Can Tibial Reference Lines Common to Mechanically Aligned TKA Be Used to Set Tibial Component Rotation in Kinematically Aligned TKA?

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INTRODUCTION

Mechanically aligned total knee arthroplasty (TKA) uses one or more of five tibial reference lines because there is no universally accepted sagittal plane for setting the rotation of the anteroposterior axis of the tibial component[1, 2]. The goal of kinematically aligned TKA is to set the anteroposterior axis of the tibial component parallel to the sagittal kinematic plane of the knee[3]. However, whether any of the five tibial reference lines used in mechanically aligned TKA is parallel to the sagittal kinematic plane and hence useful for setting tibial component rotation in kinematically aligned TKA is unknown. The present study determined whether any of five tibial reference lines used in mechanically aligned TKA set the rotation of the tibial component parallel to the sagittal kinematic plane.

METHODS AND MATERIALS

1. Image analysis software was used to create a line parallel to the sagittal kinematic plane on the tibia in fifty three-dimensional bone models of normal lower extremities from white subjects.
2. Eight landmarks were identified on each tibia (Figure 1).
3. Five tibial reference lines were drawn by connecting two landmarks (shown later in Figure 2).
4. The angle that each tibial reference line formed with the line parallel to the sagittal kinematic plane quantified the component rotation.

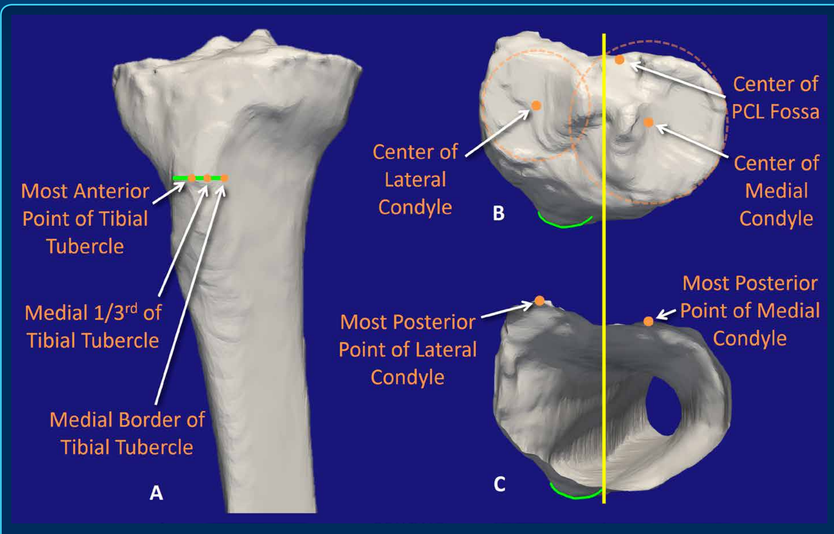

Figure 1. A composite of a right tibia shows the eight landmarks for constructing five tibial reference lines used in mechanically aligned TKA.

A. The most anterior point, medial border, and medial 1/3rd of the tibial tubercle (green arc), were identified on the projection of the tibia in the coronal kinematic plane.

B. The center of the PCL fossa and the center of the medial and lateral tibial tibial condyles were identified on the axial kinematic plane of the proximal articular surface of the tibia.

C. The most posterior points on the medial and lateral condyles were identified 10 mm distal to the deepest portion of the medial tibial condyle, which shows the hollow cavity of the cortical bone. The yellow line is parallel to the sagittal kinematic plane.

RESULTS

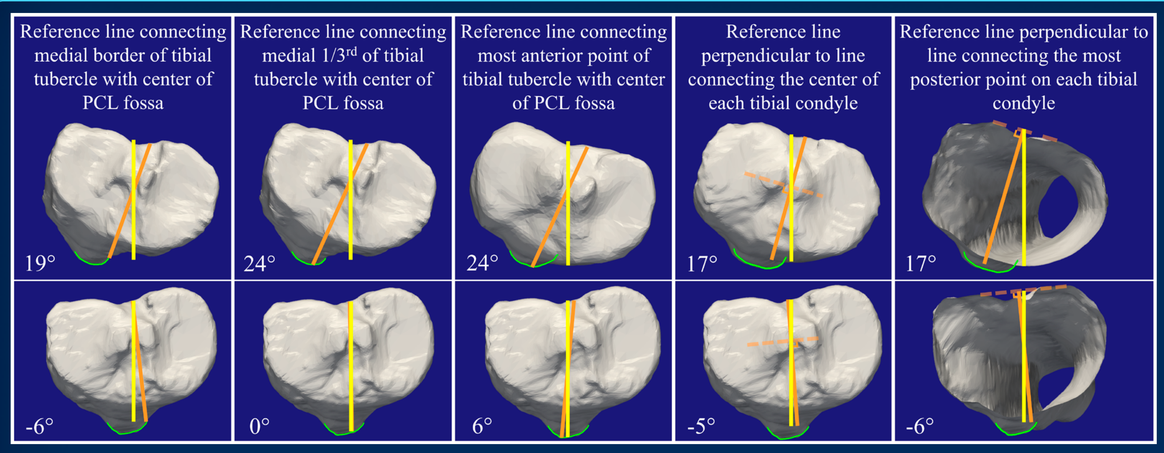

Figure 5. The composite shows the maximum external (positive) and internal (negative) rotation of each tibial reference line (orange) from the sagittal kinematic plane (yellow). Each tibia is viewed as right. The green arc outlines the tibial tubercle. The smallest range of rotation was 22°.

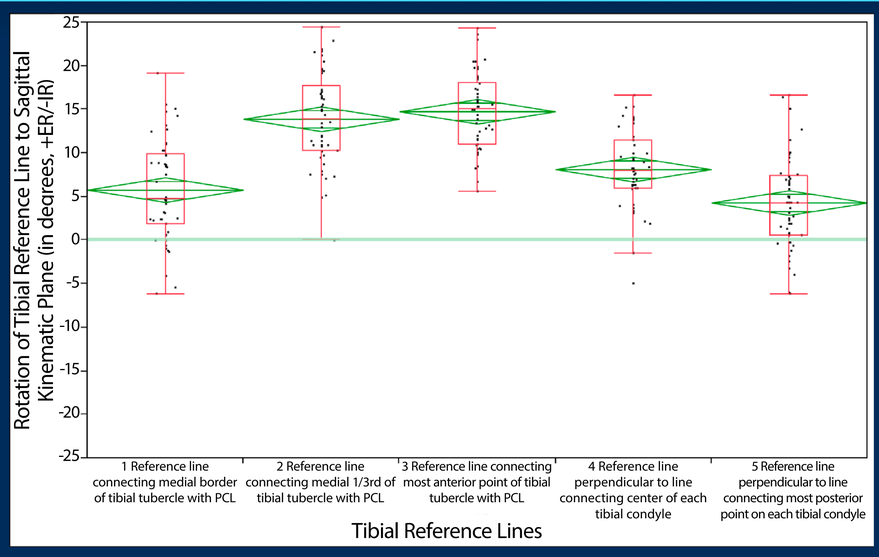

Figure 6. The graph shows the mean and the upper and lower 95% confidence limits (green diamond) of the rotation of each tibial reference line from the sagittal kinematic plane. The average rotation of each tibial reference line ranged from 4° to 15° external to the sagittal kinematic plane. The 95% confidence interval for all 5 tibial reference lines did not include 0°. On average none of the five tibial reference lines were parallel to the sagittal kinematic plane.

DISCUSSION

Our study shows that the five tibial reference lines common to mechanically aligned TKA externally rotate the tibial component from the sagittal kinematic plane. The surgeon can expect a wide range of component rotation when using a reference line that references the tibial tubercle because there is wide variability in the medial-lateral location of the tibial tubercle with respect to the medial border of the tibia[4]. Accordingly, new methods that accurately set rotation of the tibial component in kinematically aligned TKA should be developed.

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