METHODS:

Five normal knees, clinically assessed as having no pain or ligamentous laxity, were analyzed. Using CT scanning, slices were obtained six inches of the distal femur and six inches of the proximal tibia, (1.0 mm slices near the bearing surfaces and 3.0 mm elsewhere). Three-dimensional CAD models of each subject’s femur, tibia and patella were recreated from the 3D bone density data. Each subject was then asked to perform five weight-bearing activities while under fluoroscopic surveillance: (1) deep knee bend, (2) normal gait, (3) chair rise, (4) chair sit, and (5) stair descent. The fluoroscopic images of each knee during each activity were downloaded to workstation computer. The computer-generated 3D models of each subject’s femur and tibia were overlayed onto the 2D fluoroscopic images, and subsequently analyzed at various knee flexion angles. For each activity, femorotibial contact paths were determined for both the medial and lateral condyles and plotted with respect to knee flexion angle. Femorotibial contact anterior to the tibial midline in the sagittal plane was denoted as positive, and posterior a contact was denoted as negative.

RESULTS:

During all five activities, there was significantly more motion of the lateral condyle compared to the medial condyle (p<0.001). During gait, the lateral condyle experienced 7.3 mm of motion, while the medial condyle moved only 0.8 mm. During the four deep flexion activities, the medial condyle experienced minimal movement, except during chair-rise, where there was 3.8 mm of motion. In contrast, the lateral condyle experienced significant motion during the deep flexion activities, translating up to 25.2 mm during chair-sit.

INTRODUCTION:

Understanding the in vivo motions of human joints has become increasingly important. Researchers have used in vitro (cadavers), non-invasive (gait labs), and in vivo (RSA, fluoroscopy) approaches to assess human knee motion. Unfortunately, previous attempts have been unable to track the in vivo bearing surface motion of the medial and lateral condyles of the normal knee in three dimensions (3D). The objective of this study was to use fluoroscopy and computer tomography (CT) to accurately determine the 3D, in vivo, weight-bearing motion of the normal knee (Sarojak, 1998).
DISCUSSION:

This present study is the first analyses to accurately determine medial and lateral femorotibial contact pathways (3D kinematics) of the normal knee under in vivo, weight-bearing conditions using fluoroscopy and a computer model-fitting process. The results from this study have determined that 3D normal knee kinematic patterns are significantly different than previously published data pertaining to PCR and PS TKA (p<0.05) Dennis, et al., 1996, 1998). During all five activities, the lateral condyle experienced significantly more anterior/posterior translation, leading axial rotation of the tibia relative to the femur. A medial pivot pattern was predominant.

References:


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