INTRODUCTION
Revision joint replacement implants have shorter longevity, poorer functional outcome, higher costs, and longer rehabilitation times than primary implants. To improve outcome for patients with aseptic loosening, treatments that increase the fixation and longevity of revision implants are needed. In this study we investigate a new surgical technique that locally disrupts (cracks) the sclerotic endosteal rim (Figure 1) that typically forms during the process of aseptic loosening (1,2). The premise for this technique is that fixation is aided by improvement in the access of marrow, blood, and growth factors to the revision interface. The hypothesis of this study is that locally cracking the sclerotic endosteal rim increases implant interfacial strength, stiffness and energy absorption to failure, compared with the controlled revision procedure of implant removal and lavage.

MATERIALS AND METHODS
Following approval by our institution’s Animal Care and Use Committee, we implemented our previously established controlled revision protocol (2) in 16 canine knees. This protocol engenders a periprosthetic tissue reaction characteristic for implants undergoing revision, consisting of a sclerotic endosteal neocortical rim, dense layers of fibrous tissue with synovial-like epimysial membranes, macrophages with ingested particulate polyethylene (PE), and elevated inflammatory cytokines. Specifically, for eight weeks in each knee of 8 dogs, 6.0 mm loaded polymethylmethacrylate (PMMA) implants axially loaded and constrained to be stable. The implant is constrained to be stable.

RESULTS
No implants were infected (intraarticular swabs at the time of euthanasia). Revision implant fixation (specifically, ultimate shear strength and energy absorption) by cracking the sclerotic endosteal rim was significantly improved, but not significantly. Of additional note was that all of the implants with the rim cracking technique were able to support and resist pushout load, while two of the eight implants with the standard revision technique had no measureable resistance to pushout (ultimate strength = 0).

DISCUSSION AND CONCLUSIONS
This current study demonstrates a simple technique of cracking the sclerotic endosteal rim, to add to the surgeon’s armamentarium for improving revision fixation. In our previous studies, we have shown that our controlled revision technique produces significantly inferior interfacial shear properties relative to the corresponding primary implant (2). This is in agreement with the prevalence of inferior clinical results for revision implants. Also in previous studies, we have shown that the addition of bone allograft or HA or other implant coatings can provide further improvement to the rim cracking technique.

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Fig 1: Sclerotic endosteal rim in retrieved human implant

Fig. 2: Experimental protocol of two implant revision techniques