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CORR Insights

CORR Insights®: What Factors Are Associated With Failure of Compressive Osseointegration Fixation?

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Where Are We Now?

The current generation of skeletal osseointegration implants for oncologic indications can be traced back to the clearance of the Compress® (Biomet, Warsaw, IN, USA) implant by the FDA in December 2003 [7]. Since then, numerous papers have attested to its durability and reliability for diaphyseal bone fixation [2, 6, 8, 10].

In the current study, Kagan and colleagues extended our knowledge of this implant design by searching for patterns of implant failure. In their largest retrospective series to date, the authors reviewed 116 implants and found that the anatomic location of the implant predicted survival of their reconstructions. Additionally, neither the age of the patient nor chemotherapy were associated with differences in implant survival. The most common reason for failure was infection. These findings are in line with other recent oncologic series of cemented diaphyseal fixation [4].

Where Do We Need To Go?

Given that fixation is dependent on biological osseointegration rather than physical interdigitation of methymethacrylate with endosteum, it is not surprising that the authors' series demonstrated a low rate of aseptic failure. Future studies will need to determine whether diaphyseal fixation with osseointegration in oncologic settings is at least as reliable and durable as modern cemented stems in the long-term, though it is my sense that it will be.

Even so, a surgeon considering use of these implants must carefully contemplate his or her options. The advantages of reconstruction with an osseointegration-type implant include the need for a short segment of diaphyseal bone (critical when facing large resections), and the ease of revision, particularly in the setting of infection. Although not mentioned specifically in their manuscript, this type of reconstruction is also attractive in the pediatric population where significant changes in bone size and multiple revision surgeries can be expected in the long-term [9].

This CORR Insights® *is a commentary on the article* "What Factors Are Associated With Failure of Compressive Osseointegration Fixation?" *by Kagan and colleagues available at:* DOI: 10.1007/s11999-016-4764-9.

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However, as surgeons, we also need to be cognizant of potential contraindications for these implants. Despite the absence of a noteworthy increase in failures with radiation in the current study, surgeons should remain guarded in choosing this implant type if preoperative or postoperative radiation is planned. Healey and colleagues [3] have compiled a sensible list of contraindications for these implants: (1) Cortical thickness of less than 2.5 mm, (2) pre or postoperative bone irradiation, (3) metastatic disease that mandates immediate weightbearing, (4) extraarticular knee resection/inadequate soft tissue, and (5) inability to cooperate with initial protected weight bearing.

Beyond this, we need a deeper understanding of the modes of failure of osseointegration implants and their management. Following several decades of using cemented stems, we now have a clinical understanding of radiolucent lines at the cement-bone junction, and of stress shielding at the diaphyseal junction. Lazarov and colleagues [5] have proposed a simple method of categorizing healing of these implants into three phases, but this has to be validated with larger data sets to see if it can indeed predict failure and allow surgeons to intervene in a timely manner.

We also need answers to a number of other related questions. Is there a time period, before or after surgery, during which it is safe to radiate the bone? Avedian and colleagues [1] have documented that cortical hypertrophy lags in patients undergoing adjuvant chemotherapy. Although neither they nor the authors of the current study found differences in implant survival with chemotherapy, we must determine whether this patient population eventually catches up in terms of cortical hypertrophy and whether their implants remain durable in the long-term. Also, given that many of these patients are young, we need to develop logical guidelines for our patients with these implants regarding what types of sporting activities they can participate in, and which ones they should avoid.

How Do We Get There?

In order to better understand the natural history of these implants, future clinical studies will have to look closely at successful and unsuccessful healing of osseointegration implants. Perhaps proxy measures such as quantified bone density, CT measurements of cortical thickness or metabolic activity will be found to be predictive. Biomechanical studies may add to our understanding of the different stresses experienced in heavy loading between stemmed and osseointegration implants.

Despite these concerns, I believe we are just beginning to realize the promise of osseointegration for oncologic skeletal reconstruction. I would hope that we will eventually have a range of less bulky devices available for upper extremity long bones, short intercalary reconstructions or smaller patients. Similarly, we do not yet have standard line implants for resections that traverse the metaphysis, such as with epiphyseal sparing resections. This would be a natural position for osseointegration, but we currently have to choose between a segmental allograft and a custom endoprosthesis.

Finally for amputees, the advantages of osseointegration implants compared to suction cups for transmitting force and increasing comfort of their residual limbs has been recognized for some time. These implants are now finally coming closer to more widespread clinical use and promise to improve the lives of many amputees.

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