

Novel approach to reducing discrepancies in radiographic and navigational limb alignments in computer-assisted TKA

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Background: Computer-assisted navigation systems have been documented to improve the accuracy of limb alignment and implant positioning during total knee arthroplasty (TKA). However, recent studies have reported substantial discrepancies between radiographic and navigational measurements of coronal limb alignment. Large discrepancies between preoperative radiographic and intraoperative navigational assessments of limb alignment challenge the operating surgeon as to whether to accept navigation measures and proceed or whether the information should be interpreted differently, for example, by adjusting the targeted correction angle based on the assumption that navigation system-derived data are erroneous. To facilitate navigated surgical procedures and enable the interpretations of preoperative radiographic and intraoperative navigational measures, we developed a novel means of measuring coronal limb alignment. We have found that this novel method reduces discrepancies between radiographic and navigational assessments of limb alignment. This study was conducted (1) to document discrepancies between preoperative and postoperative radiographic measurements and postregistration and postimplantation intraoperative navigational measurements of coronal limb alignments, and (2) to identify predictors of discrepancies between radiographic and navigational measures. In addition, we propose the use of a novel radiographic measuring method, and we demonstrate that this method reduces discrepancies.

Methods: For 107 total knee arthroplasties performed using a navigation system, coronal alignment were assessed using preoperative and postoperative whole limb radiographs using the standard and novel radiographic methods. For radiographic assessments using the standard method, we measured the angle between the femoral and tibial mechanical axes. For radiographic assessment performed using the novel method, we measured the angle between the weight loading line and the tibial mechanical axis. The weight loading line was defined as the line connecting the hip center and the midpoint of the talar dome. During surgery, coronal limb alignment was measured using the navigation system postregistration and postprosthesis implantation. Strengths of correlations and discrepancies between radiographic and navigational assessments were compared between the standard and novel methods. Multivariate regression was performed to identify predictors of discrepancies.

Results: Differences between radiographic and navigational measurements were observed for both preoperative and postoperative assessments, but discrepancies were greater for preoperative assessments, despite their stronger correlations. Extent of preoperative varus deformity was identified as the strongest predictor of discrepancy in preoperative radiographic and navigational measurements, and varus malalignment was identified as the strongest predictor of discrepancy in postoperative measurements. Strengths of correlations between radiographic and navigational measurements were similar for the standard and novel radiographic methods, but discrepancies between the 2 were significantly smaller for the novel method for both preoperative and postoperative assessments.

Conclusions: Our study demonstrates that substantial discrepancies exist between radiographic and navigational assessments of coronal limb alignment, and that discrepancies are greater for preoperative assessments. Furthermore, preoperative varus deformity and postoperative varus malalignment were found to be the strongest predictors for discrepancies between radiographic and navigational

assessments conducted preoperatively and postoperatively, respectively. We suggest that the described radiographic measuring method can reduce discrepancies and that its use would reassure surgeons regarding the accuracy of navigation information.

Summary: The authors propose the use of the described novel radiographic method that reduces discrepancies between radiographic and navigational measurements.