3.3. TREATMENT: BONE GRAFT

Author: Michael Khazzam

QUESTION 1: Should bone graft or cement be removed during treatment of acute shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Unknown. There are no reported investigations to guide the decision-making process regarding how to manage cement and/or autograft bone graft in the setting of shoulder PJI.

LEVEL OF EVIDENCE: No Evidence

DELEGATE VOTE: Agree: 90%, Disagree: 5%, Abstain: 5% (Super Majority, Strong Consensus)

RATIONALE

There is no current literature to guide evidence-based recommendations regarding how to manage autograft bone or cement in the setting of acute infection after primary shoulder arthroplasty. Additionally, it is unknown how or if complete removal of this material is necessary to eradicate shoulder PJI. The goal of surgical intervention in the setting of PJI is to debride any material that may result in persistent infection including surfaces with biofilm. Complete removal of autograft bone or cement at times can be extremely difficult and can result in significant bone loss especially if bone graft was used to reconstruct glenoid bone deficiency. A long stem, cemented, well-fixed humeral stem requires a humeral osteotomy or cortical window for complete cement removal which adds significant additional morbidity to the revision procedure. The significance of retaining these materials is unclear and, in order to avoid the complications that come with complete removal of these materials, investigation is needed to understand the risks associated with incomplete removal of cement or bone graft and the risks of recurrent PJI that are associated with this practice. Additionally, it is unknown whether retention of this material requires a change in the postoperative antibiotic management. Finally, it is also unknown how the species of bacterial pathogen and antibiotic sensitivity profile may influence the successful treatment of PJI. Future investigation is required to answer this question in an evidence-based fashion.

Methods

Systematic review of the literature was performed using MeSH terms: cement and infection and shoulder arthroplasty/ replacement, cement and retention and infection, bone graft and infection and shoulder arthroplasty/replacement using search engines PubMed, Web of Science, and CINAHL. Inclusion criteria for this systematic review were Level of Evidence I-IV, English language, shoulder arthroplasty studies which included patient who underwent treatment for PJI and evaluation of the impact of cement removal and/or autograft bone removal classified as either acute, subacute, or chronic infection. Exclusion criteria were non-English language articles, review papers, technique papers, non-human studies, biomechanics or basic science papers, and articles that discussed only hip and or knee arthroplasty PJI. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria were used manage the data of this review. The initial search produced 213 abstracts; all of these were excluded as they did not contain any details or evaluation of the question under investigation. Therefore, there are no current studies to reference the impact or effects of cement removal or autograft bone removal in the setting of shoulder arthroplasty PJI for acute, subacute or chronic infection.

Author: Michael Khazzam

QUESTION 2: Should bone graft or cement be removed in treatment for subacute or chronic shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: Unknown. There are no reported investigations to guide the decision-making process regarding how to manage cement and/or autograft bone graft in the setting of shoulder PJI. An attempt should be made to remove all loose, necrotic and foreign material.

LEVEL OF EVIDENCE: Consensus

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

A systematic review of the literature was performed using "MeSH terms:" cement and infection and shoulder arthroplasty/ replacement, cement and retention and infection, bone graft and infection and shoulder arthroplasty/replacement using search engines PubMed, Web of Science, and CINAHL. Inclusion criteria for this systematic review were Level of Evidence I-IV, English Language, shoulder arthroplasty studies which included patient who underwent treatment for PJI and evaluated the impact of cement removal and or autograft bone removal classified as either acute, subacute, or chronic infection. Exclusion criteria were non-English language arti-

cles, review papers, technique papers, non-human studies, biomechanics or basic science papers, articles that discussed only hip and or knee arthroplasty PJI. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria were used manage the data of this review. The initial search produced 213 abstracts, all of these were excluded as they did not contain any details or evaluation of the question under investigation. Therefore, there are no current studies to reference the impact or effects of cement removal or autograft bone removal in the setting of shoulder arthroplasty PJI for acute, subacute or chronic infection.

There is no current literature to guide an evidence-based recommendation regarding how to manage autograft bone or cement that was placed at the time of primary shoulder arthroplasty and has become infected. Additionally, what is unknown is how or if complete removal of this material is necessary to eradicate shoulder PJI. The goal of surgical intervention in the setting of PJI to debride any material that may result in retained biofilm that, if not removed, may result in a recurrent infection. Complete removal of autograft bone or cement at times can be extremely difficult and can result in significant bone loss especially if bone graft was used to reconstruct bone deficiency of the glenoid. A long stem cemented well-fixed humeral stem can at times require a long humeral osteotomy or cortical windows for complete cement removal which adds significant additional morbidity to the revision procedure.

The significance of retaining these materials is unclear and investigation is needed to understand the risks associated with incomplete removal of cement or bone graft, and what risks of recurrent PJI are associated with this practice to avoid the morbidity that may come with complete removal of these materials. Additionally, it is unknown how retention of this material requires a change in the postoperative antibiotic recommendations for the type, method of delivery or duration of treatment. Finally, it is also unknown how the species of the bacterial pathogen may influence the successful treatment and risk of recurrent PJI, where some less virulent pathogens (such as *C. acnes*) may be more difficult to eradicate with retention of cement or bone graft because of the slow growing nature. Future investigation related to the impact of type of bacteria can provide data to develop a treatment algorithm for which cases can predictably be successful with retention of cement or graft and for which settings require complete removal of all graft and cement materials.

3.4. TREATMENT: COMPONENT RETENTION

Author: Michael Khazzam

QUESTION 1: Is there a role for irrigation and debridement (I&D) with implant retention when treating acute shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: There is insufficient high-quality evidence to support or discourage the use of I&D with implant retention to treat acute shoulder PJI.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 96%, Disagree: 4%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

There is little data demonstrating the outcome or infection-free implant survivorship for the treatment of acute shoulder PJI with I&D and implant retention. To date, there are only 37 patients (38 shoulders) with outcomes following this procedure reported in the literature [1–4]. These studies were all grade IV level of evidence (LOE) retrospective case series and demonstrated a 50% failure rate (defined as continued infection) and requiring additional treatment. Three of four studies treated acute, subacute and chronic infections using this technique, but the sample size was too small to analyze how time of infection influences outcomes [1,3,4]. For example, Jacquot et al. found that 1 of the 2 shoulders classified as chronic PJI, 2 of 4 subacute, and 2 of 7 acute had recurrent infection requiring additional treatment [3].

Dennison et al. was the only study found specifically investigating the efficiency of acute (surgery within 6 weeks following index arthroplasty and less than 3 weeks of symptoms) and "delayed onset/delayed acute" (more than 6 weeks following index arthroplasty with symptoms less than 3 weeks) [2]. This retrospective LOE IV case series examined 9 patients (10 shoulders) and found 3 of 10 had recurrent infection requiring resection arthroplasty (mean follow up 4.1 years range 0.58-12.8 years). The method of I&D varied in this study with 3 performed arthroscopically and 7 open. All of the subjects requiring resection had their I&D performed open; the numbers were too small to perform any meaningful analysis of how this may influence outcomes or infection free survivorship. Additionally, 6 of 10 shoulders were maintained on chronic suppressive antibiotics indefinitely without explanation of why the authors selected this treatment.

Further research will be needed to determine how irrigation and debridement with implant retention plays a role in the treatment algorithm of PJI. Specific attention towards answering the questions regarding the effect of the pathogen and the antibiotic sensitivity profile; surgical approach (open or arthroscopic); timing from presentation and index arthroplasty; need for exchange of modular component parts; and type, duration, and method of delivery of antibiotics will be critical to guide these treatment decisions.

Methods

A systematic review was performed using MeSH terms: "I&D shoulder arthroplasty/shoulder replacement, single staged shoulder arthroplasty/shoulder replacement, implant retention revision shoulder arthroplasty/shoulder replacement, acute infection shoulder arthroplasty/ shoulder replacement" using search engines PubMed, Web of Science, and CINAHL. The inclusion criteria for