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Staphylococcal adherence on graphene-UHMWPE composites

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Background: Biomaterial-related infections (BRI) occur in many different clinical settings, and can represent a devastating complication in some cases, increasing morbidity and health care costs. *Staphylococcus epidermidis* and *Staphylococcus aureus* are among the most common infecting agents associated with BRI.

Ultra high molecular weight polyethylene (UHMWPE) is one of the most relevant materials in total joint replacements. In order to obtain a material with high wear resistance, mechanical performances and high chemical resistance, different routes have been researched as alternative to the current highly crosslinked UHMWPEs. Some of them are UHMWPE based composites. The outstanding chemical, mechanical and tribological intrinsic properties of graphene are interesting to obtain UHMWPE composites. Functionalized graphene is also an interesting material to produce a good filler-matrix adhesion.

Here we describe the bacterial adherence and viability on different kind of UHMWPE composites.

Material/methods: UHMWPE composite disks reinforced with 3 % wt reduced graphene oxide (GUR 1050+3%RGO) and 3% functionalized reduced graphene oxide (GUR 1050+3%RGO. FUNC.) were prepared by a thermal-compression process at 155° C and 15 MPa. Medical grade GUR 1050 powdered UHMWPE resin was mixed mechanically with aforementioned graphene platelets. GUR 1050+3%RGO was chemical functionalized with octaldecylamine. Medical grade powdered UHMWPE resin (GUR 1050, control) was used as control.

The *S. epidermidis* ATCC 35984 and *S. aureus* 15981 strains adherence study was performed using the protocol described by Kinnari *et al.* (*J Biomed Mater Res A*. 2008; 86(3):760-8) with a 90 min

incubation with saline. After incubation, samples were stained with LIVE/DEAD BacLight Stain. Proportion of live and dead bacteria was analyzed by using ImageJ software. The experiments were performed in triplicate.

The statistical data were analyzed by nonparametric Mann-Whitney test with a level of statistical significance of $p < 0.05$. Values are cited and represented as medians.

Results: Our results are shown in the Figure 1.

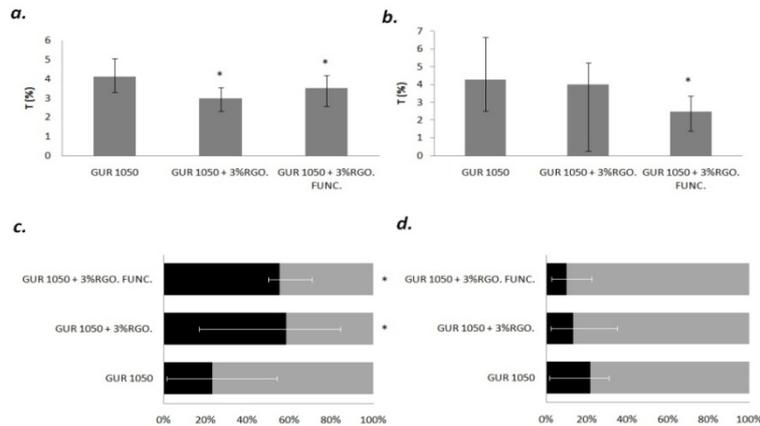


Figure 1. Percentage of covered surface: *S. epidermidis* ATCC 35984 (a) y *S. aureus* 15981 (b) and proportion of live (grey) and dead (black) bacteria: *S. epidermidis* ATCC 35984 (c) y *S. aureus* 15981 (d). The bar represents interquartile range. *: p -value < 0.05 of Mann-Whitney test compared to GUR 1050.

Conclusions: GUR 1050+3%.RGO. FUNC. has a non-stick effect against both staphylococcal species. *S. epidermidis* and *S. aureus* adherence significantly decreased on GUR 1050+3%. RGO. FUNC (27.7 % and 42.7% respectively) compared to GUR 1050. Therefore, they can be considered a promising approach to prevent BRI.