Factors Leading to Improved Patient-Reported Outcome Measures Following the Initial Learning Curve with Robotic-Assisted Total Knee Arthroplasty

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INTRODUCTION:
Robotic-Assisted Total Knee Arthroplasty (RA-TKA) provides real-time intraoperative information to help achieve accurate bone cuts, symmetric gap balancing, and target implant placement. The utilization of RA-TKA has continued to increase over the past several years. The purpose of this study was to compare the clinical differences in patient outcomes during the initial learning curve period with RA-TKA versus a later period following significant experience with use of robotic-assisted technology.

METHODS:
This was an IRB approved study from a single institution evaluating the first 200 cases (Group 1) and last 200 cases (Group 2) following primary RA-TKA in a consecutive series of 800 cases with minimum two-year follow-up. Neutral mechanical alignment (nMA) was primarily utilized in Group 1 versus restricted kinematic alignment (rKA) in Group 2, where the goal was to target the native joint line, minimize soft tissue releases, and obtain well-balanced gaps primarily through bone cuts and implant position. There were no significant differences in age or gender between the groups. Mean BMI was significantly higher in Group 2 (33.4) compared to Group 1 (31.8), p=0.01. Outcome measures included range of motion (ROM), Knee Society Scores (KSS), Forgotten Joint Score (FJS-12), KOOS JR Score, overall satisfaction, complications, and survivorship at 2-year follow-up.

RESULTS:
There were no differences with respect to preoperative ROM or mean KSS Function between Groups 1 and 2, p=0.17 and p=0.20. Group 2 (rKA) had a significantly higher mean preoperative KSS Knee (49.3) compared to Group 1 (42.3), p<0.01. There were significantly more cruciate-retaining (CR) TKAs in Group 2 (48.5%) compared to Group 1 (7.5%), p<0.01. At two years postoperatively, the mean KSS Function was significantly higher in Group 2 (89.6) compared to Group 1 (85.9), p=0.046. FJS-12 scores showed a clinically significant difference between Group 2 (76.4) and Group 1 (62.7), p<0.01. There were no significant differences in postoperative ROM, KSS Knee, KOOS JR, or overall satisfaction scores. 94% of patients in Group 1 were satisfied or very satisfied compared to 92% in Group 2, p=0.67. Survivorship with all-cause failure was 97% for both groups combined. There were no differences in revision rates or complications.

DISCUSSION:
RA-TKA demonstrated excellent survivorship and patient satisfaction in both groups. The improved postoperative KSS Function and FJS-12 in Group 2 (rKA) could be a result of multiple factors including greater CR implant usage, change from nMA to targeting the native 3D joint line, and optimizing the soft tissue sleeve or knee balance using bone cuts and implant position instead of soft tissue releases. Additional studies are needed to identify the ideal target limb alignment and soft tissue balance to minimize the learning curve during RA-TKA.

SIGNIFICANCE/CLINICAL RELEVANCE:
The use of RA-TKA has increased over the past several years. Greater experience and understanding of the capabilities of RA-TKA following the initial learning curve led to improved KSS Function and FJS-12. Further work is required to minimize the learning curve given the various intraoperative options available to restore joint line, limb alignment, and soft tissue balance during RA-TKA.

Table 1 – Demographics and Preoperative Data

	Group 1	Group 2	P-value
Age (y)	65.2 +/- 9.1	64.6 +/- 9.4	0.51
Female Sex	40%	35%	0.35
BMI	31.8 +/- 6.0	33.4 +/- 6.6	**0.01**
Preop KSS Function	47.3 +/- 12.5	49.1 +/- 9.6	0.2
Preop KSS Knee	42.3 +/- 12.0	49.3 +/- 11.9	**<0.01**
Preop Active Ext. (deg)	1.3 +/- 3.2	1.2 +/- 2.9	0.71
Preop Active Flex. (deg)	113.1 +/- 10.7	115.0 +/- 12.6	0.14

Table 2 – Results

	Group 1	Group 2	P-value
Cruciate-Retaining Implants (%)	7.5	48.5	**<0.01**
KSS Function	85.9 +/- 15.4	89.6 +/- 15.1	**0.046**
KSS Knee	92.3 +/- 8.4	92.3 +/- 8.6	1
KOOS-JR Score	84.2 +/- 14.9	86.0 +/- 15.1	0.3
FJS-12	62.7 +/- 28.6	76.4 +/- 26.3	**<0.01**
Active. Ext (deg.)	0.3 +/- 1.6	0.1 +/- 0.76	0.19
Active. Flex (deg.)	119.3 +/- 7.9	118.3 +/- 6.9	0.21
Satisfaction (1-5)	4.63 +/- 0.70	4.67 +/- 0.72	0.61