INTRODUCTION:
Most total knee arthroplasty designs have kinematics which differ from the normal knee, while unicompartmental knee arthroplasties have shown nearly normal knee kinematics. Cruciate retention and having one intact compartment in the unicompartmental knees likely provides more normal control of knee motion. It is unclear whether retention of both crucicates in a bicompartamental arthroplasty is sufficient to provide similar motions and close correspondence to the normal knee. Given that intrinsic knee stability is directly linked to functional performance, in both sports and arthroplasty populations, bicruciate retaining knee arthroplasty might provide more normal knee motions and functional benefit compared to total knee arthroplasties retaining only one or neither of the cruciates.

We hypothesized that knees with bicompartmental arthroplasty retaining both cruciate ligaments would exhibit motion patterns similar to unicompartmental knees during stair and gait activities.

METHODS:
Eight patients with 12 bi-cruciate retaining knee arthroplasties were studied. All patients provided written consent to participate in this study. Patients averaged 67 years of age (42 to 79), 73 kg weight (65 to 80), and 18 months post-surgery (12 to 37) with excellent clinical and functional outcomes. Five knees received unicompartmental arthroplasty components in the medial and lateral compartments of the knee (biUNI group) and seven knees received only medial unicompartmental replacements (UNI group). The components were placed to reproduce normal anatomical joint surfaces, including slope and rotation in each tibial compartment. The cruciate ligaments were intact and were not disturbed during surgery.

Patients performed stepping up and down on a 25cm step and walking on a treadmill at approximately 1 m/s. A lateral view of the knee was recorded using fluoroscopy for each activity. Computer assisted shape matching techniques were used to determine the three-dimensional position/orientation of the knee components using bone/implant surface models developed for each knee (Fig. 1).

RESULTS:
The UNI and biUNI knees showed approximately 5° of tibial internal rotation with flexion during the stair activity. The UNI knees showed an offset of tibial rotation averaging 5° compared to the biUNI knees (p<0.05). Medial condylar translations were essentially identical in the biUNI and UNI groups for the stair activity, showing 5mm of posterior translation from 0° to 30° flexion, and 2mm anterior translation from 60° to 80° flexion (Fig. 2). The lateral condyle of the biUNI knees translated 6mm posterior from 0° to 50°, and did not significantly reverse direction with greater flexion. There were no significant differences in condylar translations between UNI and biUNI knees for the stair activity.

At heel-strike, the medial and lateral condyles of the biUNI knees translated posteriorly ~5mm through early stance phase (Fig.3). The patterns of translation were very similar for medial and lateral condyles, and total axial rotation during gait was about 5°.

DISCUSSION:
Retaining both cruciate ligaments in resurfacing knee arthroplasty appears to maintain the essential features of normal knee motion: femoral rollback and tibial internal rotation with flexion. There were no differences in medial kinematics for the stair activity, indicating similar knee function for the UNI and biUNI groups.

The close similarity in the pattern and magnitude of medial and lateral condylar translation in the biUNI knees was a surprise, as many previous studies suggest larger lateral translations are typical of the cruciate intact knee. Both condyles moved 5mm posterior on the tibia at heel-strike, indicating a dynamic posterior slide of the femur with impact and weight-bearing. The intact knee possesses an envelope of passive laxity, and these observations suggest that dynamic stabilizers do not eliminate these motions caused by external knee loads.

Bicruciate retaining knee arthroplasty, although not completely performed, appears to provide a high level of patient function and knee kinematics retaining essential features of the normal knee.

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