Minimum 5 Year Clinical Outcomes and Survivorship For a Single Revision Total Knee Arthroplasty System Using Hybrid Fixation and Press-Fit Stems

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INTRODUCTION:
Hybrid fixation, utilizing diaphyseal press-fit stems and cement fixation in the tibial and femoral joint line & metaphyseal areas (Zones I & II) has long been a strategy for revision total knee arthroplasty (rTKA) in our institution. The purpose of this study is to evaluate the clinical outcomes and survivorship of hybrid fixation using a single rTKA revision system at mid-term follow-up, with a minimum of 5 years follow-up.
METHODS:
We retrospectively reviewed our prospectively collected database to identify 290 patients who received a single revision TKR system where hybrid fixation and press-fit stems was used for the rTKA between July 2006 and August 2016. Single single-component revisions (i.e. femur-only or tibia-only revision) were excluded from the study. The indications for the index rTKA included 96 for previous prosthetic joint infection (PJI), 74 for aseptic loosening, 48 for osteolysis/polywear, 39 for instability, 24 for painful TKA and nine for stiffness. We reviewed the clinical outcome scores, including the Knee Society Score (KSS), Western Ontario and McMaster Universities Osteoarthritis (WOMAC) index, and Veterans RAND 12 Item Health Survey (VR-12). We also evaluated the 5 and 10 year survivorship and the indications for re-operations, with a minimum of 5 years follow-up.
RESULTS:
Of the 290 patients, there were 145 female and 145 male patients with a mean age of 70.3 (±9.7), mean body mass index of 33.4 kg/m^2 (±7.5). The mean time from rTKA surgery is 11.1 years (±3.0) with follow-up of up to 13 years. A paired t-test analysis showed a significant improvement from pre-operative versus post-operative clinical outcome scores ($p<0.001$) for KSS (87.5 ± 26.9 vs. 152.4 ± 35.3), WOMAC (45.1 ± 18.2 vs. 63.3 ± 21.8) and VR-12 Physical component (30.1 ± 7 vs. 34.8 ± 9.8). The VR-12 Mental component (51.3 ± 10.9 vs. 50.8 ± 11.4) was not significant ($p=0.86$).
We classified the bone defect at the index revision rTKA using Anderson Orthopaedics Research Institute (AORI) classification. We had 133 patients with femur bone loss of at least 2 and above and 122 patients with tibia bone loss of at least 2 and above. For the entire series, only nine patients had metaphyseal cones utilized for their index rTKA surgery. One patient had femoral and tibia cone, two patients had femoral cones and six patients had tibia cones.
One hundred and thirty nine patients had an offset coupler for the femur and 111 patients had offset coupler for tibia. There were 66 patients who had constrained liner insert used and 224 patients who had posterior stabilized (PS) hi-flex insert for their index rTKA. The use of offset coupler in the index rTKA compared to patients without offset coupler did not affect re-operation rate significantly ($p=0.496$). The use of constrained liner in the index TKA compared to patients with PS hi-flex insert did not affect the rates of re-revision significantly ($p=0.332$). The components utilized for the rTKA and AORI classification is shown in Table 1.0.
There were 50 re-operations (17%) at a mean time of 11.1 years (±3.0) after index rTKA. There were 32 re-operations for prosthetic joint infections (25 treated with debridement, antibiotics and implant retention (DAIR), seven treated with two-staged rTKA), eight due to instability, three due to other causes (periprosthetic fractures, stiffness, patella mal-tracking) with only seven revisions due to aseptic loosening. The cumulative survival rate for the rTKA post-operatively requiring re-revision for all causes at 5 years was 87.8 (95% confidence interval (CI), 81.6 to 92.1%) and at 10 years was 81.8% (95% CI, 71.7% to 91.9%). The cumulative survival rate for the rTKA post-operatively requiring re-revision due to aseptic loosening/failure at 5 years was 95.4% (95% CI, 92.6 to 98.1%) and at 10 years was 94.4% (95% CI, 90.2% to 98.7%). The survival curves for the re-revision due to all causes are shown in Figure 1.0 and for aseptic loosening/failure are shown in Figure 2.0.
DISCUSSION AND CONCLUSION:
In our study, the use of rTKA system with press fit stem combined with hybrid fixation provided a significant improvement in the clinical outcomes with respect to KSS, WOMAC, and VR-12 Physical component. PJI after index rTKA was the most common failure mode with 32 patients requiring re-operations. Re-revisions due to aseptic loosening were relatively uncommon (7 patients) for this rTKA system combined with hybrid fixation with cumulative survival rate of 95.1% at 5 years and 94.2% at 10 years. The use of metaphyseal cones or sleeves to augment zone II fixation may further improve these results but PJI remains the major limitation to rTKA surgery.

Table 1.0 showing components used during index rTKA and AORI classification for femur and tibia bone loss

Femur Stem utilized	Offset Coupler: 139 patients 100mm: 237 patients 160mm: 217 patients 220mm: 55 patients
Tibia Stem utilized	Offset Coupler: 111 patients 120mm: 26 patients 160mm: 298 patients 220mm: 14 patients
Polyethylene Insert	Constrained Insert: 66 patients PS Hi Flex Insert: 224 patients
Cones (n = number of patients)	Both femur and tibia (n = 1) Femur (n = 3) Tibia (n = 6)
AORI Classification Femur (n = number of patients)	1: n = 157 2A: Lateral: n = 16 2A Medial: n = 19 2B: n = 87 3: n = 11
AORI Classification Tibia (n = number of patients)	1: n = 166 2A: Lateral: n = 12 2A Medial: n = 27 2B: n = 69 3: n = 14

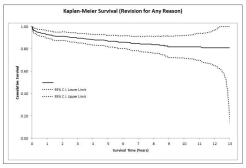

Figure 1.0 showing survival curve for revision for all cause

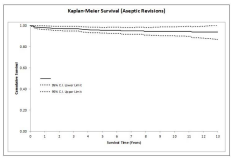

Figure 2.0 showing survival curve for revision for aseptic loosening