Lower Revision Risk with All-Polyethylene Tibial Components in Total Knee Arthroplasty: An Analysis of the American Joint Replacement Registry

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INTRODUCTION:

Modular metal-backed tibial component use predominates the market in the United States for total knee arthroplasty (TKA) procedures. This persists despite growing pressures for cost containment and decreased costs of all-polyethylene tibial components. This potentially is driven by concerns of revision risk due to the associated lack of modularity. Interest has recently returned to the use of an all-polyethylene tibial component due to reduced cost and simplicity of use. We aimed to compare the rates of all-cause revision, revision due to infection, and percentage of event free survival in patients in the American Joint Replacement Registry (AJRR) treated with all-polyethylene tibial components compared to modular metal-backed designs.

METHODS:

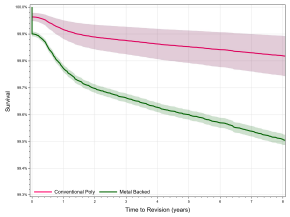
An analysis of primary TKA cases in patients age $\geq$65 years was performed utilizing data from AJRR and was merged with data from Centers for Medicare and Medicaid Services (CMS) from 2012-2019 to increase revision and infection capture. Manufacturer data via catalog numbers were queried to define the main exposure groups; all-polyethylene and modular designs. Patient demographics and cause for revision were recorded. Analysis compared all-polyethylene to modular metal-backed designs using Cox proportional regression modeling with hazard ratios (HR) for all-cause linked revision and revision for infection, adjusting for gender, age, and the competing risk of mortality. Linked revision procedures are identified as revision procedures following a primary procedure with matching patient ID and laterality. Event-free survival curves evaluated time to revision for all-cause and revision resulting from infection.

RESULTS:

A total of 485,024 patients met our inclusion criteria. We identified 5,559 patients in the all-polyethylene group and 479,465 in the metal-backed design group (Table 1). All-cause revision for the all-polyethylene group was 23 (0.41%) with revision for infection in 10 (0.18%). All-cause revision for metal-backed designed was 5,328 (1.11%) with revision for infection in 2,072 (0.43%). The Cox Proportional Hazard Ratio (Table 2), adjusted for age and gender, found a significant difference in both all-cause revision (HR = 0.367, 95% CI: 0.244;0.553, p < 0.0001) and all-cause revision for infection (HR = 0.414, 95% CI: 0.222;0.772, p < 0.0001) between the two groups. Event-free survival curves (Figures 1 & 2) demonstrate decreased risk of all-cause revision and risk of infection that persisted across timepoints to 8 years.

DISCUSSION AND CONCLUSION:

In the United States, we found that all-polyethylene tibial components in TKAs are associated with lower rates of all-cause revision and revision due to infection. This data should ease concerns about using all-polyethylene tibial components which are typically lower in cost than metal-backed tibial components.



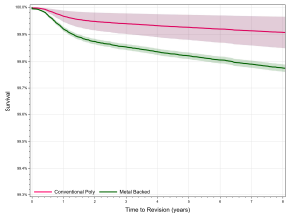


Table 1 – Demographics and Revision Outcomes by TKA Design Type

	Design			
	All Polyethylene (N = 5,559)	Metal Backed (N = 479,465)	Total (N = 485,024)	P Value
Age				
Mean (SD)	77.40 (8.25)	72.01 (7.86)	72.07 (7.88)	<0.001
Gender				
Female	3,818 (68.68%)	297,703 (62.09%)	301,521 (62.17%)	<0.001
Male	1,741 (31.32%)	181,762 (37.91%)	183,503 (37.83%)	
Revision				
No	5,536 (99.59%)	474,137 (98.89%)	479,673 (98.90%)	<0.001
Yes	23 (0.41%)	5,328 (1.11%)	5,351 (1.10%)	
Revision for Infection				
No	5,549 (99.82%)	477,393 (99.57%)	482,942 (99.57%)	0.004
Yes	10 (0.18%)	2,072 (0.43%)	2,082 (0.43%)	

Table 2

All-time Revision, AJRR 2012-2019 Total Knee Arthroplasty (N=485,024)

Variable	Hazard Ratio	95% Hazard Ratio Lower Confidence	95% Hazard Ratio Upper Confidence	p-Value
All Poly vs. Metal Backed	0.367	0.244	0.550	<0.0001

All-time Revision for Infection, AJRR 2012-2019 Total Knee Arthroplasty (N=485,024)

Variable	Hazard Ratio	95% Hazard Ratio Lower Confidence	95% Hazard Ratio Upper Confidence	p-Value
All Poly vs. Metal Backed	0.414	0.222	0.772	0.0036

*Hazard ratios are adjusted for age and sex
**All poly is significantly associated with lower rates of revision and revision for infection