THE COMPRESSIVE PROPERTIES OF BONE CEMENTS CONTAINING LARGE DOSES OF ANTIBIOTICS
+Pelletier, MP; Malisano, L; +Smitham, P; +Walsh, WR
+Surgical & Orthopaedic Research Laboratories, University of New South Wales, Sydney, Australia
w.walsh@unsw.edu.au

Introduction
Cemented prostheses allow a means of controlling infection following arthroplasty; the addition of antibiotics to bone cement provides a local release, reducing the occurrence of infection [1]. Unfortunately, bone cements containing antibiotics are not commercially available to all surgeons. This leads to the addition of varying amounts and types of antibiotics at the time of mixing. There are no guidelines for the addition of antibiotics and few studies into the effects of adding large amounts to PMMA. Presently the highest concentrations commercially available are around 4.2 wt% [2].

Aim
The aim of this study is to determine what influence the addition of two different antibiotics at two high dose levels has on the properties of commercially available bone cements. The endpoints examined will be the static compressive properties and the porosity of the cured cements.

Materials and Methods
Two PMMA bone cements were evaluated in this study; Simplex (Stryker, Ireland), and VersaBond (Smith & Nephew, USA). The following groups were tested; 1) PMMA 2) PMMA with 1g Flucloxacillin and 1g of Vancomycin (5 wt%) 3) PMMA with 3g Flucloxacillin and 3g Vancomycin (15 wt%). Antibiotic was added to the powder portion of the cement and mixed. The liquid portion was added and mixed by hand (1Hz) at room temperature until of the appropriate ‘doughy’ consistency. The cement was then loaded into a mold to form 6mm x 12mm dowels. The cement dowels were tested 24 hrs later, as laid out in ASTM designation F451-99a. Specimens were tested in uni-axial compression at a displacement rate of 25.4 mm/min using an 858 Mini Bionix MTS testing machine (Minneapolis, MN). The results were analyzed using ANOVA followed by post hoc comparisons and Bonferroni (SPSS for Windows). One dowel from each group was selected for a micro-computed tomography (micro-CT) scan. The results from this scan were used to assess porosity.

Results
When compared to the unaltered mix; the compressive properties of VersaBond were affected at both antibiotic levels, while Simplex was affected only at the higher dose. When comparing both antibiotic loaded conditions no differences were seen.

Discussion
The addition of antibiotics had an overall negative effect on the compressive properties of both cements. However, there was no significant difference when antibiotic load was tripled from 2g to 6g. Porosity was seen to decrease with small antibiotic load and ultimately increase at higher loads, this ultimate increase in porosity may also help elution characteristics in vivo. These two factors provide some support for increasing the amount of antibiotic used in arthroplasty.

The porosities reported here are generally higher than those commonly seen in the literature using other methods [3]. It should be noted that the use of micro-CT for measuring porosity in bone cement is a new concept and results should be treated as such.

References
1) Buchholz, HW. J Bone Joint Surg (Br), 1981, 63(3), 342-353
3) Faber, C et.al. Biomat 26(28), 5717-26

Figure 1- Compressive Strengths of cements tested

* p<0.05 when compared with pure PMMA

Figure 2 From left to right: (top) VersaBond, VersaBond + 5 wt%, VersaBond + 15 wt% (bottom) Simplex, Simplex + 5 wt%, Simplex + 15 wt%

Figure 3- Porosity of cements tested

Micro-CT scans from a section of each sample can be seen in figure 2. Differences in the average size of the pores are evident. Figures 3 displays the results of an image analysis to determine porosity.