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## The impact of patellar resurfacing in two-stage revision of the infected total knee arthroplasty.

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**Abstract:**

Evidence for optimal management of the patellofemoral joint in revision surgery for the infected TKA is limited. We reviewed 69 infected TKAs undergoing two-stage revision. Fifty four patellae were resurfaced, 11 had patelloplasty performed, two were augmented with trabecular metal, one had impaction grafting, and one knee underwent patellectomy. Average follow-up was 4.5 years. The patients that received patellar resurfacing at re-implantation experienced statistically significant improvements in KSS pain score, functional KSS, and patellar score ( $P < 0.03$ ). One further patient treated with impaction grafting improved significantly in terms of pain and function. Patients treated with patelloplasty, trabecular metal augmentation, or patellectomy did not have significant improvements in clinical or functional outcome. Patient age, use of dynamic vs. static spacer, use of extensor mechanism release, and differences in Charlson index did not seem to statistically affect outcome. We recommend that every effort should be made to minimize patellar bone loss in first stage resection, as inability to resurface the patella at time of reimplantation may adversely affect patient outcome.

**Introduction:**

Periprosthetic joint infection (PJI) is a devastating outcome following total knee arthroplasty (TKA), occurring in approximately 2% of cases [1,2]. Two-stage revision is currently the most reliable treatment option for an infected TKA [2]. This consists of complete resection of components, insertion of an antibiotic-loaded spacer block, and delayed reimplantation.

Revision of the infected TKA poses unique surgical challenges for the patella: First, it may be necessary to remove any well-fixed patellar components, potentially risking patellar bone loss. Second, two-stage revisions require the placement of an antibiotic-loaded cement spacer; this inhibits knee flexion, promotes quadriceps and collateral ligament contracture, and can occasionally migrate and erode the patella [3]. Third, surgical exposure must be expanded in TKA revisions in order to view the entire knee joint, and it may necessary to release the extensor mechanism. This can be done through a quadriceps snip, described by Insall, or a V-Y quadricepsplasty when scar contraction of the quadriceps is encountered [4,5]. Osteotomy of the tibial tubercle may be helpful in patients with multiple irrigation and debridements since repeated V-Y incisions may cause excessive scarring [6]. Any of these methods can result in post-operative extensor mechanism dysfunction.

Treatment options for the patella at reimplantation include a) resurfacing with a new prosthesis where this is possible, b) leaving the patella unresurfaced, but debriding osteophytes and necrotic bone (patelloplasty), c) bone grafting, d) implantation of a tantalum porous augment with resurfacing, or e) patellectomy. The purposes of this study are (1) to assess whether patellar resurfacing results in improved outcome compared to other treatment options (2) to assess

whether spacer type or extensor mechanism release affect functional outcomes following two stage revision of the infected TKA.

### **Materials and Methods:**

Following institutional review board approval, we retrospectively identified 204 patients that underwent two stage exchange arthroplasty for treatment of an infected total knee arthroplasty at our institution between February 1997 and June 2010. Patients were excluded from our study if they (1) had a pre-established extensor mechanism problem before resection arthroplasty (7 patients), (2) had a documented knee revision surgery involving the patella between the primary procedure and resection stage (66 patients), (3) had repeat revision following the two-stage exchange (19 patients), (4) had a lower limb amputation following two-stage exchange (one patient), or (5) had less than one year of follow-up (42 patients). The remaining 69 patients comprised our study cohort.

Our study group comprised 39 males (39 knees) and 30 females (30 knees). The average age was 68.7 years (range, 45–89) at the time of resection. The average mean body mass index (BMI) was 33.2 kg/m<sup>2</sup> (range, 18.8–63.0 kg/m<sup>2</sup>). Patient co-morbidities were also collected and graded according to the Charlson Co-morbidity Index [7].

Irrigation and debridement was elected for 14 knees (13%) as the initial treatment for infection. These patients eventually underwent two-stage revision arthroplasty due to recurrent infection. The remaining 55 knees underwent resection arthroplasty followed by delayed reimplantation as the initial treatment for infection. Prior incisions were utilized and medial parapatellar arthrotomy performed for access to the knee joint. For all patients, tissue specimens were collected intraoperatively for Gram stain and culture.

During resection, all hardware and cement was removed, including the patella button where present, and soft tissue debridement was performed on bony surfaces. A patellar button was not present in 5 knees during the resection arthroplasty. At reimplantation, the patella was resurfaced wherever feasible. The same three criteria as outlined by Della Valle et al were used to determine patellar suitability for resurfacing, namely: Bone thickness of at least 10–12 mm, an intact patella without fracture, and adequate vascularization [6]. Patelloplasty comprised shaving of the retained patella with removal of osteophytes.

Fifty four patellae underwent resurfacing, eleven knees had patelloplasty performed, two knees had trabecular metal augments sewn to the patella, one had impaction grafting, and one knee underwent patellectomy. Clinical and functional outcomes of these patients were evaluated using the functional Knee Society Score (KSS), KSS pain score, [8] and a patellar score as described by Feller [9]. This latter allocates 15 points for anterior knee pain and 5 points for each of quadriceps strength, ability to rise from a chair and stairclimbing. It is scored from 3 (worst) to 30 (best outcome). A patellar score was included to address the limitations of the KSS in showing differences in pain and function relating specifically to the patellofemoral joint. Questionnaires were obtained at follow-up visits in the office and administered to patients via telephone. Average duration of follow-up was 4.5 years (range: 1.0–10.9 years).

Further data on specifics of spacer usage and surgical exposure during re-implantation were collected from patient charts. Fifty two knees received static spacers and seventeen received dynamic spacers. Three knees (4.3%) required a quadriceps snip, four knees (5.8%) required V-Y quadricepsplasty, and two knees (2.9%) required an osteotomy of the tibial tubercle. A lateral retinacular release was performed in ten knees (14.5%) to prevent lateral subluxation of the patella and improve extensor mechanism tracking.

Pre and post-operative functional outcomes of each treatment of the patella were compared using Student's t test. Setting a definition of "good outcome" as a functional KSS greater than or equal to 60, we compared the frequencies of each patellar treatment, extensor mechanism release, and each spacer type between patients with good and poor outcomes. Pearson chi-square was used to analyze categorical variables. Statistical significance was defined as a P value less than 0.05.

### **Results:**

The 54 patients that received patellar resurfacing at the time of reimplantation experienced statistically significant improvements in KSS pain score, functional KSS, and patellar score, from 9.2 to 32.5, 29.4 to 52.2, and 10.9 to 21.6, respectively (P < 0.03). Eleven patients that did not have adequate patellar bone to resurface and retained their unresurfaced patellae at time of re-implantation did not experience significant improvements in their functional outcome. Two patients that received trabecular metal patellar augments had minimal improvements in their pain score from 10.0 preoperatively to 25.0 postoperatively (P > 0.05), but results were not statistically significant. Similarly, the patient that underwent patellectomy did not have significant improvements in clinical or function outcome. The one patient that received impaction grafting improved significantly in pain and function, reporting a postoperative functional KSS of 100 (Table 1).

When identifying predictors of an outcome of functional KSS 60 or greater, resurfacing the patella and lower BMI were trending towards significance (p = 0.08 and p = 0.06 respectively). Use of dynamic vs. static spacer, extensor mechanism release, differences in Charlson index, and age did not seem to statistically affect outcomes (Table 2).

## **Discussion:**

Revision surgery for PJI in TKA is complicated by bone loss from tissue destruction, debridement of necrotic material at first-stage revision surgery, difficulty with removal of infected implants, and bone loss in the presence of a cement spacer device [10]. Problems affecting the patellofemoral joint have been identified as the most common cause of failure in primary TKA [11], and appropriate management of the patella during revision TKA has similarly been shown to strongly influence the clinical outcome [12,13]. Complications can include soft tissue impingement, avascular necrosis, patellofemoral instability, extensor mechanism ruptures, and patellar fracture [12].

Controversy still exists regarding the efficacy of patellar resurfacing in primary TKA [14–17]. While many authors have addressed the issue of patellar revision in aseptic TKA [12,18–20], this study is the first to our knowledge to specifically address management of the patella in two-stage revision for infected TKA.

The first objective was to determine the success rate of the various treatment options for the patellofemoral joint at reimplantation. The majority of patients, 50 (72.5%) were treated with patellar resurfacing at re-implantation, and this led to significant improvement in postoperative Knee Society Pain and Function Scores, as well as Patellar Scores ( $P < 0.003$ ). In a study by Patil et al looking at patellar resurfacing in revision TKA, no significant difference in outcome was found between resurfacing and non-resurfacing in aseptic patients. However, a subgroup of patients who had revision for infection noted a significant clinical improvement with patella resurfacing [20]. Patelloplasty has been reported to have outcome inferior to that of resurfacing in primary TKA [21]. While early results of patelloplasty in revision surgery are satisfactory, Knee Society scores show deterioration with time [22]. The eleven patients in this study who

were treated with patelloplasty did not experience any significant improvement in their outcome measures.

Hanssen reported significant improvement in post-operative Knee Society pain and function scores in a series of nine patients who had bone grafting of a patellar shell performed at the time of revision. The technique involves creation of a retropatellar soft tissue pouch which is filled with bone graft. Patellar thickness was largely maintained at final follow up [19]. Only one patient in our study had this performed, and they obtained significant benefit, reporting a score of post operative functional Knee Society score of 100.

Good outcomes have been reported with porous tantalum augments in the setting of patellar bone deficiency [23,24]. To be effective, they require a vascularized bony patellar remnant [24,25]. The two patients in our study treated with these augments did not achieve significant improvement in their Knee Society or Feller scores. Similarly, the one patient who had patellectomy performed showed no improvement in their outcome. Patellectomy has historically been reported as showing a poor outcome, with inferior quadriceps strength, easy fatigue and reduced active range of motion post procedure and delayed disruption of the extensor mechanism [23].

The second objective of the study was to identify any prognostic factors which would negatively impact on the fate of the patellofemoral joint following revision arthroplasty for infection. A functional Knee Society Score of less than 60 was taken as implying a poor outcome. Hypothesized predictors for poorer outcome included patellar treatment other than resurfacing, the type of spacer used (dynamic versus static) at first stage revision, whether an extensor release was performed, Charlson index of comorbidities, advanced age and BMI.

There is evidence to suggest that there may be less bone loss, and better post-reimplantation range of motion of the knee with use of an articulating spacer [26,27]. There is little evidence available outlining the effect of extensor release on revision knee arthroplasty outcome, but Barrack reported poorer outcomes in patients who had quadriceps turndown and tibial tubercle osteotomy versus quadriceps snip [28]. Neither of these variables reached statistical significance in predicting a poor outcome. In the same way, advanced age and higher incidence of comorbidities were not prognostic for a poorer outcome in this study.

Patients with increased BMI do not achieve the same improvement in outcome scores post primary TKA [29,30]. Although there was a trend towards patients with lower BMI having a better outcome, the difference was not significant. Patients who had patellar resurfacing performed also showed a trend toward having a post-operative KSS score greater than 60, but this was not a significant finding either.

Limitations of the study include the retrospective nature, the relatively small study group (69 knees in 69 patients), the absence of a control group and the short duration of follow up (average of 4.5 years follow up, range one to 10.9 years). Revision procedures for infected total knee arthroplasty are very complex procedures, and the varying condition of the bone and soft tissues do not make for a homogeneous patient population. Furthermore, there was potential for bias on the part of the treating surgeon, although in all cases an attempt was made to resurface the patella where this was deemed feasible. Finally, we compared the demographic data of patients who underwent patellar resurfacing to those who did not. There was no significant difference in age, gender or Charlson comorbidity index between the two groups (data not shown), but BMI was significantly lower in the group who underwent patellar resurfacing than in the group who had another treatment of their patella ( $31.6 \pm 8.7$  vs  $38.7 \pm 15$ ,  $P = 0.043$ ). This

might suggest that a lower BMI could influence the improvement in outcome seen with patellar resurfacing, although we did not find that BMI was a significant predictor of good outcome (KSS N 60) with revision TKA. Similarly, in a subgroup analysis of patients undergoing revision TKA, Singh et al noted that increased BMI was not associated with worse pain outcomes [31].

In conclusion, this study shows that patients undergoing revision TKA have a significantly better outcome if patellar resurfacing is performed. Factors postulated to lead to poorer patellofemoral function, including extensor mechanism release and type of spacer used after first stage debridement, did not significantly affect outcome following TKA reimplantation. Salvage procedures for treatment of patellar bone loss, with the exception of patellar bone grafting in one case, provided minimal benefit for the patient. We recommend that every effort should be made to minimize bone loss in first stage resection to allow for resurfacing during reimplantation, as inability to resurface the patella at the time of reimplantation may adversely affect patient outcome.

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