SH8: Is bone-grafting associated with higher rate of PJI when compared to metal reconstruction in revision surgery?

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Response/Recommendation: Unknown. There is limited data to compare prosthetic joint infection rates of bone grafting or that of metal reconstruction in revision surgery due to heterogeneity of the current available literature.

Strength of Recommendation: Limited

Rationale: A comprehensive literature review was performed to identify all studies on prosthetic joint infection (PJI) in revision surgery when bone-grafting or metal reconstruction was used. Searches for the terms "shoulder replacement", "joint replacement", "infection", "prosthesis-related infection", "reoperation", "bone grafting", "allograft", "patient-matched", and "prosthesis and implant" were performed using the search engines PubMed and Google Scholar which were searched through January 2025. Inclusion criteria for our systematic review were all English studies (Level I-IV evidence) that reported on prosthetic in cases of revision shoulder arthroplasty. Exclusion criteria were non-English language articles, nonhuman studies, retracted papers, case reports, review papers, studies with less than <10 patients in the sample size, studies without clinical follow-up/infection rates, and technique papers without patient data. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) criteria were followed. There are no current comparative studies to reference whether bone grafting or metal reconstruction has a higher rate of PJI in revision surgery. Given the limited literature available, comparative studies in primary surgeries, as well as discrete studies focusing on glenoid or humeral side revision surgeries, were assessed in the review.

There is no literature comparing the periprosthetic joint infection rates of bone-grafting to that of metal reconstruction in revision shoulder surgery. The goal of using bone-grafting or metal reconstruction is to address the bone loss or defect in the glenoid and/or the humeral side. However, the etiology and the indication for the usage are different, and the available options for bone-grafting and for metal reconstruction are varied. Due to this heterogeneity, comparing current available studies that describe prosthetic joint infection in specific discrete application of bone-grafting or metal reconstruction is limited.

Comparative systematic reviews in primary surgery to address glenoid defect have shown prosthetic joint infection (PJI) rates of 1.9% in bone-grafting and of 0.7% in metal reconstruction[1], but there are no comparative systematic reviews in revision surgery setting. For bone-grafting in revision surgery, it can be used as a structural or non-structural adjunct but reported PJI incidences are low and the reported data on the types of bone-grafting are pooled or non-discrete. A retrospective cohort of 30 revision reverse patients, comparing iliac crest structural bone autograft to nonstructural bone allograft on the glenoid defect, showed only 1 patient in the structural bone autograft cohort having an infection[2]. Wagner et al. had 40 revision shoulder arthroplasty patients with glenoid bone-grafting with 1 infection reported at a mean of 3.1 year follow-up[3].

The etiology for revision surgery requiring bone-grafting or metal reconstruction have also varied, ranging from instability, aseptic loosening, to infection. In the case of pre-existing infection, many studies have not provided adequate information on patient history, causative organism, nor cultures. Of the 15 revision patients with structural bone-grafting, Viswanath et al. had 4 infected patients who had no recurrence of the infection at a minimum of 2-year follow-up[4], but no reports of the initial causative organism nor cultures. For metal reconstruction, there are limited studies on outcomes and infections in revision surgeries. The largest cohort of 28 revision surgeries with metal reconstruction had 4 cases of infection, which were in patients in immunocompromised or with multiple history of chronic infections[5].

For humeral-sided revision surgery, a systematic review and meta-analysis of allograft prosthetic composite (APC) versus endoprosthesis reconstruction for massive proximal humeral bone loss showed that APC cohort had an infection rate of 2.4% (5 out of 213 patients) while endoprosthesis cohort had a rate of 2.1% (3 out of 144 patients)[6]. However, these studies pooled results from tumor, fracture and failed arthroplasty literature. Another systematic review on the outcomes after allograft prosthetic composite showed that most studies are from oncological reconstruction literature, where infection rate can be high as 13%[7,8]. In studies that investigated outcomes of APC in humeral-sided revision surgery, Cox et al. had 73 patients with failed arthroplasty requiring APC with an average follow-up of 67.9 months, 19 complications occurred. Yet only two infections were documented.[9] Sanchez-Sotelo et al. had 18 revision reverse arthroplasty with APC reconstruction but had no reported infections in the revision group.[10] Lastly, for humeral-sided revision using endoprosthesis, Labrum IV et al. had 27 patients with two reported infections at a minimum of one-year follow-up.

Based on the limited literature and the heterogeneity of the studies, whether bone-grafting or metal reconstruction has a higher prosthetic joint infection in revision surgery remains unclear.

References:

1. Lanham NS, Peterson JR, Ahmed R, Pearsall C, Jobin CM, Levine WN. Comparison of glenoid bone grafting vs. augmented glenoid baseplates in reverse shoulder arthroplasty: a systematic review. Journal of Shoulder and Elbow Surgery. 2022;32(4):885-891. doi:10.1016/j.jse.2022.11.017
2. Mahylis JM, Puzzitiello RN, Ho JC, Amini MH, Iannotti JP, Ricchetti ET. Comparison of radiographic and clinical outcomes of revision reverse total shoulder arthroplasty with structural versus nonstructural bone graft. Journal of Shoulder and Elbow Surgery. 2018;28(1):e1-e9. doi:10.1016/j.jse.2018.06.026
3. Wagner E, Houdek MT, Griffith T, et al. Glenoid Bone-Grafting in revision to a reverse total shoulder arthroplasty. Journal of Bone and Joint Surgery. 2015;97(20):1653-1660. doi:10.2106/jbjs.n.00732
4. Viswanath A, Newell AK, Cunningham LJ, et al. Survivorship of allologous structural bone graft at a minimum of 2 years when used to address significant glenoid bone loss in revision Shoulder Arthroplasty: A Computed Tomographic and Clinical review. Journal of Shoulder and Elbow Arthroplasty. 2023;7. doi:10.1177/24715492231172371
5. Michelin RM, Manuputy I, Rangarajan R, Lee BK, Schultzel M, Itamura JM. Primary and revision reverse total shoulder arthroplasty using a patient-matched glenoid implant for

severe glenoid bone deficiency. Journal of Shoulder and Elbow Surgery. 2024;33(6):S93-S103. doi:10.1016/j.jse.2024.03.005
6. Hao KA, Gutowski CT, Bindi VE, et al. Reverse allograft Prosthetic-Composite versus Endoprosthesis reconstruction for massive proximal humerus bone loss: A Systematic review and Meta-analysis of Outcomes and complications. Indian Journal of Orthopaedics. 2024;58(10):1339-1348. doi:10.1007/s43465-024-01248-7
7. Rampam S, Segu H, Gonzalez MR, Lozano-Calderon SA. Complications and functional outcomes after reconstruction of the proximal humerus with allograft-prosthetic composite: a systematic review of the literature. Journal of Shoulder and Elbow Surgery. 2024;33(8):1873-1883. doi:10.1016/j.jse.2024.02.037
8. Potter BK, Adams SC, Pitcher JD, Malinin TI, Temple HT. Proximal humerus reconstructions for tumors. Clinical Orthopaedics and Related Research. 2008;467(4):1035-1041. doi:10.1007/s11999-008-0531-x
9. Cox JL, McLendon PB, Christmas KN, Simon P, Mighell MA, Frankle MA. Clinical outcomes following reverse shoulder arthroplasty–allograft composite for revision of failed arthroplasty associated with proximal humeral bone deficiency: 2- to 15-year follow-up. Journal of Shoulder and Elbow Surgery. 2019;28(5):900-907. doi:10.1016/j.jse.2018.10.023
10. Sanchez-Sotelo J, Wagner ER, Sim FH, Houdek MT. Allograft-Prosthetic composite reconstruction for massive proximal humeral bone loss in reverse shoulder arthroplasty. Journal of Bone and Joint Surgery. 2017;99(24):2069-2076. doi:10.2106/jbjs.16.01495
11. Labrum JT, De Marinis R, Atwan Y, et al. Reverse shoulder arthroplasty megaprosthesis for surgical management of severe proximal humeral bone loss. Journal of Shoulder and Elbow Surgery. 2024;33(6):S64-S73. doi:10.1016/j.jse.2023.12.020