# THE KNEE JOINT PIVOTS ON THE LATERAL COMPARTMENT DURING AMBULATION

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## INTRODUCTION

Knee joint kinematics and its influence on the movement of tibiofemoral contact have been suggested as an important consideration in analysis of factors leading to the initiation of knee osteoarthritis [Andriacchi, 2004]. While the movement of tibiofemoral contact for non-ambulatory activities such as chair rising, deep knee bending and lunging, have been extensively studied [Komistek, 2003, Li, 2005, Banks 2004] using radiographic methods, there is limited information on tibiofemoral contact movement during walking in spite of the fact that walking is the most frequent activities of daily living. When considering reports that knee joint kinematics differs between activities [Dyrby, 2004], it is important to evaluate the tibiofemoral contact movement during walking. In this study, we investigated the movement of tibiofemoral contact in the medial compartment relative to the lateral compartment and tested the hypothesis that the movement is different than the patterns reported for non-ambulatory activities.

## METHODS

Twenty six healthy subjects (age 39.3±13.6 years, 17 males, BMI 23.8±2.3 $kg/m^2$) without any previous knee injuries underwent gait test after IRB approval and informed consent were obtained. The six degree of freedom knee joint kinematics were measured during ambulation using the point cluster technique [Andriacchi, 1998] at self-selected normal walking speed for bilateral limbs of the subjects (#knees=52). The motion of the femoral anatomical axis was described relative to the tibial anatomical axis. A generic three-dimensional geometric model of the femur was used to reconstruct the motion of the femur relative to the tibia. The tibial surface was assumed to be flat to calculate the tibiofemoral contact points. The lowest points of medial and lateral condyle of the geometric femur model were found throughout the stance phase of ambulation. The contact points were projected on to the flat tibia surface. A line connecting the medial and lateral contact points were drawn at each instance during stance phase of ambulation. Anterior-posterior ranges of movement (ROM) of the medial and lateral contact points were calculated for each knee [Figure 1].

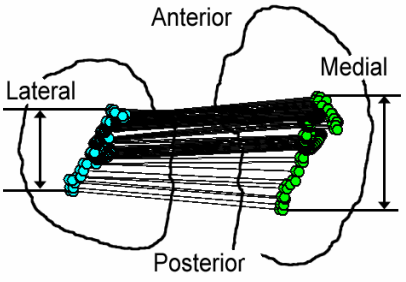


**Figure 1:** Anterior-posterior ROM of the contact points in medial and lateral compartments were measured.

Paired Student's t-test was used to test the difference of ROMs of contact points between the medial and lateral compartments at $\alpha=0.05$.

## RESULTS AND DISCUSSION

The tibiofemoral contact points in the medial compartment moved significantly more than those in the lateral compartment in the anterior-posterior direction according to paired Student's t-test ($p<0.01$, 95% CI: 3.7~ 6.4 mm).

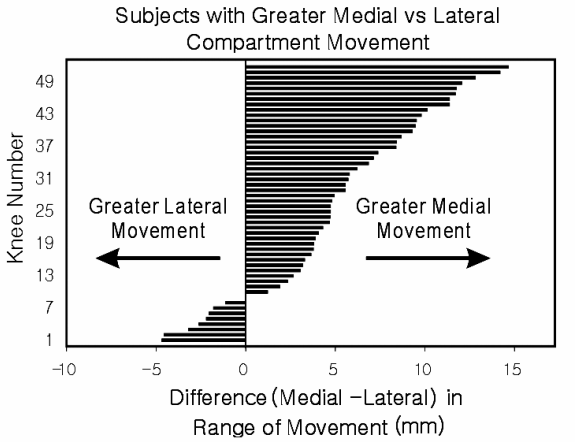


**Figure 2:** ROM of contact points was larger in medial than lateral compartments.

Forty three knees out of 52 knees (83%) had larger contact point movement in medial than lateral compartment [Figure 2].

The fact that the majority of subjects had greater movement in the medial rather than lateral compartments during walking supports the conclusion that knee joint kinematics is highly dependent on physical activities [Dyrby, 2004]. These results are consistent with the reports [Lafortune, 1992] of anterior-posterior (AP) translation and internal-external (IE) rotation at the knee during walking, where at heel strike the femur is posterior and internally rotated relative to tibia. The femur moves anterior and rotates externally during stance phase thus creating greater movement in the medial compartment and pivoting in the lateral compartment [Figure 3].

The fact that previous studies have reported that the knee joint pivots on the medial compartment for non-ambulatory activities such as chair rising, deep knee bending [Komistek, 2003], and lunging [Li, 2005] motions for normal subjects or unrealistically slow walking speeds [Komistek, 2003], suggest the importance of describing knee kinematics in the context of a specific activity or the constraints of the test conditions.

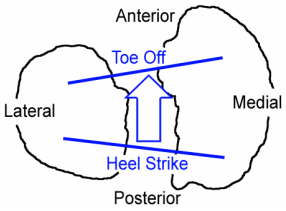


**Figure 3:** Lines connecting contact points at heel strike and toe off were drawn.

The finding of greater medial compartment movement of the knee during walking is an important consideration in evaluating knee pathology. In particular, the prevention and treatment of osteoarthritis would benefit from a better understanding of the knee kinematics during the walking. In addition, these results suggest that it is not possible to extrapolate knee kinematics from non-ambulatory activities to ambulatory kinematics.

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