

Computer-assisted surgery versus custom cutting guides for component alignment in total knee arthroplasty

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Background: Several techniques are available to the orthopaedic surgeon in performing total knee arthroplasty (TKA). Standard intra/extramedullary guides, computer assisted surgery (computer navigation), and now prefabricated, patient specific, custom guides are all options to the orthopaedic surgeon. Although there are no long term studies showing any clinical advantages or increased survivorship of one technique as compared to another, numerous studies have shown improved alignment with the use of computer-assisted surgery (CAS) techniques as compared to guides. To our knowledge, there are no studies comparing post-operative alignment comparing CAS to patient specific cutting guides. There are certainly theoretic advantages of patient specific guides including improved surgical times and cost efficiency over other techniques.

Hypothesis: We hypothesized that there is no difference in radiographic coronal alignment at one year follow-up between TKA performed using CAS techniques versus a patient specific cutting guide technique.

Methods: A retrospective study was performed analyzing TKA using two techniques performed by a single high volume adult reconstruction surgeon over the time period of May 2009 through January 2011. Two groups were compared, a CAS group and a patient specific guide (TruMatch) group. The primary outcome measure was one year radiographic coronal alignment comparison between the two groups. Based on previous studies assessing a similar outcome measure, this study was adequately powered¹. A total of 340 TKAs were performed over this time period and were eligible for inclusion in this study. 270 TKAs using CAS were and 66 TKAs using a custom guide system (TruMatch, DePuy, Warsaw, IN) were eligible. The technique chosen for a given patient was a decision made jointly between patient and surgeon. All surgeries were performed at a single hospital using similar surgical technique in both groups with identical postoperative protocol. Preoperative (demographic) and intraoperative variables (e.g. surgical time, estimated blood loss, etc.) were recorded. The CAS group used a standard commercially available navigation system. The patient specific group used TruMatch (DePuy) CT based patient specific cutting guides. All knee arthroplasties implanted were DePuy Sigma rotating platform implants. Knee Society Scores were obtained preoperatively and at 3 and 12 months per the surgeon's standard protocol. Long-leg radiographs were obtained at the 12 month follow-up appointment to determine component and knee alignment. Measurements were made by an orthopaedic surgery resident not involved in the surgical procedures. The incidence of complications was also observed over 1 year follow-up. Institutional Review Board approval was obtained prior to performing the study.

Results: Preoperative and operative details were available for all patients in the study cohort. There were no significant differences in the patient populations for preoperative variables in terms of age, sex, BMI, and preoperative Knee Society Score. In terms of operative variables, there was no significant difference in EBL. A statistically significant difference ($p < 0.05$) was observed in operative time, tourniquet time, and anesthesia time favoring the custom guide group. These are summarized below.

Variable	CAS (mean)	TruMatch (mean)	P<0.05
	N=270	N=66	
Age	67.9	66.8	No
BMI	31.8	33.3	No
Preop extension	6	6	No
Preop flexion	113	117	No
KSS (knee)	37	40	No
KSS (function)	52	52	No
EBL	113	102	No
Procedure Time	85	78	Yes
Tourniquet Time	59	49	Yes
Anesthesia Time	115	108	Yes

47 (71% of total) TKAs in the patient specific group and 127 (47% of total) TKAs in the CAS group had adequate follow-up with long leg radiographs available for appropriate measurements. The femoral component mechanical axis, the tibial component mechanical axis, and the knee mechanical axis were measured as has been previously described². Angles for component axis were measured on the lateral aspect of the joint. In the TruMatch group, the mean femoral component alignment was 92.3° (range 89.01-99.13°, standard deviation 2.05°); mean tibial component alignment was 90.27° (range 87.02-93.25°, standard deviation 1.89°). In the CAS group, the mean femoral component alignment was 92.6° (range 90.12-96.13°, standard deviation 1.35°); mean tibial component alignment was 89.47° (range 85.00-95.39), standard deviation 1.99°). In the TruMatch group, the mean knee mechanical axis was 2.4° varus (range 2.61 valgus – 8.26 varus, standard deviation 2.49°). In the CAS group, the mean knee mechanical axis was 1.91° varus (range 2.85° valgus – 8.48° varus, standard deviation 2.21°). There were 16/47 (34%) in the patient specific group versus 28/127 (22%) outliers in CAS group outside the acceptable range of 3 degrees of varus or valgus deviation from the neutral (0 degrees) mechanical axis. A statistically significant difference in means between groups in terms of measured radiographic variables was observed only in the tibial component alignment (p=0.019).

Conclusion: As hypothesized, a significant difference in coronal plane mechanical alignment at 1 year follow-up was not observed in two groups of TKA performed using CAS techniques versus a custom cutting guide technique. A significant difference was observed only in tibial component alignment favoring the custom guides. Anesthesia time, tourniquet time, and operative time were all significantly shorter for the custom guide technique which carries implications pertaining to increased operating room efficiency and lowered costs for the performance of primary total knee arthroplasty.

Clinical Relevance: This retrospective study suggests that custom cutting guide TKA is a viable technique available to the reconstructive orthopaedic surgeon and offers advantages in terms of a faster operative procedure without sacrifice of comparable coronal plane alignment outcomes in the short term. Future studies could clarify whether long term clinical or radiographic outcomes differ significantly between these techniques.

References

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