

HK67: Is there a role for sub radical exchange (leaving some implants) arthroplasty in patients with chronic PJI?

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Response/Recommendation: Sub-radical exchange arthroplasty, that is, leaving parts of implants in place, may be considered during management of patients with chronic periprosthetic joint infections when a component is proven to be well-fixed and its removal precludes opportunity for future reconstruction.

Level of Evidence: Moderate

Rationale:

Debate exists as to the optimal treatment of patients with late, chronic periprosthetic joint infection (PJI). Removal of all prostheses and foreign materials, whether one-stage with immediate revision or two-stage with delayed reimplantation after an interval of antibiotic therapy, is the current gold standard, even in situations where there is a well-fixed, with ingrown or well-cemented, component on one side of the arthroplasty. However, removal of well-fixed components can result in additional perioperative morbidity and cause iatrogenic bone loss that may compromise subsequent reconstruction. Selectively retaining a well-fixed component while removing only the loosened or suboptimal parts may be an option to avoid compromise of host bone in the setting of PJI treatment.

Included were studies reporting outcomes in patients managed with sub radical exchange for treatment of infection after hip or knee arthroplasty, either in one or two stages, with partial retention of one or more well-fixed major metallic components. We excluded studies with complete component exchange, revisions for causes other than infection, treatment of septic arthritis prior to primary hip or knee arthroplasty, studies involving infection of joints other than the hip or knee, studies with complete component retention or exchange of modular parts only such as hip femoral head and/or acetabular liner or knee insert as part of a debridement, antibiotics, and implant procedure (DAIR), and studies with removal of metallic cemented components with retention of the cement mantle only. While we considered both hip and knee studies, sub radical exchange is more commonly used in revision of infected hip arthroplasty.

Overall, 550 studies were identified using the search terms supplied across EMBASE and PubMed. After title and abstract review, 40 full text reviews were performed, reducing the full data extraction to 31 studies published from 1989 to 2024. Eleven studies were from Asia, ten from Europe, nine from North America, and one from South America. Two articles that were systematic reviews only of studies already included in the current review were withdrawn from analysis [2, 24]. There were 27 practice registry studies, one national registry study [10], and one multicenter study with patients from 20 hospitals who underwent one-stage revision arthroplasty with unexpected positive intraoperative cultures [19]. There were three level III evidence studies and 26 level IV, with six case reports, 19 case series, and four case control series with comparator group(s).

The studies included 591 patients undergoing sub radical exchange for treatment of periprosthetic joint infection (PJI), with 322 patients (54%; 10 studies) undergoing one-stage exchange and 269 (46%, 19 studies) treated with two-stage exchange. The involved joint was the hip in 580 of 591 patients (97%) with only one study, the multicenter review by Mancheño-Losa and colleagues, that included a small number of patients (11 of 110) with infected total knee or total shoulder arthroplasty undergoing partial revision [19]. Retained components were hip femoral components in 281 (48%) patients, acetabular components in 39 (7%), hip distal stem segments in 16 (3%), and not reported for 255 (43%) patients in 4 studies, all one-stage exchange. Fixation of retained components was cementless in 225 (38%) patients, cemented in 24 (4%), and not fully reported in 8 studies (342 patients, 58%). Overall, the mean weighted patient age was 66.3 years (range, 19 to 95 years; reported in 28 studies), mean weighted body mass index (BMI) was 28.8 kg/m² (range, 18 to 58; reported in 11 studies with 205 patients), 51% (302 of 588) of involved joints were in women (range, 42% to 100%, reported in 28 studies), and mean weighted follow-up was 4.0 years (range, 0.3 to 18.5 years; reported in 28 studies).

Most common infecting organisms cultured were methicillin-sensitive *Staphylococcus aureus* in 81 (13.6%), coagulase negative *Staphylococcus* in 118 (19.8%), methicillin-sensitive *Staphylococcus epidermidis* in 36 (6.1%), methicillin-resistant *Staphylococcus aureus* in 30 (5.0%), methicillin-resistant *Staphylococcus epidermidis* in 9 (1.5%), other *Staphylococcus* in 12 (2.0%), *Streptococcus* species in 27 (4.5%), gram-negative bacilli in 19 (3.2%), gram-positive bacilli in 17 (2.9%), *Enterococcus faecalis* in 18 (3.0%), *Pseudomonas aeruginosa* in 11 (1.8%), *Escherichia coli* in 9 (1.5%), *Peptostreptococcus* in 6 (1.0%), *Propionibacterium* in 5 (0.8%), 4 *Enterobacter*, 3 *Candida albicans*, 2 gram-negative cocci, 7 polymicrobial (1.2%), and one each *Anaerococcus prevotii*, *Corynebacterium jeikeium*, *Klebsiella oxytoca*, *Morganella morganii*, *Proteus mirabilis*, *Salmonella* group D, *Yersinia enterocolitica*, and *unspecified fungal*. One study with 4 polymicrobial infections did not specify which organisms were in combination. Forty-one patients (6.9%) were culture negative. Infecting organisms were not reported in two studies involving 132 patients (22.2%) [10, 13].

For two-stage exchange the mean weighted interval between stages was 18.1 weeks (range, 0.4 to 96 weeks; reported in 17 studies with 253 patients). Most patients (210 of 269; 78%) were treated with articulating spacers made from antibiotic-laden bone cement, static spacers were used in 28 (10%), antibiotic-laden cement beads were used in an early case report [26], and spacer type was not reported for three studies [13, 14, 25]. The antibiotic most frequently added to the spacers was vancomycin, in doses ranging from 2 to 4g per unit of cement. Other antibiotics utilized in cement spacers were tobramycin (up to 4.8g per unit), gentamicin, cefotaxime, erythromycin, teicoplanin, colistin, cefuroxime, and other organism-specific options. For the one-stage exchange articles, two mention using powdered Vancomycin poured into the wound at time of revision [15, 20].

For patients undergoing one-stage exchange, 6 of 10 studies reported administration of organism-specific intravenous antibiotics postoperatively followed by a course of oral antibiotics. Intravenous antibiotic therapy typically lasted for 5 days to 6 weeks, while oral treatment extended for up to 9 months. For the two-stage exchange studies, most recommended a 6-week course of organism-specific intravenous antibiotics after the first stage, ranging from “discontinued the same day the drainage tube was removed” [6] to 12 weeks, usually followed by a course of oral antibiotics. Some studies also recommended the continuation of intravenous antibiotics after the second stage reimplantation, followed by oral antibiotic therapy.

For two-stage exchange, complications during the interval between stages were reported in 8 studies. Eight patients required further debridement for persistent infection; at least 5 of these patients had resection arthroplasty without reimplantation. One patient died at 3 months without reimplantation. Spacer dislocation was reported in four patients, of whom two were treated with closed reduction and two underwent second stage revision to the definitive implant. Five patients refused reimplantation and were satisfied with the pain relief and function achieved with the spacer.

For patients treated with sub radical exchange for PJI, rate of reinfection at one-year was 7.8% (26 of 332) overall, with no significant difference between patient undergoing one-stage versus two-stage exchange ($P=1.0000$): 7.6% (5 of 66) of patients in the six one-stage exchange studies reporting, and 7.9% (21 of 266) of patients in 18 studies of two-stage exchange. At final mean overall follow-up of 4.0 years (range, 0.3 to 18.1), the overall reinfection rate was 16.5%, observed in 97 of 588 patients. For 322 patients treated with sub radical one-stage exchange, reinfection occurred in 20.5% (66) at mean weighted follow-up of 3.6 years (range, 1.3 to 18.1), while for 266 patients treated with sub radical two-stage exchange, results were more favorable with a lower reinfection rate of 11.7% (31 patients, $P=0.0051$) at mean weighted follow-up of 4.6 years (range, 0.3 to 18.5 years).

Limitations of this review are that all of the studies included were retrospective in nature, there was a small number of patients overall with seven articles limited to case reports with one or two patients, a wide variety of methods were utilized, including postoperative antibiotic protocols, and overall 6.9% of patients were culture negative.

The success rate for patients treated with two-stage partial exchange was significantly higher at a longer final follow-up ($P=0.0051$), with 88.3% free of re-infection at a mean of 4.6 years compared with 79.5% at 3.6 years for patients undergoing one-stage partial exchange. However, the higher eradication rate must be balanced with the substantial complications observed between the two stages and the interval mean duration of 18.1 weeks, extending up to 96 weeks, and the burden and impact of those factors on the patient's quality of life.

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