

## SUBSPECIALTY PROCEDURES

# TECHNIQUES TO REMOVE PRESS-FIT OSSEOINTEGRATION IMPLANTS

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*Investigation performed at the Limb Reconstruction Centre, Macquarie University Hospital, Macquarie University, Macquarie Park, New South Wales, Australia*

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### Abstract

**Background:** Transcutaneous osseointegration for amputees (TOFA) has proven to consistently, significantly improve the quality of life and mobility for the vast majority of amputees, as compared with the use of a socket prosthesis<sup>1,2</sup>. As with any implant, situations such as infection, aseptic loosening, or implant fracture can occur, which may necessitate hardware removal. Although it may eventually occur, to date no osseointegration implant has ever required removal in the setting of periprosthetic fracture. Since TOFA implants are designed to facilitate robust bone integration, removal can be challenging. Even in cases in which portions of the implant are loose, other areas of the implant may remain strongly integrated and resist removal. Further, there can be cases in which an implant fractures, leaving the residual portion of the implant in place without the interface for an extraction tool. Although the outcomes of revision osseointegration has not been the primary focus of any publication, the fact that revision can be necessary and generally succeeds in restoring similar mobility has been documented<sup>3-5</sup>. As with any hardware removal, preserving healthy tissue and avoiding iatrogenic injury are critically important. This article demonstrates several techniques to remove press-fit osseointegration implants that we have found safe and effective.

**Description:** The procedure is performed with the patient in the supine position and with the affected extremity prepared and draped in a typical sterile fashion. The use of a tourniquet can help reduce blood loss, but it may be safer to not use a tourniquet during the portions of the procedure that create increased or prolonged bone thermal exposure, such as during reaming or drilling. If patients are clinically stable, withholding antibiotics until cultures are obtained may improve diagnostic yield. The implant removal technique should proceed from conservative to aggressive, as necessary: slap hammer, thin wire-assisted slap hammer, and extended osteotomy. Trephine reaming is discouraged because of the need for and difficulty of removing the dual cone interface portion of the implant, along with the extensive damage often caused to the surrounding bone during reaming, which can be avoided with the osteotomy technique.

**Disclosure:** The **Disclosure of Potential Conflicts of Interest** forms are provided with the online version of the article (<http://links.lww.com/JBJS/ST/A440>).

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**Alternatives:** It is important to emphasize that most infections related to transcutaneous osseointegration do not require implant removal; the use of antibiotics alone or soft-tissue and/or limited bone debridement is sufficient to resolve infection in the majority of cases. If a patient has a non-infectious indication for removal (such as a loose implant) but declines surgery, activity modification with close observation may be reasonable. If a patient has an infectious indication for removal but declines surgery, very close observation must be maintained to avoid potential osteomyelitis. The use of suppressive antibiotics (oral and/or intravenous) may help reduce the severity of the infection. An alternative surgery to manage implant-associated infection can be amputation above the implant (within the same bone, through-joint amputation, or through the femur for a transtibial osseointegration). This should be considered only if there is a tremendously compelling reason to do so, such as an emergency need to amputate due to a life-threatening infection.

**Rationale:** Indications for implant removal include persistent pain, deep infection recalcitrant to soft-tissue or bone debridement and implant retention, or mechanical complications involving the implant, such as loosening or breakage. The following are specific examples of indications for removal: infection that cannot be resolved with oral and/or intravenous antibiotics or with debridement of soft tissue and/or bone, implants that have not achieved or not maintained stable integration (aseptic or loosening) and are causing pain, and implants that have fractured or have deformed and are a concern for fracture.

**Expected Outcomes:** Most patients who require removal of press-fit osseointegration implants are suitable for reimplantation after a decontamination period involving a local antibiotic depot and intravenous antibiotics. This duration is often 6 to 12 weeks. Following revision osseointegration, patients generally achieve similar levels of performance as they had during the stable period prior to removal<sup>3-5</sup>. Infection does not appear to be associated with an increased risk of mortality<sup>6</sup>. Patients who decline revision osseointegration are able to return to the use of a socket prosthesis.

**Important Tips:**

- Infection is often treatable with use of oral and/or intravenous antibiotics, with or without soft-tissue and/or bone debridement. Consider these options before reflexively removing an implant.
- Preserving bone stock and quality is important for an optimal revision to another osseointegration prosthesis or conversion to a socket prosthesis. Living bone, even if infected, can be decontaminated with antibiotics. Minimize thermal injury by releasing the tourniquet and using saline solution irrigation during reaming or similar portions of the procedure. If the implant can only be removed by fully removing a portion of bone (rather than through a single clamshell-type osteotomy), attempt screw osteosynthesis to preserve a canal for future osseointegration.
- Be gentle and patient during the removal techniques. Elevating bone quickly or violently may cause propagating fractures, increased morbidity, or splinter bone fragments. Carefully separating bone from implant will reduce bone loss and preserve the bone condition for a potential revision.
- Although patients may not appear to have an infection in some cases, it is advised to treat every removal as if it involves an infection. The first surgical stage should be for removal, culture acquisition, and decontamination with antibiotics. A separate second surgery can be performed after the antibiotics have eradicated infection.
- Many implants have been removed with slap hammer or fine wire techniques; osteotomy should be reserved for situations in which diligent attempts using these techniques have proven unsuccessful, in order to optimize bone integrity.

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## References

1. Hebert JS, Rehani M, Stiegelmar R. Osseointegration for lower-limb amputation: A systematic review of clinical outcomes. *JBJS Rev.* 2017 Oct;5(10):e10.
2. Kunutsor SK, Gillatt D, Blom AW. Systematic review of the safety and efficacy of osseointegration prosthesis after limb amputation. *Br J Surg.* 2018 Dec; 105(13):1731-41.
3. Hoellwarth JS, Tetsworth K, Akhtar MA, Oomatia A, Al Muderis M. Transcutaneous Osseointegration for Oncologic Amputees with and without Radiation Therapy: An Observational Cohort Study. *J Limb Lengthening Reconstr.* 2022;8:32-9.
4. Akhtar MA, Hoellwarth JS, Tetsworth K, Oomatia A, Al Muderis M. Osseointegration Following Transfemoral Amputation After Infected Total Knee Replacement: A Case Series of 10 Patients With a Mean Follow-up of 5 Years. *Arthroplast Today.* 2022 May 21;16:21-30.
5. Haidary A, Hoellwarth JS, Tetsworth K, Oomatia A, Al Muderis M. Transcutaneous osseointegration for amputees with burn trauma. *Burns.* 2023 Aug;49(5): 1052-61.
6. Hoellwarth JS, Tetsworth K, Oomatia A, Akhtar MA, Xu H, Al Muderis M. Association Between Osseointegration of Lower Extremity Amputation and Mortality Among Adults. *JAMA Netw Open.* 2022 Oct 3;5(10):e2235074.