[4]. Based on this data, it is unknown what bacterial load is necessary to evoke infection and overwhelm the host response [3].

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# QUESTION 6: What is the relationship between implanted metal and colonization under a vacuum-assisted closure (VAC) in open fractures?

**RECOMMENDATION:** The use of negative pressure wound therapy (NPWT or VAC) over exposed orthopaedic implants has been reported but its role remains unknown. Furthermore, no evidence exists regarding the effect of NPWT on the colonization of metal implants in open fractures. Further research is required to provide more insight into this question.

**LEVEL OF EVIDENCE:** Consensus

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

## RATIONALE

NPWT has emerged as a promising modality for the treatment of open fracture wounds between operative debridements and delayed wound closure or coverage [1,2]. Traditional management of fractures with soft tissue defects included wet-to-dry dressings with the risk of wound contamination and infection rates reportedly as high as 50% [3]. In addition to providing a semiocclusive dressing, NPWT mechanisms of action include stabilization of the wound environment, reduction of wound edema, improvement of tissue perfusion and stimulation of cells at the wound surface [1]. While initial randomized controlled trials (RCTs) favored NPWT in reducing infection in open fractures [4], a recent Cochrane database review found little difference compared to standard dressings [5]. The ability to successfully clear the infection may be tied to the VAC's effect on the wound bioburden [6].

A recent systematic review identified 24 studies investigating the topic of bacterial growth and NPWT, but none contained exposed implants [6]. The authors identified 10 experimental studies, 4 RCTs, 6 clinical studies and 4 using an instillation VAC system [6]. Of the RCTs, only one quantified bacterial proliferation and performed species analysis. Moues et al. found that NPWT selectively reduced non-fermentative gram-negative bacilli (NFGNB) but increased the proliferation of *S. aureus* [7]. The other three RCTs found no difference with the NPWT in regard to reduced bacterial growth or number of positive cultures [6]. The authors of this review concluded that there was a lack of concensus in the literature if the NPWT increases, decreases, or has no effect on the wound bioburden.

Perhaps even less is known about the relationship between implanted metal and colonization under a NPWT device in open fractures, as no studies have investigated this topic. The main reason is that contemporary "fix and flap" open fracture treatment does not advocate the use of NPWT devices over exposed metal. Some cases where this treatment might be an option include: (a) open fracture treated initially with hardware that undergoes wound breakdown, (b) if hardware removal at debridement is not feasible or would drastically compromise limb stability or (c) the patient is not a medical candidate for additional soft tissue coverage or additional surgery [8]. In such cases, the recommendation is to perform a secondary early coverage with local or distant flaps, but NPWT is not an option for definitive treatment. While case reports and small series have described the use of a wound VAC over exposed orthopaedic hardware in other instances [8–13], no studies have included bacterial proliferation or speciation analysis.

In conclusion, while there is evidence supporting the safety and efficacy of NPWT over exposed metal for a period of time without infectious complications, there are no published studies investigating this in associaton with open fractures. While the use of NPWT in open fractures with exposed metal is a viable option, it is not a part of the contemporary treatment of open fractures. Further research and study into implant colonization under a NPWT will be required before such a practice can be routinely recommended.

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