

Does Method of Fixation and Use of Robotic Assistance Influence Patient Outcomes in Total Knee Arthroplasty?

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INTRODUCTION: With the increasing use of cementless and robotic-assisted techniques in total knee arthroplasty (TKA), the current literature presents conflicting evidence regarding their impact on early complications and revision risk. Some studies suggest that cementless TKAs are associated with a slightly higher early revision rate, particularly in younger patient populations. This study compares the reoperation rates across four TKA cohorts, cemented vs. cementless, with and without robotic assistance.

METHODS: A retrospective cohort study was conducted using a national administrative claims database. A total of four matched cohorts were created: robotic-cemented (R-CEMENT), robotic-uncemented (R-UNCEMENT), conventional-cemented (C-CEMENT), and conventional-uncemented (C-UNCEMENT). Matching was performed based on age, gender, Elixhauser Comorbidity Index (ECI), obesity, tobacco use, and diabetes, resulting in 5,210 patients per group. Outcomes assessed included one, five, and ten-year ipsilateral reoperations, 30-day emergency department visits, and ED-related hospital readmissions. Chi-square tests were used for group comparisons, with $p < 0.05$ indicating significance.

RESULTS: In the matched cohort ($n = 20,840$, C-UNCEMENT, C-CEMENT, R-UNCEMENT, R-CEMENT; $n = 5,210$ each), 1-year reoperation rates were lowest in C-UNCEMENT (0.44%, $n=23$) and R-UNCEMENT (0.52%, $n=27$), followed by R-CEMENT (0.84%, $n=44$) and C-CEMENT (0.92%, $n=48$) ($p = 0.005$). At 5 years, reoperation rates remained lowest in C-UNCEMENT (0.79%, $n=41$) and R-UNCEMENT (1.02%, $n=53$), compared to higher rates in C-CEMENT (1.86%, $n=97$) and R-CEMENT (1.71%, $n=89$) ($p < 0.001$). Lastly, 10-year reoperation rates were lowest in C-UNCEMENT (0.86%, $n=45$) and R-UNCEMENT (1.07%, $n=56$) where C-CEMENT (2.17%, $n=113$) and R-CEMENT (1.75%, $n=91$) exhibited higher rates. No significant differences were observed in 30-day ED utilization ($p = 0.11$) or readmissions ($p = 0.75$) across all four matched cohorts (Table 1).

DISCUSSION: Cementless fixation in TKA, whether robotic or conventional, demonstrated comparable short-term reoperation rates and equivalent long-term survivorship to cemented fixation. Robotic assistance did not significantly impact failure-free survival or healthcare utilization. All four cohorts showed excellent 10-year outcomes.

SIGNIFICANCE: This study provides the largest matched national cohort comparison of fixation technique and robotic assistance in TKA, demonstrating that cementless fixation offers comparable or improved 5- and 10-year survivorship. It also challenges the routine use of robotic-assisted TKA by showing no added survivorship benefit, informing cost-effective surgical decision-making.

Table 1: Comparison of one-year, five-year, and ten-year revisions and short-term complications by fixation method and robotic assistance in primary TKA

Metric	Conventional		Robotic		P-value
	Uncemented n (%)	Cemented n (%)	Uncemented n (%)	Cemented n (%)	
Matched (n)	5,210	5,210	5,210	5,210	
1-year revisions	23 (0.44)	48 (0.92)	27 (0.52)	44 (0.84)	0.005
5-year revisions	41 (0.79)	97 (1.86)	53 (1.02)	89 (1.71)	4.88×10^{-07}
10-year revisions	45 (0.86)	113 (2.17)	56 (1.07)	91 (1.75)	1.48×10^{-08}
ED visits	340 (6.53)	397 (7.62)	367 (7.04)	394 (7.56)	0.11
Readmissions	15 (0.29)	16 (0.31)	18 (0.35)	21 (0.40)	0.75