IMPROVING ANTIBACTERIAL ACTIVITY OF BONE CEMENT DOPED WITH NANOSILVER

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Introduction
The use of biomaterials, such as acrylic bone cement, is always associated with the opening of the body's layers and contributed to the hospital-acquired infections. Most of these infections are due to a group of multi-drug resistant clinical bacterial strains, mainly *Staphylococcus aureus*, which also produce biofilm [1]. Currently, the gold standard that reduces the adhesion and proliferation of bacterial colonies is doping bone cement with antibiotic/s. However, there is an emerging problem of reduced the antibiotic's effects by biofilm structures and/or increased bacterial resistance [2]. Therefore, more effective solution is sought and particularly noteworthy are nanometals, especially nanosilver. Bone cement containing nanosilver seem to be a good solution, due to better bactericidal properties [2-4]. However, there remains a problem with its proper release from a non-biodegradable and low-porosity cement matrix. In this work, nanosilver-doped bone cement was modified with different biodegradable components to increase nanosilver release and improve its antibacterial properties [5].

Materials and Methods
Acrylic bone cement Cemex (Tecres, Italy) was used as the base material, doped with nanosilver (1.5 wt.%; MkNano, USA) and modified with one of following biodegradable components: cellulose, chitosan, magnesium, polydioxanone and tri-calcium phosphate (5 wt.% Merck, Germany). All bone cement specimens with/without modifications were prepared as described earlier [2-5]. The following tests were performed to evaluate its antibacterial effectiveness: measurement of the turbidity of cultured bacteria broth according to the McFarland standard and measurement of dehydrogenase activity of formed biofilm. *Staphylococcus aureus* strain (ATCC) was used for the tests. Moreover, an analysis of nanosilver release was assessed using the UV-VIS spectrophotometry method.

Results and Discussion
It is possible to incorporate a biodegradable component in acrylic bone cement structure and obtain a time-varying porosity of its matrix. The addition of modifiers did not negatively affect the polymerization temperature and curing time of cements. After one-month exposure to the PBS solution, porosity of modified bone cement significantly improved. The enhanced dissolution of modifiers contributed to the increase of nanosilver release rate indicated in the UV-VIS analysis. The greatest impact on the release of nanosilver had cellulose, tri-calcium phosphate, magnesium and chitosan, after short incubation time (3 days) and cellulose, polydioxanone, magnesium and tri-calcium phosphate, after long time (28 days). The high inhibition of *Staphylococcus aureus* growth in bacterial broth was observed for nanosilver-doped bone cement modified with cellulose and chitosan. While the high inhibition of dehydrogenase activity of *Staphylococcus aureus* biofilm was observed for all modifiers except tri-calcium phosphate.

Conclusions
Our results show that the studied modifiers are suitable for obtaining the partially-biodegradable bone cement and cellulose seems to be the most promising modifier for bone cement doped with nanosilver to improve its antibacterial activity.

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