Calculation of loading pressure

The system geometries and mechanical properties (Young's modulus [E] and Poisson's ratio [v]) of the two interacting surfaces were used to calculate the required load necessary (2.5N) to generate a target mean contact pressure of 2.79 MPa. This pressure was chosen as it exceeded the mean cartilage contact pressure of 2.14 MPa generated by a 2.4 × body-weight force at the hip (appropriate for the single-leg support phase of level walking) as previously reported by Rushfeldt et al. (1981).

The specific values of the parameters were: PMMA bone cement, E = 2.8 GPa, v = 0.3 (values as reported by Chandler et al., 2006); hydroxyapatite HVOF coating on Ti disc, E = 22.8 GPa v = 0.28 (values as reported by Yung-Chin & Chan, 2005)

Linear contact Herztian stress calculations based upon these parameters and the geometry of the wear set-up described in the Materials and Methods section indicated that an applied load of 2.48 N was needed to achieve the target contact pressure. 2.5 N was used due to the availability of loadings.

References:

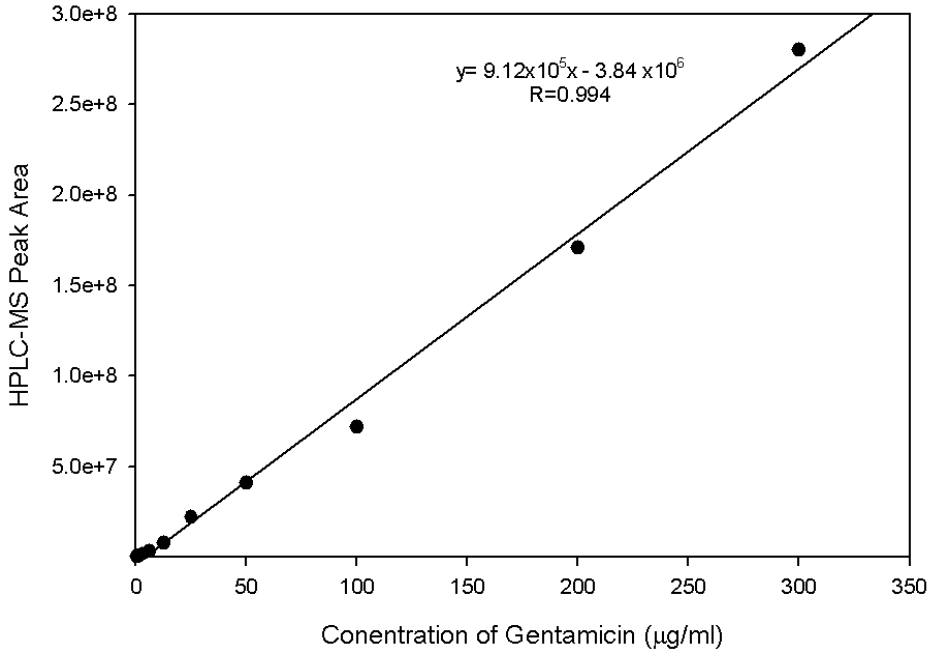
Rushfeldt, P. D., R. W. Mann, and W. H. Harris. 1983. Improved techniques for measuring in vitro the geometry and pressure distribution in the human acetabulum – ii. instrumented endoprosthesis measurement of articular surface pressure distribution. J. Biomechanics **14:**315-323.

Chandler, M., R. S. Z. Kowalski, N. D. Watkins, A. Briscoe, and A. M. R. New. 2006. Cementing techniques in hip resurfacing J. Eng. Med. **220:**321-331.

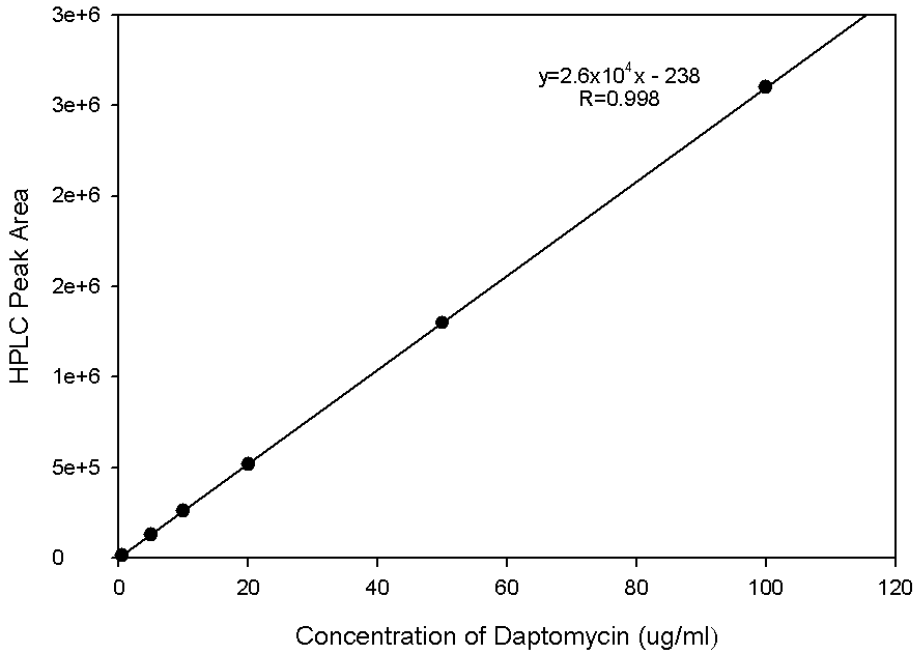
Yung-Chin. Y, and E. Chang. 2005. Measurements of residual stresses in plasma-sprayed hydroxyapatite coatings on titanium alloy. Surface Coatings Technol. **190:**122-131.

HPLC assays for antibiotics

Details of the methodology used for quantifying gentamicin and daptomycin by means of HPLC and HPLC-MS are given in the Materials and Methods sections. Standard curves were performed on the day that the assays were preformed and representative curves are shown in Supplemental Figure 1. As shown in Supplemental Figure 1, the linearity of the daptomycin curve (where UV detection was used) was generally better than that of gentamicin (where MS detection specific to one fragment ion was utilised). Nonetheless, both methods gave reasonable linearity and the standard curves (together with repeated elution experiments) show that the effects of wear on elution (which were in excess of two-fold) can safely be concluded from the data. Precision of the assays was also assessed via percent coefficient of variation (%CV) determination (Supplemental Tables 1 and 2).



(a)



(b)

Supplemental Fig. 1. Calibration curve of (a) HPLC-MS assay for gentamicin, (b) HPMC assay for daptomycin.

Supplemental Table 1. Precision of gentamicin assay

Gentamicin (μg ml^{-1})	Intra-day % CV (n=3)
12.5	10.5
3.125	14.3
1.56	11.9
0.39	10.3

Supplemental Table 2. Precision of daptomycin assay

Daptomycin (μg ml^{-1})	Intra-day % CV (n=3)
10	13.7
5	7.22
1	25.3
0.5	50.5

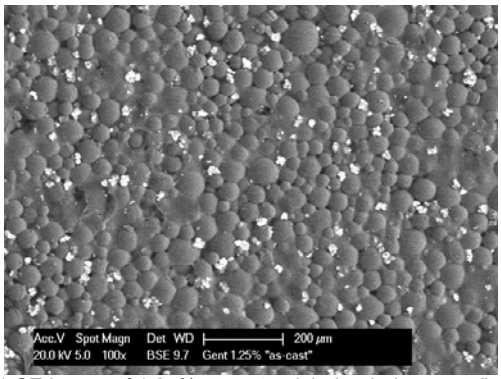
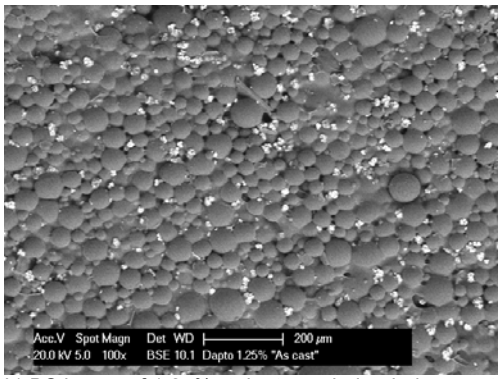
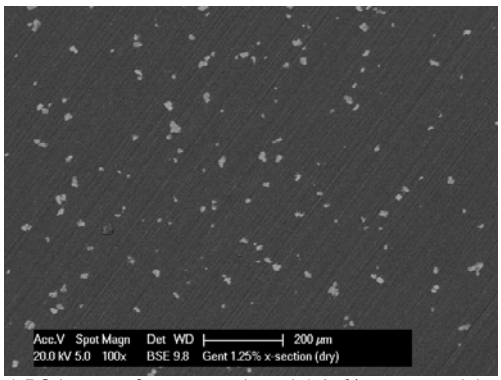
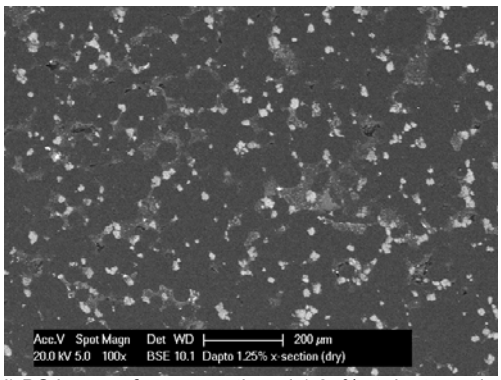
Crystal size and microstructural homogeneity

Cross sections of the PMMA samples were prepared and imaged using the scanning electron microscope, as described in the Materials and Methods section. To determine the average crystal size and crystal distribution within the PMMA matrix, calibrated image measurements of these images were made using Sigma Scan Pro 5.0 (Systat Software Inc, USA).

The mean crystal size was recorded as 102 μm (SD = 69 μm) for gentamicin in PMMA bone cement containing 1.25 % wt/wt gentamicin and 56 (SD = 14 μm) for daptomycin in cement containing the same loading of daptomycin.

Crystal homogeneity within the PMMA matrix was calculated using the mean "nearest neighbour" (MNN) technique. Results indicated MNN distances to be 280 μm (SD = 136.4 μm) for gentamicin-loaded samples and 45.6 μm (SD = 17.3 μm) for the daptomycin-loaded samples.

Electron microscope images of the samples used for these calculations, before and after sectioning (note: samples were cross-sectioned crystal measurements) are shown in Supplemental Figure 2 (panels c and d) of the surface of the samples before cross-sectioning (panels a and b).

Gentamicin-loaded cement	Daptomycin-loaded cement
 a) SE image of 1.25%wt gentamicin-loaded cement "as cast"	 b) BS image of 1.25%wt daptomycin-loaded cement "as cast"
 c) BS image of cross-sectioned 1.25%wt gentamicin-loaded cement "as cast"	 d) BS image of cross-sectioned 1.25%wt daptomycin-loaded cement "as cast"

Supplemental Figure 2. Electron microscope analysis of antibiotic crystal distribution within uneluted and unworn ("as cast") bone cement. SE, secondary electron; BS, backscatter. All scale bars are 200 µm.