

## ORIGINAL RESEARCH

# Revision Total Knee Arthroplasty, Mid Term Outcomes and Boneless Quality Evaluation and Treatment: An Institutional Based Study

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## ABSTRACT

**Background:** Performing revision total knee arthroplasty (rTKA) is a challenging surgical procedure marked by a considerable risk of complications, failures, substantial bone losses, and low bone quality. Hence, this study was conducted to analyse the outcomes, boneless quality and treatment.

**Materials & Methods:** All subjects who underwent revision total knee arthroplasty (rTKA) were included in the study. Logistic regression was used to analyze the relationship between these factors and the occurrence of RLL. The results were analysed using SPSS software.

**Results:** 20 percent of the patients were identified having poor bone quality according to modified AORI classification. Out of these 10 cases of poor bone quality, AORI 1 was seen in 4% patients, AORI 2 was seen in 6% patients, AORI 2B was seen in 8% patients and AORI was seen in 2% patients. Good bone quality was seen in 80 percent of the cases. AORI 1 was seen in 20% patients, AORI 2 was seen in 40% patients, AORI 2B was seen in 24% patients and AORI was seen in 16% patients. The KSS significantly improved from 13.2 points preoperatively to 78.4 points at final follow-up ( $P < 0.001$ ). Postoperative complications occurred in 8% of the patients. This included superficial infection and quadriceps tendon lesion.

**Conclusion:** Performing revision total knee arthroplasty (rTKA) is a complex procedure, and effectively addressing bone loss is essential to attain favorable outcomes.

**Keywords:** Total Knee Arthroplasty, Bone Quality, Outcomes.

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## INTRODUCTION

The long-term outcomes following revision total knee arthroplasty (RTKA) and factors that contribute to these outcomes remain an area of important research in orthopaedics. While the outcomes following primary total knee arthroplasty (TKA) have been well documented, the long-term outcomes of RTKA are less robustly supported by the literature. Although RTKA has been shown to result in considerable improvement in outcomes in comparison to the pre-RTKA condition,<sup>1</sup> the factors affecting outcomes following RTKA are poorly understood.<sup>2</sup> It remains widely accepted that RTKA is a challenging surgical procedure and that postoperative outcomes are poorer than those for primary TKA.<sup>3,4</sup> Revision total knee arthroplasty (TKA) is a laborious, technically difficult surgery with poorer results than (in) primary TKA which has become a

routine intervention for treating advanced osteoarthritis.<sup>5</sup> The actual estimates showed that a 7-fold increase in revision TKA surgery is expected between 2005 and 2030, while primary knee replacement surgeries will rise by approximately 174%. Although good results after this procedure have been presented, the outcomes are worse in comparison with those of primary TKA, with a higher failure rate.<sup>6,7</sup> Adequate implant fixation accounting for bone loss amount and bone quality is paramount to improve implant survivorship. Morgan Jones et al. described "zonal" fixation in rTKA, considering three zones: epiphysis, metaphysis, and diaphysis. The authors concluded that good fixation should be achieved in at least 2 zones in rTKA.<sup>8</sup> Bone loss in rTKA has been historically classified according to the Anderson Orthopaedics Research Institute (AORI) classification,

which considers the location of bone loss and defect size.<sup>9</sup> Different authors described the available options to treat bone losses in rTKA which include cement, impaction bone grafting, traditional metal augments, structural allograft, metal cones, or sleeves.<sup>10</sup> However, some authors reported high mid-term failure rates using cement, morselized, or structural bone allograft, probably due to poor bone quality in the metaphysis.<sup>11</sup> Hence, this study was conducted to analyse the outcomes of rTKA, boneless quality and treatment.

## MATERIALS & METHODS

The present study was conducted among 53 patients over a period of time between January 2014 to December 2020. 3 patients doesn't came for follow-up, therefore 50 patients were included in the study. All subjects who underwent revision total knee arthroplasty (rTKA) in Department of Orthopaedics, GMERS Medical College, Sola, Ahmedabad, Gujarat (India) were included in the study. The rTKA surgeries were conducted by the same surgeon and followed the three-step technique. The assessment of bone loss incorporated a proposed classification that considered bone quality. Clinical evaluation employed the Knee Scoring System (KSS), the Hospital for Special Surgery Knee Score (HSS), and the SF-12. Radiological assessment adhered to the Knee Society Roentgenographic Evaluation System. Various potential

risk factors, such as gender, age, and extent of bone loss, associated with the development of revision limb lengthening (RLL) were pinpointed. Logistic regression was used to analyze the relationship between these factors and the occurrence of RLL. The results were analysed using SPSS software.

## RESULTS

A total of 50 sTKA patients were enrolled. Mean age of the patients was 69.2 years. mean follow-up time was 62.5 months. Among them, there were 68 percent were males while the remaining were females. Mean BMI of the patients was 27.9 kg/m<sup>2</sup>. 20 percent of the patients were identified having poor bone quality according to modified AORI classification. Out of these 10 cases of poor bone quality, AORI 1 was seen in 4% patients, AORI 2 was seen in 6% patients, AORI 2B was seen in 8% patients and AORI 3 was seen in 2% patients. Good bone quality was seen in 80 percent of the cases. AORI 1 was seen in 20% patients, AORI 2 was seen in 40% patients, AORI 2B was seen in 24% patients and AORI 3 was seen in 16% patients. The KSS significantly improved from 13.2 points preoperatively to 78.4 points at final follow-up ( $P < 0.001$ ). Postoperative complications occurred in 8% of the patients. This included superficial infection and quadriceps tendon lesion.

**Table 1: Bone loss according to AORI classification**

Classification	Good bone quality	Poor bone qualityn(%)
AORI 1	10(20%)	2(4%)
AORI 2A	20(40%)	3(6%)
AORI 2B	12(24%)	4(8%)
AORI 3	8(16%)	1(2%)
Total	40(80%)	10(20%)

**Table 2: Improvement in ROM**

ROM	Mean	SD
Preoperative	102.8	3.5
Postoperative	111.3	4.5
p-value	0.001 (significant)	

**Table 3: Improvement in KSS**

KSS	Mean	SD
Preoperative	68.3	13.2
Postoperative	78.4	15.7
p-value	0.003 (significant)	

## DISCUSSION

The reasons for increased difficulty of surgery and poorer outcomes have been attributed to difficult surgical exposure, stiffness, adhesion of tissues, instability due to ligamentous laxity, and poor bone stock.<sup>4</sup> The revision procedure imparts an additional

burden of disability onto patients, and accordingly most revision patients will never experience an outcome as favorable as their primary procedure.<sup>12</sup> Hence, this study was conducted to analyse the outcomes of rTKA, boneless quality and treatment. In the present study, a total of 50 rTKA patients were enrolled. Mean age of

the patients was 69.2 years. mean follow-up time was 62.5 months. Among them, there were 68 percent were males while the remaining were females. Mean BMI of the patients was 27.9 kg/m<sup>2</sup>. 20 percent of the patients were identified having poor bone quality according to modified AORI classification. Out of these 10 cases of poor bone quality, AORI 1 was seen in 4% patients, AORI 2 was seen in 6% patients, AORI 2B was seen in 8% patients and AORI 3 was seen in 2% patients. Good bone quality was seen in 80 percent of the cases. AORI 1 was seen in 20% patients, AORI 2 was seen in 40% patients, AORI 2B was seen in 24% patients and AORI 3 was seen in 16% patients.

A study by Rosso F et al, fifty-one patients (53 knees) were included (60.8% female, average age 71.5 years). The average follow-up was 56.6 months (range 24–182). The most frequent cause of failure was aseptic loosening (41.5%). 18.9% of the cases demonstrated poor bone quality. Bone losses were treated according to the proposed algorithm. In all the cases, there was a significant improvement in all the scores ( $P < 0.05$ ). The average post-operative range of motion was 110.5° (SD 10.7). At the radiological evaluation, all the implants resulted well aligned, with 15.1% of non-progressive RLL. There were 2 failures, with a cumulative survivorship of 92.1% at the last follow-up (SD 5.3%). At the logistic regression, none of the evaluated variables resulted associated to RLL development. rTKA is a demanding procedure, and adequate treatment of bone losses is mandatory to achieve good results. However, also bone quality should be taken into consideration when approaching bone losses, and the proposed classification may need surgeons after an adequate validation.<sup>13</sup> In the present study, good bone quality was seen in 80 percent of the cases. AORI 1 was seen in 20% patients, AORI 2 was seen in 40% patients, AORI 2B was seen in 24% patients and AORI 3 was seen in 16% patients. The KSS significantly improved from 13.2 points preoperatively to 78.4 points at final follow-up ( $P < 0.001$ ). Postoperative complications occurred in 8% of the patients. This included superficial infection and quadriceps tendon lesion. Another study by Quinn J et al, cohort demonstrated a 93.5% survival rate and an 85% satisfaction rate at a mean of 6.5 years postoperatively. Mean ROM improved from 100° (range, 5°–145°) to 112° (range, 35°–135°) ( $p < 0.001$ ). The mean OKS was 39.25 (range, 14–48). The factors associated with improved postoperative outcomes included male gender, fewer previous revision total knee arthroplasty procedures, increased preoperative ROM, and receiving a less constrained implant.<sup>14</sup> Unfortunately, it is often difficult to accurately assess the main factors related to the surgical revision procedure due to the lack of sufficient data that demonstrate a clear relationship with the results after

this intervention. On the other hand, it is hard to draw conclusion from different studies because of the different implants used and the various types of revision surgery performed. Because revision TKA is extremely difficult from a technical point of view and requires adequate equipment and generates high costs, these interventions are challenging for both the patient and the surgeon and the results are worse than in primary TKA.<sup>15,16</sup> Complications in revision TKA surgery vary between 5-50% depending on the literature. The most common are: persistent pain joint stiffness, neurovascular problems, impairment of the extensor mechanism, complications related to surgical wound healing, occurrence of skin necrosis, and tibial tubercle fracture. Thrombosis and infection are two times more common than in primary TKA.<sup>17</sup> Survival of the revision implant at 10 years varies between 75-80%. It is found that with progression over time, the duration of the survival of the implant tends to decrease in all the analyzed studies (endpoint, re-revision of prostheses).<sup>18</sup> All the patients underwent a rTKA according to the “three-step technique” proposed by Kelly Vince.<sup>19</sup> In all the cases, the tourniquet was used only during cementation. All the implants were cemented using antibiotic-loaded cement. Tranexamic acid was used to reduce blood loss in all the cases. Femoral or tibial stems were used in all the cases to achieve a good diaphyseal fixation. Offset stems were used in case of (1) anatomical mismatch between the center of the metaphysis and the center of the diaphysis, (2) need for malalignment correction, and (3) need to improve gap balancing (in order to reduce flexion gap or to avoid femoral notching).<sup>20</sup> Bone loss may be treated with different options, depending on the severity of the defect and the quality of bone losses, including cement, impaction bone graft, traditional metal augments, structural allograft, tantalum cones, or sleeves.<sup>21</sup> Particularly, tantalum cones have been relatively recently introduced to treat major bone loss, with good outcomes.<sup>22</sup> Different authors described the biomechanical properties of tantalum, including high biocompatibility, high density, and possibility of porous structure with increased osteoconductive properties.<sup>23</sup> For all these reasons and because of their osteoconductive and positive biological properties, tantalum cones may be also useful to achieve a good metaphyseal fixation in presence of poor bone quality one, allowing for a stable “zonal” fixation as previously described by Morgan.<sup>24</sup> Rajgopal et al.<sup>25</sup> described no significant difference in outcome measures between RTKAs for septic and aseptic causes of failure in a retrospective review of 142 patient charts with a mean follow-up of 73 months. They concluded that septic failure does not preclude good outcomes of RTKA. In contrast, Barrack et al.<sup>26</sup> reported outcomes following 125 RTKAs with a mean follow-up of 36 months,

showing that patients who underwent RTKA for infection had poorer postoperative functional and clinical outcomes. Despite these differences, satisfaction was similar between groups. van Kempen et al.<sup>27</sup> described the 2-year outcomes of 150 RTKA patients, with best functional results in the aseptic loosening group and poorest results in the stiffness group. They also identified reason for revision as having statistically significant influence on postoperative range-of-motion (ROM) and approaching statistical significance for postoperative OKS.

## CONCLUSION

Performing revision total knee arthroplasty (rTKA) is a complex procedure, and effectively addressing bone loss is essential to attain favorable outcomes.

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