Impact of Metaphyseal Sleeves and Porous Cones on Risk Reduction for Total Knee Arthroplasty Aseptic Re-Revision in a US integrated Health Care System

Adrian D Hinman[1], Richard Nick Chang, Kathryn Elizabeth Royse[1], Liz Paxton[1]
[1]Kaiser Permanente

INTRODUCTION: Bone loss is often encountered during revision total knee arthroplasty (rTKA) making achieving a well-fixed construct challenging. Metaphyseal sleeves and porous cones have been designed to enhance fixation during rTKA, and they are typically used in combination with cemented or non-cemented modular stems. Little is known, however, how the addition of sleeves and cones to stemmed implants impacts aseptic re-revision, particularly due to loosening. Therefore, we sought to compare patients undergoing revision TKA with cones or sleeves plus stems to those with just stems in a US integrated health care system.

METHODS: We conducted a cohort study from a US integrated healthcare system's TKA registry. The study population included patients with an index revision including a stemmed component, completed between 2008-2020. Only the 6 highest frequency implant systems with cone/sleeve options (representing 94.8% of cone/sleeve implant types) were included to minimize variability across manufacturers. Stem configuration at revision surgery, classified as stem only vs stem with cone/sleeve, was the exposure of interest. Propensity score-weighted Cox proportional hazard regression was used to evaluate the risk of aseptic re-revision and aseptic re-revision due to loosening during follow-up. Propensity score weights were calculated prior to outcome evaluation using multivariable logistic regression and included: age, sex, body mass index, race/ethnicity, and American Society of Anesthesiologist's classification. Hazard ratios (HR) and 95% confidence intervals (CI) are presented. $p<0.05$ was considered statistically significant.

RESULTS: The study cohort consisted of 3,198 index revisions; 2618 with stem alone and 580 with stem + cone/sleeve. At 7-years follow-up, the crude cumulative aseptic re-revision probability for stemmed implants was 7.18% for stem alone and 6.23% for stem + cone/sleeve; for re-revision due to aseptic loosening, the 7-year incidence was 3.38% for stem and 2.09% for stem + cone/sleeve (**Figure 1**). After propensity score weighting, no difference was observed in aseptic re-revision for stem + cone/sleeve compared with stem alone (HR=0.75, 95% CI=0.45-1.23). Similarly, we observed no difference for the outcome of aseptic loosening for stem + cone/sleeve vs stem alone (HR=0.59, 95% CI=0.26-1.35) (**Table 1**).

DISCUSSION AND CONCLUSION: In a study of more than 3,000 index revision TKAs, we found that the addition of metaphyseal sleeves and porous cones did not change the risk of aseptic re-revision overall or specifically due to loosening. The additional cost and operating time these implants add to revision surgery should be considered when evaluating other options for optimizing patients with bone loss.

Figure 1: Cumulative Incidence of Re-revision by Stem Configuration

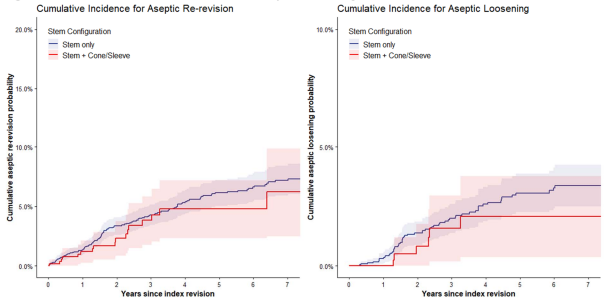

Table 1: Crude cumulative re-revision probability and adjusted risk after index revision by stem configuration

Outcome/ Stem Configuration	Crude 7-Year revision probability	HR (95% CI)	*P*
Aseptic re-revision			
Stem only	7.18 (5.99-8.50)	Ref	
Stem + cone/sleeve	6.23 (3.21-10.64)	0.75 (0.45-1.23)	0.257
Aseptic re-revision due to loosening			
Stem only	3.38 (2.58-4.35)	Ref	
Stem + cone/sleeve	2.09 (0.84-4.37)	0.59 (0.26-1.35)	0.213

CI, confidence interval; HR, hazard ratio
Crude revision probability calculated as one minus the Kaplan-Meier estimator.
Propensity score weighted models included the following covariates: patient age, body mass index, sex, race/ethnicity, and American Society of Anesthesiologist's classification