

# Implant Survivorship with the Use of Engaging Cones in the Femoral Diaphysis in the Setting of Distal Femur Replacement

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## INTRODUCTION:

This study aims to describe a cohort of patients indicated for distal femoral replacement (DFR) megaprosthesis for non-oncologic reasons to determine outcomes, survivorship, and rates of reoperation and revision across those patients who were treated with and without additional utilization of a diaphyseal femoral engaging cone.

## METHODS:

IRB approved retrospective chart review was performed of adult patients (18 years and older) who underwent DFR screened via billing codes for revision total knee arthroplasty or total knee arthroplasty with hinge prosthesis between January 1, 2003 – December 31, 2023. Patient charts were reviewed for inclusion via operative notes and radiographic imaging confirming DFR; those indicated for DFR for oncologic indications were excluded. Patients were categorized as having a DFR with femoral diaphyseal engaging cone, or without a cone. The primary outcome was incidence of revision or reoperation, including time to revision or reoperation. Revision was defined as complete removal of the implant and replacement with new prosthesis or spacer; reoperation was defined as any return to the operating room other than for full revision, including replacement of modular components, irrigation and debridement, hematoma evacuation, or open reduction internal fixation of fracture without removal of components intended for bony ingrowth. Comparative analyses were performed using Mann-Whitney U and Fisher Exact tests where appropriate. Survival to revision or re-operation were calculated using Log Rank and Kaplan-Meier tests. Cox hazard analyses were performed for revision and for reoperation, considering the following variables as individual predictors: age at surgery, sex, indication for initial surgery, BMI, DFR as a primary or revision procedure, number of previous procedures, construct dimensions, or use of a femoral diaphyseal engaging cone. Analyses were performed using SPSS.

## RESULTS:

32 patients with 38 unique DFRs met inclusion criteria. 27 prostheses were without a femoral diaphyseal cone, 11 with a cone. Patients with a cone were on average, 71 years old ( $\pm 10.5$  yrs), with a BMI of 37.0 ( $\pm 7.3$  kg/m<sup>2</sup>), 88.9% white, 55.6% male, and 77.8% insured through Medicare/Medicaid. Patients without a cone were on average, 77 years old ( $\pm 7.3$  yrs), with a BMI of 31.7 ( $\pm 7.6$  kg/m<sup>2</sup>), 100.0% white, 17.4% male, and 73.9% insured through Medicare/Medicaid. None of these variables differed significantly between groups. Indication for DFR surgery significantly varied between cohorts ( $p = 0.01$ ), with the majority of those with a cone indicated for periprosthetic joint infection (36.3%) or aseptic loosening (27.3%), and those without a cone indicated for fracture (29.6%) or periprosthetic fracture (29.6%). Patients with a cone had significantly more previous knee surgeries ( $5 \pm 3$  with cone vs.  $2 \pm 3$  without cone,  $p = 0.009$ ), including more previous DFRs. Log rank analyses showed cumulative survival to revision for any cause was not significant between groups ( $\chi^2 = 0.002$ ,  $p = 0.966$ ), nor was cumulative survival to re-operation for any cause ( $\chi^2 = 2.232$ ,  $p = 0.135$ ). At 3 years post-op, cumulative survival to revision was 80% in those with cones and 60% in those without. Similarly, at 3 years post-op, cumulative survival to re-operation was 90% in those with cones and 43% without cones. 7.4% of patients without a cone required a revision due to aseptic loosening compared to 0.0% of patients receiving a DFR with a cone required a revision due to aseptic loosening. Variables including age, indication for surgery (fracture, nonunion, mechanical failure, multiple dislocations, PJI, periprosthetic fracture), BMI, primary or revision DFR, construct dimensions (stem length, stem diameter, total construct length, stem:length diameter ratio), and the presence or absence of a cone were not predictive of revision on Cox hazard analysis. However, females had a significantly lower risk of revision (HR = 0.097; 95%CI: 0.011-0.829;  $p = 0.033$ ). Patients indicated for DFR due to prior aseptic loosening had significantly higher risk of revision compared to other indications (HR = 4.72; 95%CI: 1.00 – 22.29;  $p = 0.050$ ), and each additional previous procedure increased the hazard of revision by 41% (HR = 1.41; 95%CI: 1.04 – 1.90;  $p = 0.027$ ). No patient factors were predictive of reoperation.

## DISCUSSION AND CONCLUSION:

While the advent of engaging cones has allowed surgeons to attempt achieving adequate fixation in patients with poor bone stock, patients treated with DFR with a femoral diaphyseal engaging cones did not exhibit significantly increased survivorship in time to revision or re-operation, although at 3 years postoperatively, cumulative survival to revision or re-operation was higher in those patients with cones. This may be due to cones more frequently utilized in more complex cases as a last attempt to delay joint fusion or amputation. This increased survivorship may become statistically significant if longer periods of follow-up are considered which will be the target of future study.

