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QUESTION 3: Should bone graft be removed in patients with postoperative spine infection? If yes, should a distinction be made between allograft and autograft?

RECOMMENDATION: Bone graft need not be routinely removed following irrigation and debridement, especially if partially incorporated. However, loose or purulent graft should be considered for removal. Retained allograft may increase the risk for requiring repeat debridement compared to autograft.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 87%, Disagree: 0%, Abstain: 13% (Super Majority, Strong Consensus)

RATIONALE

No literature could be found that directly stratified patients who had bone graft retained versus removed. Weinstein et al. studied 46 postoperative infections in 2,391 patents [1]. In their regimen, bone graft material that appeared viable was left in place and instrumentation was retained as well. After six weeks of antibiotics, all of the wounds healed. Massie et al. similarly reported that bone graft may be retained and rarely is it necessary to remove all bone graft [2]. Ahmed et al. also showed in their retrospective review that debridement and antibiotics with implant and bone graft retention (allograft and autograft) can result in complete eradication of infection [3].

Nonetheless, bone graft loosened by irrigation may be removed. It seems rational that unincorporated bone graft and loose, dead bone serves as a continued nidus for infection and as such should be removed [4]. Multiple authors thus recommend thorough irrigation and debridement with removal of nonviable, purulent and loose graft material. However, this appears largely based upon intuition and not strict evidence.

There is limited evidence that perhaps autograft is better tolerated in the setting of an infection. Dipola et al. created a predictive model to differentiate patients requiring one versus multiple debridements [5]. The use of bone graft rather than autograft

was shown to be predictive of requiring multiple debridements. Perhaps, therefore, closer attention ought to be given to the viability and infection burden in patients with allograft. However, no specific recommendations can be given and this should be considered on a case-by-case basis, with considerations of host status, infectious organism and infection burden.

REFERENCES

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QUESTION 4: What are the indications for implant retention or removal of hardware in spinal infections?

RECOMMENDATION: In early or acute infections, debridement with retention of the implant might be possible and should always be favored, as removal of the implant carries a great risk for non-fusion despite the risk of chronic low-grade infections with possible implant loosening. In late infections, removal is recommended if feasible.

LEVEL OF EVIDENCE: Consensus

DELEGATE VOTE: Agree: 87%, Disagree: 7%, Abstain: 6% (Super Majority, Strong Consensus)

RATIONALE

Similar to periprosthetic joint infections (PJI), several authors recommend that in early spinal implant-associated infections (within one month after surgical treatment or symptom duration less than three weeks), a debridement with retention of the implant constitutes a sufficient treatment strategy [1-5]. However, their recommendation is based on a retrospective, small case series of patients. There

are also reports describing continuous irrigation in early infections [6,7], but no controlled studies with non-continuous irrigation are published.

In chronic infections, which are often caused by low-grade pathogens, such as coagulase-negative staphylococci or *Cutibacterium acnes*, removal of implants is regarded as the treatment of