INTRODUCTION:
Surgical site infection related to orthopaedic implants is one of the serious complications. The infection rate for joint replacements alone is approaching 3.0%1. In the previous works, we developed a novel thermal sprayed coating, which combined silver (Ag) presenting with a wide spectrum of antibacterial activity, low incidence of resistance and the ability to inhibit bacterial colonization, with hydroxyapatite (HA) displaying good biocompatibility and osteoconductivity2. The in vivo silver-releasing property of this coating (Ag-HA) has been already reported (Figure 1)3.

METHODS:
Commercial pure titanium discs (8 mm diameter × 1 mm thickness) were used as backing materials. Both sides of each disk were roughened using sand-blasting machine with 180 grit aluminium oxide media. After roughening, these surfaces were ultrasonically irrigated in ethanol for 3 min to eliminate residue materials. HA loaded with 3 wt % of silver oxide (Ag2O) or plain HA powder were sprayed on surface of titanium disks (8 mm diameter × 1 mm thick) by the flame spraying, which is a kind of thermal spraying method with acetylene torch. These coated samples were singly packed, and then applied on gamma sterilizer.

All animal procedures were conducted with the approval of our institution’s Animal Research Ethics Committee. Male Sprague-Dawley rats, weighing 250-300 g, were anesthetized, and then four transverse 1 cm incisions were made on the dorsum, two centered 2 cm lateral to midline at level of scapula and two centered 2 cm lateral to midline at level of at level of scaupla and then centered 2 mm lateral to midline of sternal notch. Ag-HA or HA coated samples were implanted with MRSA (1.2 × 10^6 colony-forming units (CFU)) singly into the back subcutaneous pockets of 10 rats. All procedures were performed under standard sterile conditions. After explanting, the number of viable MRSA on HA coating was (1.1 ± 0.4) × 10^4 CFU, whereas that on Ag-HA coating was (1.5 ± 0.5) × 10^4 CFU. This is the first report to elucidate the in vivo antibacterial activity of HA-Ag coating.

RESULTS:
After explanting, the number of viable MRSA on HA coating was (1.5 ± 0.5) × 10^4 CFU, whereas that on Ag-HA coating was (1.1 ± 0.4) × 10^4 CFU. There was significant difference between two groups (P < 0.001) (Table 1). No animal of both groups died throughout the experiment.

DISCUSSION:
This is the first report to elucidate the in vivo antibacterial activity of HA-Ag coating. The presence of implants will cause the infection in clinical use, even if 100 CFU bacteria disseminated3. In this study, we inoculated 10^6 CFU, because pilot study prior to this study suggested that little quantities of viable bacteria failed to develop infection using rat models. Therefore, our experimental result is interpreted two ways: Ag-HA coating do not zero the number of bacteria if large quantity of bacteria are inoculated or Ag-HA coating has strong bactericidal activity even if large quantity of bacteria are inoculated. As normal intraoperative aseptic techniques do not induce bacterial contamination as much as 10^6 CFU, the latter is proper interpretation. One limitation of this study was that we were unable to experimentally demonstrate intramedullary antibacterial effect and bone ingrowth on Ag-HA coating. Further studies in bone are thus necessary to validate whether the Ag-HA coating could kill and provide rigid interface.

In conclusion, this study provides novel and important information on in vivo antibacterial activity of HA-Ag coating, and suggests this coating has good ability to sterilize MRSA in vivo.

REFERENCES: