

Original Research Article

Functional and radiological outcomes in revision total knee arthroplasty

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ABSTRACT

Background: Following a primary total knee arthroplasty, patients with rheumatoid arthritis and osteoarthritis are reported to have comparable clinical prognoses and overall failure rates. Information on revision techniques is limited, despite the fact that the causes of failure and survivorship for primary total knee arthroplasty (TKA) have been well investigated. This study, which investigated the radiological and functional outcomes of revision total knee arthroplasty, was conducted as a consequence of these factors.

Methods: This observational study was conducted in the Department of Orthopedics in Sapthagiri institute of medical sciences and research centre among cases who underwent revision TKA during November 2022 to June 2023. A total of forty cases who underwent RTKA during the study period were included in the study. After taking the written informed consent, principal investigator assessed the detailed history of the participants and clinically examined the patients. Pre and post-operative functional and radiological outcomes were measured. The data was entered in excel sheet and analyzed using statistical package for the social sciences (SPSS) - version 19.

Results: Pre op and post-operative HSS score, KS score including the sub-scales like objective knee score, patient satisfaction score, patient expectations core and functional activity score and radiological outcome scores were found to be statistically improved post-operatively. Also, pain was markedly reduced postoperatively based on VAS scale. However, only one case died who underwent two stages TKA, which was not statistically significant.

Conclusions: We infer that further improvement in prevention and management of infection following TKA can help to prevent the proportion of cases requiring RTKA and thus much attention is warranted on this dreaded complication.

Keywords: Total knee arthroplasty, Revision arthroplasty, Functional outcome, Pain score

INTRODUCTION

Primary total knee arthroplasty (TKA) is an effective procedure that results in significant improvements in the patient's quality of life and the return of their function. Primary TKAs are long-lasting surgeries with a second-decade survival rate of over 90%. TKA failures, however, could happen and necessitate revision arthroplasty.¹ Despite the low rate of primary TKA failures, it is realistic to anticipate an increase in the yearly total of revision TKAs given the steadily rising primary TKA rate.² In general, revision TKA is regarded as a dependable technique with predictable results.^{3,4} However, due to a number of issues, such as the difficulty of the surgery

related to bone loss and soft tissue, the requirement to utilise larger and more limited prostheses, and more, the outcome of revision TKA is not as successful as initial TKA.^{4,5} TKA revisions, on the other hand, are more expensive than main procedures due to the greater technical requirements (implants and allografts), duration of hospital stay, higher complication rate, and longer convalescence period.⁶

Despite the positive outcomes of primary TKA, more revision TKAs are being performed, and a future rise in revision procedures is anticipated.⁷ The market for RTKA is anticipated to develop steadily, with a 601% rise forecast in the United States by 2030.⁷ Other Western nations are predicted to follow a similar path. Primary implants are

different from revision implants in that they have no stems or augmentations and are inserts (constraints). The surgeon must deal with additional ligament injury and bone loss with RTKA, which could cause the knee joint to become unstable.⁸ In order to address these issues, a more constrained implant is advised, and augmentations are frequently employed to make up for bone deficiencies.⁹

Revision total knee arthroplasty surgeries are increasingly common in recent days and this trend is anticipated to increase rapidly.¹⁰ A very small percentage of these revision surgeries are carried out on rheumatoid arthritis patients. Patients with osteoarthritis or rheumatoid arthritis are said to have a similar overall failure rate (need for subsequent revision) and clinical prognosis following a primary total knee arthroplasty.^{11,12} For patients with rheumatoid arthritis, the reported failure rate after revision total knee arthroplasty ranged from 19% to 28%.¹³ In the first publication, Rooser showed that 28% of a sample series of 76 revisions failed for both mechanical and infectious reasons.¹⁴ In a subsequent research, Sheng et al also showed that a smaller set of 16 revision procedures had a high failure rate of 19%.¹³ Although the causes of failure and survivability for primary TKA have been extensively studied, information on revision methods is sparse.¹⁵ These considerations led to the conduct of this study, which examined the radiological and functional results of RTKA.

METHODS

This observational study was conducted in the department of Orthopedics in Saphthagiri institute of Medical Sciences and Research Centre among cases who underwent revision TKA during November 2022 to June 2023. Cases from both gender, aged >18 years, cases who underwent a prior TKA, planned for revision procedure, cases who underwent RTKA, cases who came for minimum of 6 months of follow up, cases who have co-morbid conditions like diabetes, hypertension and any type of implant used in primary TKA were included in the study. Patients who have tumor and trauma were excluded from the study. A total of forty cases who underwent RTKA during the study period were included in the study. Ethical committee approval was obtained for this study from the Institutional Human Ethics Committee.

After taking the written informed consent, principal investigator assessed the detailed history of the participants and clinically examined the patients. For the prospective component, patients admitted as inpatients were assessed preoperatively. Post-operative functional and radiological outcomes were measured. In post op visits pain, ambulatory status, radiographic scoring, functional assessment with knee scoring system score, and complications if any were also evaluated. Hospital for Special Surgery Knee Score, Knee Society Scoring System was used for clinical assessment, while Knee Society Roentgenic evaluation system was used to evaluate radiological outcomes in the patients undergoing surgery.

All the findings from both cases and controls were entered in the same proforma where clinical presentation was noted by the principal investigator.

The data was entered in excel sheet and analyzed using statistical package for the social sciences (SPSS) - version 19. Descriptive statistics with mean, standard deviation and proportions (%) were calculated for quantitative variables. To test the hypothesis Chi square test, paired t test and paired sample t tests were used. P value of <0.05 was considered as statistically significant.

RESULTS

In this study mean age of participants was 65.3 years with mean body mass index (BMI) of 25.9. Notably, there was male predominance with 65% of male and 35% of females in this study (Table 1).

Table 1: Demographic profile of study participants.

Parameter	Mean	SD
Age (in years)	65.3	8.1
BMI	25.9	3.4
Duration of procedure (in min)	141.3	35.3
Interval to RTKA (in years)	8.2	3.6

On assessing the initial profile of TKA, there were 85%, 5%, 2.5%, 5% and 2.5% of cases underwent combined spinal epidural anesthesia (CSEA), CSEA with nerve block, spinal anesthesia alone, epidural anesthesia alone and general anesthesia, respectively. Also, single stage procedure was done in 17.5% cases and two staged procedures was done in 82.5% of cases. On assessing the side of pathology, there were 62.5% and 37.5% of cases had left sided and right sided pathology, respectively (Table 2).

Table 2: Clinical profile of initial TKA.

Variables	Frequency	Percentage
Route of anesthesia		
CSEA	34	85.0
CSEA with NB	2	5.0
SA alone	1	2.5
EA alone	2	5.0
GA	1	2.5
Procedure		
Single stage	7	17.5
Two stages	33	82.5
Duration of procedure (min)		
≤120	6	15.0
121-180	29	72.5
>180	5	12.5
Side of pathology		
Left side	25	62.5
Right side	15	37.5

On assessing the revised TKA, interval between initial and revised TKA was reported as less than 5 years, 6-10 years and more than 10 years in 7.5%, 70% and 22.5%, respectively with mean interval of 6.8 years. Additionally, on assessing the reasons for revised TKA, 60%, 27.5%, 7.5%, 2.5% and 2.5% of had infections, loosening, instability, PE wear and osteolysis, respectively (Table 3).

Table 3: Clinical profile of revised TKA.

Variables	Frequency	Percentage
Interval to RTKA (years)		
≤5	3	7.5
6-10	28	70.0
>10	9	22.5
Reasons for RTKA		
Infections	24	60.0
Loosening	11	27.5
Instability	3	7.5
PE wear	1	2.5
Osteolysis	1	2.5

On assessing the pre and post-operative HSS, KS scores (objective, patient satisfaction, patient expectation and functional activity scores) and VAS scores were significantly improved post-operatively compared to pre-operative scores (Table 4).

Table 4: Comparison of pre and post op HSS, KS and VAS scores.

Parameters	Preoperative	Postoperative	P value
HSS score	51.3±18.1	84.4±13.3	<0.0001*
KS score	45.6±15.1	83.3±13.5	<0.0001*
KS sub scales-objective knee score	47.3±12.5	74.4±15.2	<0.0001*
KS sub scales-patient satisfaction score	18.2±7.6	30.5±5.5	<0.0001*
KS sub scales-patient expectations core	6.3±2.3	11.4±1.5	<0.0001*
KS sub scales-functional activity score	49.4±15.1	80.6±17.4	<0.0001*
Radiological outcome	8.1±3.5	2.4±1.1	<0.0001*
VAS score	6.1±3.0	4.3±2.3	0.0031*

*P value statistically significant

DISCUSSION

Findings of the present study were comparable with the findings of the following studies. Mortazavi et al analysed the revision TKA survival and identified the causes and risk factors for failure.¹⁶ At the time of the index

adjustment, the average age was 63.9. Surgery that needed the replacement of at least one component was described as revision surgery. There were 18.3% failures at an average follow-up of 64.8 months when reoperation or re-revision were counted as failures. The most common reason for failure (44.1%) was infection, which was followed by stiffness (22.6%), issues with the patellar or extensor mechanisms (12.8%), periprosthetic fractures (5.9%), loosened (4.9%), haematoma development (3.9%), malalignment (2.9%), and instabilities (2.9%). 83% of failures overall occurred early. The most frequent cause of revision TKA failure was infection. The first two years following revision are usually when TKA revision failures predominate. The mode of primary TKA failure appears to be quite different from revision TKA failure. Lee et al evaluated the clinical results of a second TKA between infected and uninfected patients.¹⁷ Patients who underwent surgery for non-infectious conditions had postoperative ROM that was noticeably better than the infected group. In comparison to the non-infected group, the infected group had significantly lower HSS, KSKS, KSFS, and WOMAC scores. There was no discernible difference between the infected and non-infected groups in terms of postoperative joint line elevation. Revision TKA is a powerful procedure that can successfully cure both infected and uninfected patients. Overall, the non-infected revision produced better results than the infected revision.

Also, Hardeman et al claimed that after modification, mean KS increased from 27.6 to 71.5 and mean FS from 27.5 to 53.3.¹⁸ At 5 years, the overall survival rate was 90%, and at 10 and 14 years, it was 85%. None of the result parameters were significantly impacted by the index failure's root cause. Significantly, partial modifications and revisions in elderly patients had superior results. The main reasons for early modifications were infection and instability, whereas the main reasons for late revisions were polyethylene wear and loosening. Late revisions had a considerably higher survival rate than early revisions. They came to the conclusion that revision TKA causes a notable decrease in symptoms and an increase in function. For early revisions in young patients, the worst outcomes might be anticipated. Tay et al analysed the causes and effects of revision TKA in a single institution with a 2-year follow-up.¹⁹ According to their findings, aseptic loosening accounted for 13 (31.7%) of the criteria for revision, along with mechanical wear/component failure (24.4%), infection (22%), malalignment (9.8%), instability (7.3%), periprosthetic fracture (2.4%), and chronic stiffness (2.4%). Postoperatively, all 3 tools used to assess the clinical outcome showed significant improvements. These gains were evident six months after the operation and persisted throughout the whole two-year follow-up. No significant changes occurred in any of the scores during the 6-month and 2-year follow-up periods. The implants had a 100% survival rate and no postoperative problems necessitated surgical intervention. They came to the conclusion that local indications for revising TKA are comparable to those in other sizable centres. Revision total knee arthroplasty gives patients dramatically increased

function and quality of life, and these improvements remain for at least two years after the procedure. They achieved 100% implant survival in their series.

However, Meijer et al compared primary implant survival rates to revision implant survival rates when used during rTKA.²⁰ The top three reasons for revision were osteolysis (25%), aseptic loosening (25%) and infection (30%). Nine knees underwent rTKA with a primary implant, and 60 underwent rTKA with a revision implant. Primary implants had a 100% success rate after one year, 73% after two years, and 44% after five years. Revision implants survived for 95% of the first year, 92% of the second year, and 92% of the fifth year. When implanted during rTKA, primary implants had a considerably worse survival rate than revision implants. Rajgopal et al evaluated the medium-term results between aseptic failure and RTKA for septic failure.²¹ According to their findings, the KSS increased by 18% in the septic group from 51 to 69% and by 18% in the aseptic group from 52 to 70%.

In another study, Stammers et al assessed the two-stage correction for infections in TKA, and its overall success rate.²² Out of 51 patients, 46 (90%) were referred by other hospitals. Of the 37 patients who had an initial two-stage surgery, the infection was completely eliminated in 24 (or 65%). Following a failed two-stage revision, 19 patients underwent a second, successful two-stage revision that eliminated infection in 8 (42%). With an average follow-up of 43 months, a third two-stage procedure was conducted in five of these patients, curing the infection in three of them. 69% of patients had multidrug resistance, while 47% of patients had several organisms affected. Compared to 43% of the successful cohort, every failed outcome involved at least one multidrug-resistant pathogen. The groups with successful and unsatisfactory outcomes did not significantly differ in terms of serological indicators prior to a second-stage surgery. They came to the conclusion that, notwithstanding prior failures, one or more two-stage modifications can completely remove infection. Failure in this series is linked to multiple medication resistance, earlier attempts to get rid of the infection, and a less than ideal host response.

Similarly, Lee et al examined the root causes and therapeutic effects of RTKA with a minimum follow-up of two years.²³ According to their findings, septic complications caused 120 revision TKAs while aseptic complications caused 86. The most common aseptic consequence was 36 cases of periprosthetic fracture, followed by 25 cases of loosening, 13 cases of polyethylene wear, and 9 cases of instability. Patients improved in ROM and KS, HSS, and WOMAC scores at the last follow-up. Seven patients out of the total had revision due to periprosthetic fracture in one patient and reinfection in six others. They came to the conclusion that whereas septic problems comparatively increased as implants and surgical procedures advanced, mechanical issues such as aseptic loosening as well as instability that

required revision reduced. Stockwell et al evaluated the early to mid-term survival, clinical outcomes, and radiographic evaluation of this revision TKA.²⁴ At one year, two years, and five years, they reported that aseptic survivorship was 100%, 100%, and 99.1%, respectively. At one, two, and five years, any-cause survival rates were 99.6%, 98.7%, and 92.3%, respectively. Patient satisfaction consistently topped 70% at all periods. A component that had a radiography failure (0.4%) was later updated. In 83% of cases, neutral mechanical alignment was accomplished. Alignment was in valgus (7%) or varus (10%) in the remaining instances. Clinical results were not consistently correlated with radiographs or mechanical alignment. Evangelopoulos et al stated that the septic main TKAs had a 5% reinfection rate.²⁵ The majority of second revisions, up to 50% of the time, were due to infection. The findings of this study confirm that the first two years after implantation are the most likely time for a primary TKA to experience septic failure. Failure of the first TKA due to septic infection has no effect on the life of the revision prosthesis.

Additionally, Sachdeva et al found out if the clinical outcomes of the revision TKA are comparably similar to those of the primaries using the identical implant design.²⁶ In order to assess postoperative results, they reported comparing the KSS and range of motion measurements taken both preoperatively and at the most recent postoperative visit. Both cohorts showed an average 28-point improvement in pre- and postoperative KSS function ratings, which was similar in both groups. At a 2-year checkup, 87% of patients who underwent aseptic revision operations had survived from all causes. When controlling for implant type, patients who receive revision TKA for aseptic loosening may anticipate comparable gains in clinical function scores and survivability compared to those who undergo main TKA. Leta et al evaluated prosthesis survival rates, revision risk, and mortality rate after various surgical approaches used to treat PJI.²⁷ According to their findings, debridement and irrigation produced good results when compared to earlier published trials. Although older patients who underwent 1-stage revisions had a fourfold higher probability of undergoing a second revision compared to those who underwent 2-stage revisions, both types of revisions' overall results were comparable.

However, Agarwal et al examined the reasons why revision knee replacements fail.²⁸ According to their findings, aseptic loosening (30.5%) and infection (32.6%) were the two leading reasons for revision knee replacement failure. 12.6% of patients had unstable conditions, 10.5% had persistent stiffness, 7.3% had continuing discomfort, 5.2% had issues with the extensor mechanism, and one had probable metal allergy. The two main causes of failed knee revisions are still infection and loosening. Reductions in unsuccessful knee revisions may be made possible by improved fixation techniques and outcomes for infection control. Wignadasan et al reported that after revision TKA with a rotating hinge implant,

established long-term functional outcomes, radiological results, and survivability were achieved.²⁹ They claimed that a rotating hinge implant used in revision TKA produces adequate clinical results and very good implant survivability at long-term follow-up. Na et al figured out how frequently and what went wrong following TKA in their hospital over the previous 17 years.³⁰ Overall, they claimed that 51% of failures were caused by infection. A considerably higher percentage of patients in the recent group underwent revision TKA for mechanical loosening as well as instability compared to the past group, but a comparatively less percentage underwent revision TKA for infection, polyethylene (PE) wear, osteolysis, and malalignment. When comparing the rates of infection and mechanical loosening as well as instability between early and late revision TKA procedures, according to the time between main and revision TKA, infection rates were found to be relatively lower. They came to the conclusion that infections and aseptic loosening accounted for the majority of revision TKA cases in both the old and new groups. Revision TKA caused by mechanical loosening has lately grown considerably while revision TKA caused by PE wear has reduced dramatically over time.

CONCLUSION

In this study the mean Interval between TKA and RTKS was reported as 8.9 years with SD of 3.5 years. On assessing the reasons for RTKS, the most common was infections followed by loosening, instability, PE wear, osteolysis, and malalignment. Pre op and post-operative HSS score, KS score including the sub scales like objective knee score, patient satisfaction score, patient expectations core and functional activity score and radiological outcome scores were found to be statistically improved post operatively. Also, pain was markedly reduced postoperatively based on Vas scale. However, only one case died who underwent two stages TKA, which was not statistically significant. Hence we infer that further improvement in prevention and management of infection following TKA can helps to prevent the proportion of cases requiring RTKA and thus much attention is warranted on this dreaded complication.

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