SH84. What are the indications for one versus two-stage exchange arthroplasty in the management of acute shoulder PJI?

A comprehensive literature review was performed to identify all studies on revision shoulder arthroplasty for treatment of PJI. Searches for the terms "shoulder replacement", "arthroplasty," "postoperative," "infection," "revision", "reimplantation," "one stage," "1-stage," "two stage," "2-stage," "prosthetic-related infection" amongst others were performed using the search engines PubMed, Scopus, and Google Scholar which were searched through November 2024. Inclusion criteria for our systematic review were all English studies (Level I-IV evidence) that reported on infection eradication rates for single or two-stage revision arthroplasty for PJI of the shoulder with a minimum of one year of follow-up. We defined single-stage revision arthroplasty as a complete removal of components followed by irrigation and debridement and reimplantation of prosthetic components in the same procedure. We defined two-stage revision as patients who underwent an initial procedure to remove the existing prosthetic components, irrigation and debridement, and antibiotic spacer placement, followed by a second procedure to remove the spacer, repeat irrigation and debridement, and reimplantation of prosthetic components. Exclusion criteria were non-English language articles, studies not reporting on infection eradication, studies without 12 months of clinical follow-up, review papers, and technique papers without patient data. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) criteria were followed. 48 articles were identified that met inclusion and exclusion criteria for final review.

Recommendation: Indications for one-stage versus two-stage revision remain unclear. The pooled data demonstrate one-stage revision to have higher rates of infection eradication compared to two-stage. However, given the retrospective nature of the studies included in this review this may be due to selection bias with two-stage exchange being performed for more severe cases.

Strength of Recommendation: Limited (Evidence is insufficient and does not allow a recommendation for one intervention over the other)

Rationale:

PJI following shoulder arthroplasty can be a devastating complication causing significant disability and morbidity to the patients affected. Incidence of PJI has been reported to range from 1-4% in primary cases and 4-15% in revision cases.[4,9] Previously, two-stage exchange arthroplasty has been considered the gold standard for treatment of PJI of the shoulder.[4] Recently, one-stage exchange arthroplasty has been advocated for as several studies have reported lower complication rates compared to two-stage exchange as well as similar reinfection rates.[1,5-7] The purpose of this review was to compare the outcomes of single-stage versus two-stage exchange arthroplasty and their role in treatment of acute shoulder PJI.

We identified 18 articles that evaluated one-stage exchange arthroplasty and 39 articles that evaluated two-stage exchange arthroplasty for treatment of shoulder PJI. Studies diagnosed PJI based on the previous ICM guidelines.[3] Patient demographics, surgical treatment method, rate of reinfection, and non-infection related complications were consistently reported amongst the studies included. Other variables including timing of infection, associated pathogens, clinical findings (ie: draining sinus, erythema, etc), antibiotic treatment, and functional outcomes were inconsistently reported. In studies that did report timing of infection this was defined according to Sperling et al. and Strickland et al. with acute meaning < 3 months from primary arthroplasty, sub-acute meaning 3-12 months, and chronic > 12 months.[10,11]

To address the question of the role of one versus two-stage exchange in shoulder PJI we reviewed the data on infection eradication/reinfection rates in single and two-stage procedures as defined above and evaluated complication rates and functional outcomes. Studies were grouped according to their revision type (single-stage or two-stage). Studies with both single and two stage revisions were separated into two different groups. Number of reinfections and sample sizes were extracted to calculate the proportion of reinfections on follow-up. A proportional meta-analysis using a fixed-effects (sample size) model with

double arcsine transformation (Freeman-Tukey) was conducted to identify the pooled rate of reinfections with 95% confidence intervals for single-stage and two-stage separately. Confidence intervals were compared and a p-value was calculated. Weighted means for continuous outcomes (forward flexion, external rotation and Constant Murley Score) were calculated. Weighted means were not compared between surgery types. All analysis were performed using JBI SUMARI.

Out of the 48 studies included in this systematic review, 18 studies had a single-stage group and 39 studies had a two-stage group (9 studies with both arms). Figure 1 presents the pooled incidence of reinfection for single-stage surgeries and Figure 2 presents it for two-stage studies. The incidence of reinfection was 2.7% (1.0%, 5.0%) in single-stage studies and 12.5% (9.8%,15.3%) for two-stage surgeries, which is statistically different ($p < 0.001$). The incidence of non-infectious related complications was 11.9% (7.7%, 16.7%) in single-stage studies and 21.4% (17.6%, 25.4%) for two-stage surgeries, which is statistically different ($p = 0.003$). The above data as well as functional outcomes are summarized in Table 1.

Most studies report timing of infection but few report success of treatment related to timing of infection. When specifically evaluating acute PJI, we identified three studies that reported on reinfection rate related to timing of infection for single-stage exchange and three studies that reported on reinfection rate for two-stage exchange. Beekman et al. reported three cases of single-stage exchange for treatment of acute PJI with no recurrent infection.[1] One patient underwent revision for instability. Klatte et al and Ince et all each reported no recurrent infections in 4 patients and 2 patients respectively who were treated with single-stage exchange for acute PJI.[5,6]

In regard to two-stage exchange for treatment of acute PJI, there was no recurrent infection amongst 6 patients across three studies.[2,8,12] One patient had to undergo revision for aseptic loosening of components and was found to have negative aspiration and negative intra-operative cultures at the time of revision surgery.[2]

Overall, this review demonstrates that there is a substantial gap in the current literature regarding single versus two-stage exchange arthroplasty for treatment of shoulder PJI. Of the 48 articles included two were prospective cohort studies and the remainder were retrospective reviews, thus selection bias is a concern. While the pooled data suggests single-stage exchange has a lower reinfection rate than two-stage exchange, these studies did not control for confounding variables including organism(s), antibiotic treatment, timing of infection, other clinical findings such as draining sinus, or adjuvant treatment at the time of sugery. Additionally, most studies had small sample sizes and highly variable follow-up which may have influenced the detection of recurrent infection, especially in cases of indolent infection in patients with C. acnes.

When specifically evaluating treatment of acute PJI using single or two-stage exchange, the current number of cases reported in the literature that identify reinfection rate, complication rate, and functional outcomes in relation to timing of infection is insufficient.

Figure 1. Reinfection rate for single-stage studies

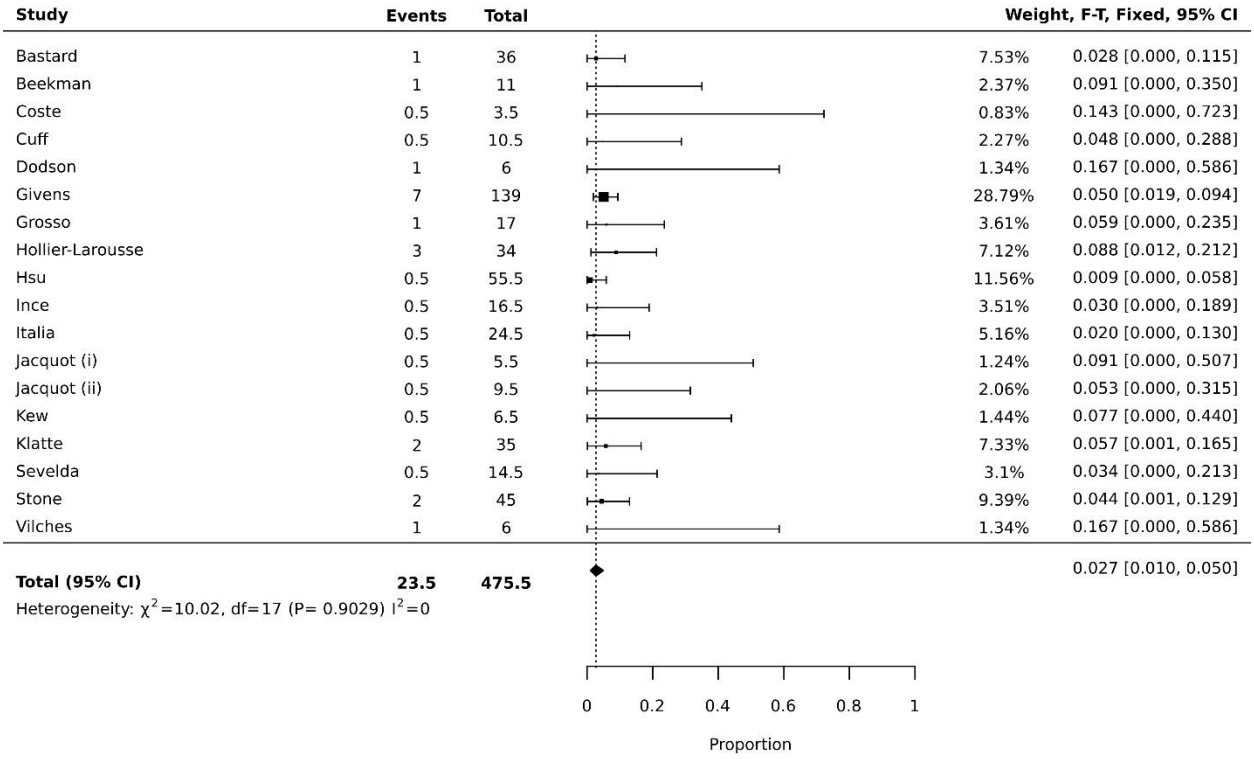
Study
Events
Total
Weight, F-T, Fixed, 95% CI
Bastard 1 36 7.53% 0.028 [0.000, 0.115]
Beekman 1 11 2.37% 0.091 [0.000, 0.350]
Coste 0.5 3.5 0.83% 0.143 [0.000, 0.723]
Cuff 0.5 10.5 2.27% 0.048 [0.000, 0.288]
Dodson 1 6 1.34% 0.167 [0.000, 0.586]
Givens 7 139 28.79% 0.050 [0.019, 0.094]
Grosso 1 17 3.61% 0.059 [0.000, 0.235]
Hollier-Larousse 3 34 7.12% 0.088 [0.012, 0.212]
Hsu 0.5 55.5 11.56% 0.009 [0.000, 0.058]
Ince 0.5 16.5 3.51% 0.030 [0.000, 0.189]
Italia 0.5 24.5 5.16% 0.020 [0.000, 0.130]
Jacquot (i) 0.5 5.5 1.24% 0.091 [0.000, 0.507]
Jacquot (ii) 0.5 9.5 2.06% 0.053 [0.000, 0.315]
Kew 0.5 6.5 1.44% 0.077 [0.000, 0.440]
Klatte 2 35 7.33% 0.057 [0.001, 0.165]
Sevelda 0.5 14.5 3.1% 0.034 [0.000, 0.213]
Stone 2 45 9.39% 0.044 [0.001, 0.129]
Vilches 1 6 1.34% 0.167 [0.000, 0.586]
Total (95% CI) 23.5 475.5 0.027 [0.010, 0.050]
Heterogeneity: χ2=10.02, df=17 (P= 0.9029) I2=0
0
0.2
0.4
0.6
0.8
1
Proportion

Figure 2. Reinfection rate for two-stage studies

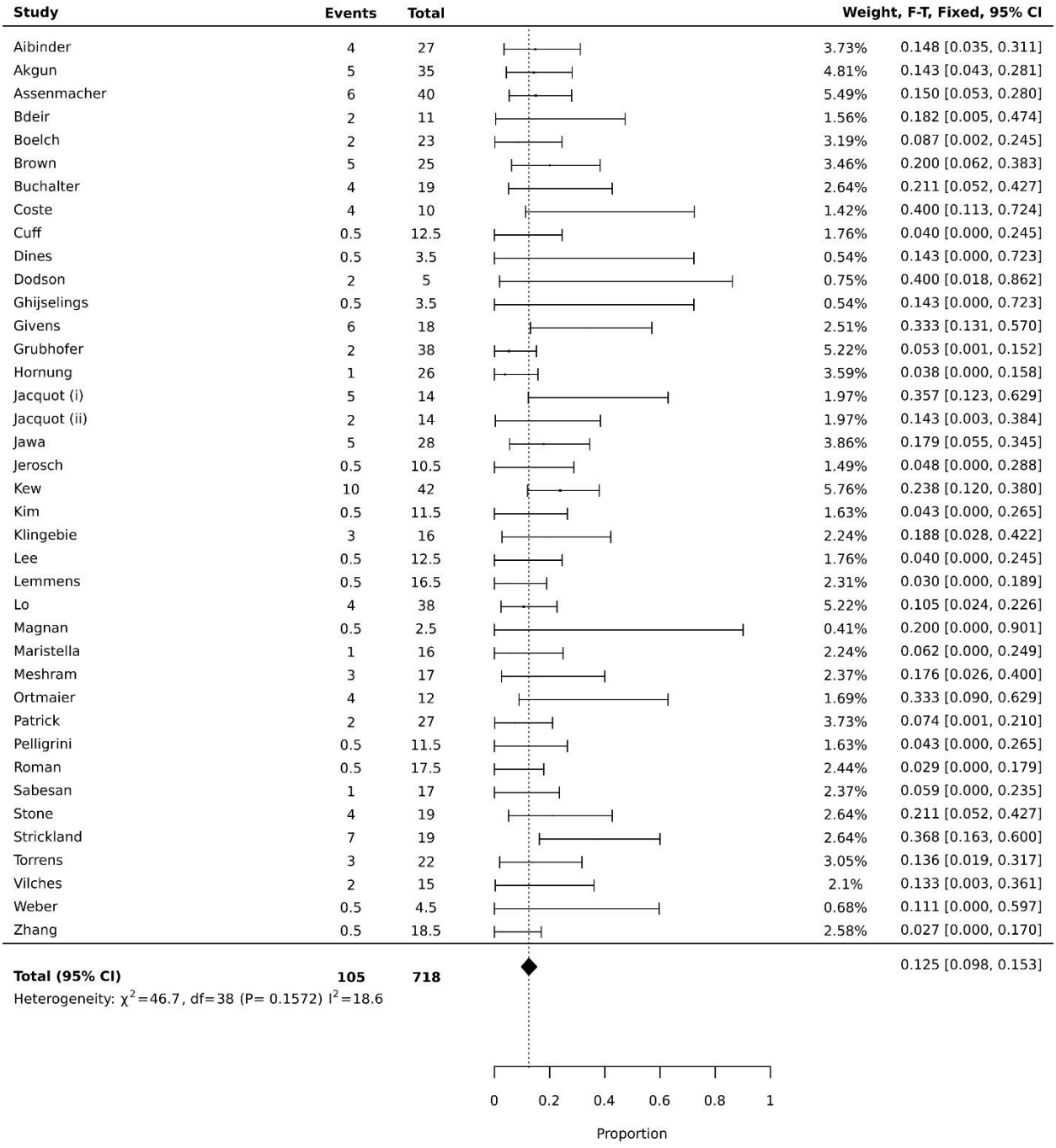

Table 1. Reinfection, complication, and functional outcomes.

One-Stage	Pooled Reinfection Rate	Pooled Non-infectious Related Complication Rate	Constant-Murley Score	Forward Flexion (Degrees)	External Rotation (Degrees)
18 Papers	2.7% (1.0%, 5.0%) p < 0.001	11.9% (7.7%, 16.7%) p = 0.003	50.76 +/- 7.48	111.79 +/- 15.79	27.25 +/- 7.87
Two-Stage	**Pooled Reinfection Rate**	**Pooled Non-infectious Related Complication Rate**	**Constant-Murley Score**	**Forward Flexion (degrees)**	**External Rotation (Degrees)**
39 Papers	12.5% (9.8%, 15.3%) p < 0.001	21.4% (17.6%, 25.4%) p = 0.003	46.82 +/- 10.10	105.61 +/- 19.43	33.04 +/- 12.93

References:

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