

Correlation of parameters which affect clinical outcomes after kinematic alignment of total knee arthroplasty

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Background: Traditional prosthetic designs incorporate symmetric femoral condyle with a centered trochlear groove. But distal femur is not symmetric and mechanical axis does not reflect this difference. It is because of the fact that the morphologic shape of the distal part of the femur is unique: medial condyle of femur is bigger than lateral condyle. So the axis of the limb (mechanical axis) to the location and orientation of the flexion-extension axis of the knee in three-dimensional space is different real kinematic axis of the knee joint. The concept of kinematic alignment came up.

Purpose: The purpose of our study is to certify correlation between parameters of implant position and postoperative clinical outcomes after kinematic alignment of TKA.

Materials & Methods: We obtained postoperative knee CT scans on all 32 patients with primary osteoarthritis who need surgical treatment, and undergoing TKA with electromagnetic navigation system (Zimmer, Indiana, US) between June 2006 and July 2009. During operation we targeted tibial varus of 2 degree and femoral valgus of 2 degree on coronal plane, and neutral rotation on axial plane of the knee. We used Zimmer EM navigation system (Medtronic Stealth Station Treon Plus and AxiEM). After the surgery we used a Siemens Somatom Sensation 64 CT scanner (Siemens Medical Solutions, German) for all scans. For the femur, we concentrated on the TEA, the line connecting the tip of the lateral epicondyle to the medial epicondylar ridge (clinical TEA) or the medial epicondylar sulcus (surgical TEA) as described by Berger et al. (5). This allowed us to calculate two angles: (1) the posterior condylar angle (PCA), which is the angle formed by the posterior condylar line and the surgical TEA (Fig. 1); and (2) the condylar twist angle (CTA), which is the angle formed by the posterior condylar line and the clinical TEA, useful when the sulcus is not detectable (Fig. 2). With patience and choosing the best CT slice for sulcus identification, usually 30 mm from the joint line (16), the sulcus was detected in 80% of our patients.

For the tibial side, Akagi et al.'s (2, 3) concept is a line perpendicular to the projection of the femoral TEA and passing through the midposterior cruciate ligament attachment is tangent to the medial patellar tendon (PT) attachment (Fig. 3). To verify this, two tibial cuts were superimposed on the computer, one passing through the midposterior cruciate ligament attachment and the other passing through the PT insertion. In this manner, the angle between the perpendicular line to the TEA and Akagi's line was measured (tibial rotation angle [TRA]) (Fig. 4). All measurements were performed twice by a radiologist (GD) and an orthopedic consultant (LS). We computed the intra- and interobserver variability by Pearson coefficient calculation. The intraobserver variability was 0.9 and the interobserver variability was 0.8.

Active ROM (range of motion) and Passive ROM were checked at final visit to office with radiology. Average follow up was 44.5 months (range 36-60). We used the Pearson correlation coefficient to determine any relationship between coronal deformity and PCA or TRA for the entire population and individually for each gender.

Clinical outcomes including post op active knee ROM, TRA (the angle between the perpendicular line to the TEA and Akagi's line), varus and valgus angle of the knee were also analyzed after a minimum of 3 year follow-up.

Results: There were negative linear relationships between the femoral component rotation (internal and external) and active and passive range of motion after kinematic alignment of TKA. And we also

found a negative linear relationship between the tibial rotation of the component and active and passive range of motion. And we also found a negative linear relationship between the gamma angle and active and passive range of motion. The gamma angle is most powerful predictive parameter of postoperative range of motion of the knee.

Conclusion: The alignment of the component set into the kinematic alignment of the knee: internal rotation of femur implant with good gamma angle in sagittal plane will assure better clinical outcome; ROM and scores. Coronal alignments of component (valgus or varus) were weak predictive parameters.