Precision and Accuracy of Polyethylene Thickness in Total Knee Arthroplasty: A Comparison Between Conventional and Robotic Assisted Techniques

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INTRODUCTION:
Accurate polyethylene thickness is critical for achieving optimal soft tissue gap balancing and ensuring implant stability and longevity following total knee arthroplasty (TKA). Prior studies suggest robotic-assisted TKA (RA-TKA) may allow for greater adherence to preoperative plans for polyethylene thickness compared to conventional TKA (C-TKA). This study sought to compare the accuracy and precision of planned versus implanted polyethylene thickness between these two techniques.

METHODS:
A retrospective review was conducted of all patients who underwent TKA performed by a single surgeon between March 2018 and July 2022. Patients were classified as having undergone RA-TKA or C-TKA. In all cases, preoperative planning specified a polyethylene thickness of 9 mm. Patient demographic characteristics and final polyethylene thickness were assessed. The mean difference between planned and implanted polyethylene thickness, distribution of final implant sizes, and variance in polyethylene thickness were compared between the two groups.

RESULTS:
A total of 815 patients were included, with 404 (49.6%) undergoing C-TKA and 411 (50.4%) undergoing RA-TKA. There was no difference in sex distribution between groups. Patients in the RA-TKA group were significantly older (70.46 ± 8.52 years vs. 69.14 ± 8.34 years, p=0.027). The mean polyethylene thickness was significantly lower in the RA-TKA cohort (9.34 mm ± 0.61 mm vs. 10.67 mm ± 1.18 mm, p<0.001). The mean difference from the planned 9 mm thickness was 0.34 mm in the RA-TKA cohort and 1.67 mm in the C-TKA cohort. Adherence to the preoperative planned polyethylene thickness of 9 mm was substantially higher in the RA-TKA group (72.26% vs. 16.09%) and variance in thickness was significantly lower (0.37 vs 1.39, p<0.001).

DISCUSSION AND CONCLUSION:
RA-TKA demonstrated greater adherence to preoperative planned polyethylene implant thickness, thus leading to more bone preservation and improved gap balancing.

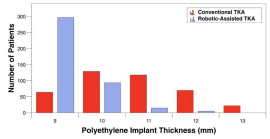

Figure 1. Distribution of polyethylene implants used in conventional TKA (C-TKA) and robotic-assisted TKA (RA-TKA) by thickness (in mm).

Table 1. Demographic Characteristics

	Conventional TKA (C-TKA) N = 404		Robotic-Assisted TKA (RA-TKA) N = 411		
	Average	Standard Deviation (SD)	Average	Standard Deviation (SD)	P-value
Age (years)	69.14	8.34	70.46	8.52	0.027
	N	%	N	%	P-value
Female	228	56.44%	241	58.64%	0.572
Male	176	43.56%	170	41.36%	

RA-TKA: robotic-assisted total knee arthroplasty; C-TKA: conventional total knee arthroplasty; SD: Standard deviation

Table 2. Average Polyethylene Thickness

	Conventional TKA (C-TKA) N = 404		Robotic-Assisted TKA (RA-TKA) N = 411		
	Average	Standard Deviation (SD)	Average	Standard Deviation (SD)	P-value
Planned (mm)	9.00	0.00	9.00	0.00	–
Actual (mm)	10.67	1.18	9.34	0.61	<0.001
Mean Difference (mm)	1.67	–	0.34	–	<0.001

Table 3. Distribution of Polyethylene Implants By Thickness

	Conventional TKA (C-TKA) N = 404		Robotic-Assisted TKA (RA-TKA) N = 411		
	N	%	N	%	P-value
9 mm	65	16.09%	297	72.26%	<0.001
10 mm	129	31.93%	94	22.87%	
11 mm	118	29.21%	15	3.65%	
12 mm	70	17.33%	5	1.22%	
13 mm	22	5.45%	0	0.00%	