	0.833	

* Except where indicated otherwise, values are the mean ± SD (range). Less severe knee OA is defined as a Kellgren/Lawrence (K/L) grade ≤2, and more severe as a K/L grade ≥3. BMI = body mass index; VAS = visual analog scale; JSN = joint space narrowing.

† *P* values are based on paired (patients versus controls) and independent (between patient groups) Student's *t*-tests, except for the sex distribution, which is compared by Mann-Whitney U test.

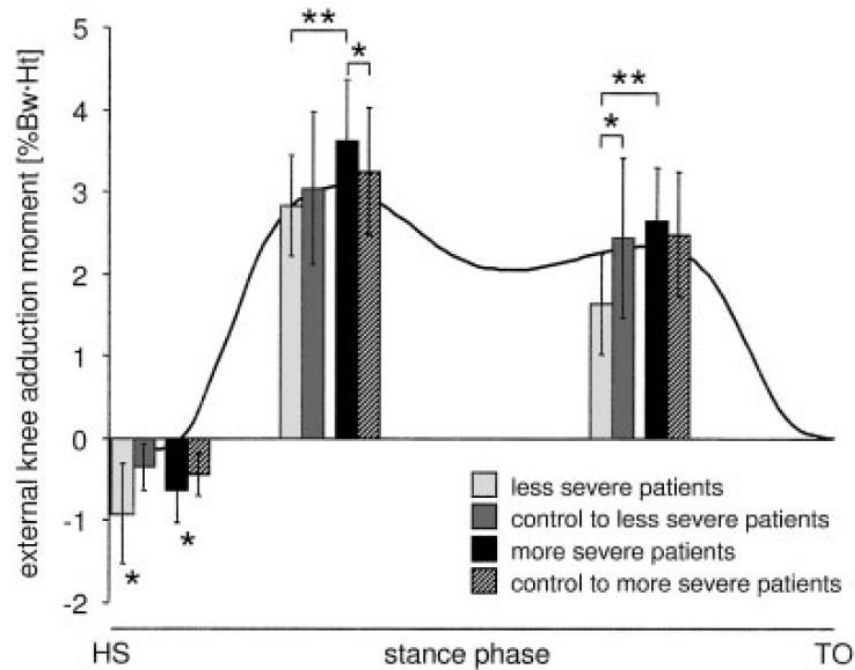


Figure 1. Maximum external knee abduction moment and first and second maximum external knee adduction moments (expressed as percent body weight and height [%Bw·Ht]) during the stance phase of walking in patients with less severe (Kellgren/Lawrence [K/L] grades ≤ 2 ; $n = 19$) and more severe (K/L grades ≥ 3 ; $n = 23$) medial compartment knee osteoarthritis (OA) and asymptomatic control subjects matched for sex, age, height, and mass ($n = 42$). The solid curve represents the shape of the average external knee adduction moment during one step for asymptomatic subjects. * = $P < 0.05$ versus matched control group; ** = $P < 0.05$ for patients with less severe versus more severe knee OA. Bars show the mean \pm SD. HS = heel strike; TO = toe-off.

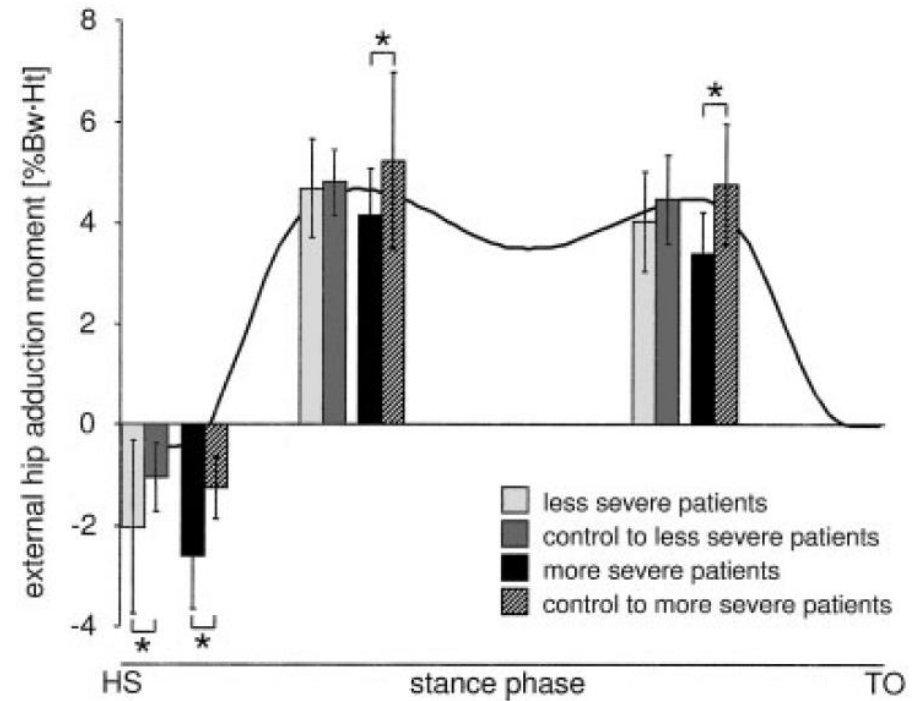


Figure 2. Maximum external hip abduction moment and first and second maximum external hip adduction moments during the stance phase of walking in patients with less severe (K/L grades ≤ 2 ; $n = 19$) and more severe (K/L grades ≥ 3 ; $n = 23$) medial compartment knee OA and asymptomatic control subjects matched for sex, age, height, and mass ($n = 42$). The solid curve represents the shape of the average external hip adduction moment during one step for asymptomatic subjects. * = $P < 0.05$ versus matched control group. Bars show the mean \pm SD. See Figure 1 for definitions.

Gait Changes Secondary to Knee OA

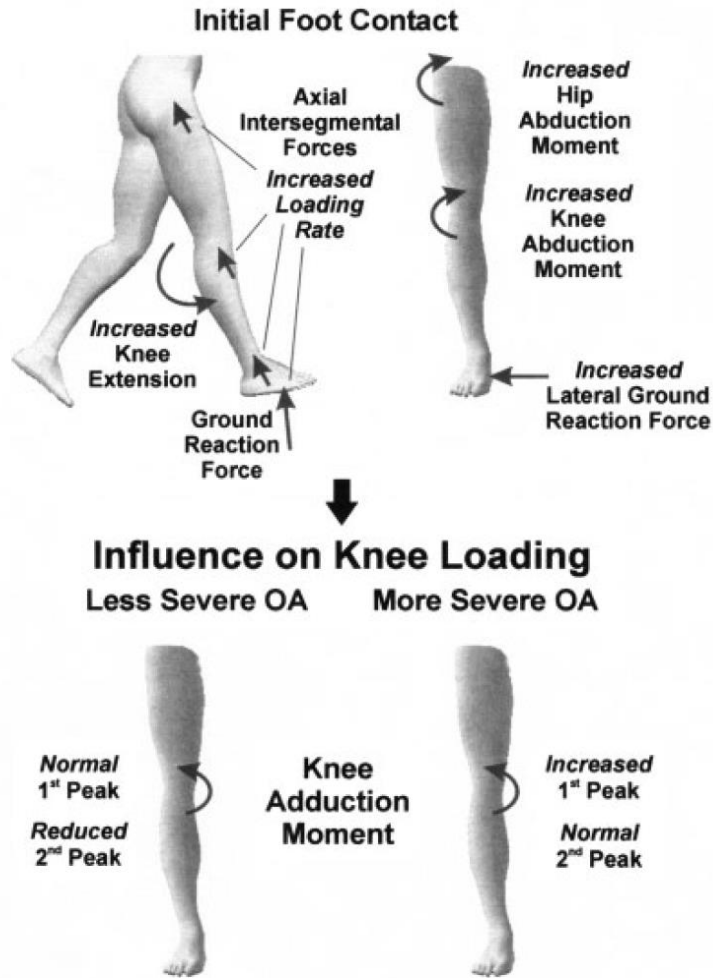


Figure 4. Gait changes and potential mechanism of gait compensation in patients with medial compartment knee osteoarthritis (OA). Differences are relative to control subjects matched for sex, age, height, and mass and are shown between patients with less severe knee OA and patients with more severe OA. Negative effects of the presence of knee OA, greater varus alignment, and presumably weak hip abductor muscles include high axial loading rates at the ankle, knee, and hip and high first peak knee adduction moments.

- ◆ 重度のOAほどKAMが増大する。
- ◆ KAMを少なく戦略のひとつにHAMを減少させることがあげられる（もうひとつはtoe out歩行）
- ◆ HAMを減少すると結果的に外転筋の弱化が生じる
- ◆ 一方、トレンデンプルグ歩行を呈すると、HAMとKAMが増大する
- ◆ 膝OAのデュシェンヌ歩行は良い代償と捉えるべき？