A POROSITY EFFECT ON PRE-OSTEOBLASTIC CELL GROWTH ONTO ALUMINA AND CALCIUM PHOSPHATE CERAMIC MATERIALS FOR BONE TISSUE ENGINEERING

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Introduction

Ceramic materials such as alumina (Al_2O_3) and calcium phosphates are used extensively in bone tissue repair, due to their exceptional suitability for load-bearing and wear-resistant applications. Nevertheless, limitations such as their moderate toughness and poor bioactivity have directed research towards the development of advanced ceramics, which may lead to improved mechanical and biological features. The aim of this study is to investigate the pore size and porosity effect of alumina and calcium phosphates specimens on MC3T3-E1 cell behaviors in terms of cell viability and proliferation.

Experimental Methods

Tailored made open-cell Alumina and calcium phosphates foams were produced by employing a novel dissolution sintering process [Michailidis, 2011], using crystalline raw cane sugar as a leachable pore former material. The process parameters of the production stages were properly adjusted to optimise the quality and structure of open-cell ceramic foams.

$50x10^3$ cells were seeded on each disc-shaped sample, and cell viability and proliferation were quantified by the reduction of the PrestoBlue® reagent. When cells are viable, they maintain a reducing environment within their cytosol. PrestoBlue® is a resazurin-based reagent that functions as a cell viability indicator by using the reducing power of living cells.

Results and Discussion

Our results show that the cell viability and proliferation on day 2 and 14 are higher on the alumina samples with the higher porosity (Fig. 1). Comparing the cell growth on these materials, we obtain a 3 to 5-fold higher proliferation onto the 0.32 and 0.56 mm pore size samples compared to the bulk. Furthermore, between the 60% porosity, the calcium phosphate samples with a 0.50 mm pore size indicate a significant cell viability and growth compared to the 0.28 mm pore size (Fig. 2). Increasing porosity up to 75% increases cell proliferation (compared to porosity 60%) without a pore size effect.

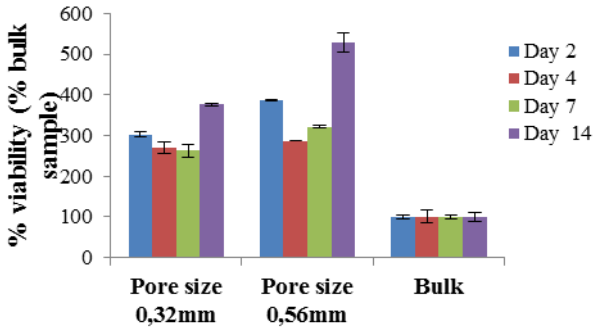

Figure 1: Cell viability and proliferation of pre-osteoblasts after 2, 4, 7 and 14 days on alumina samples normalized to the bulk material.

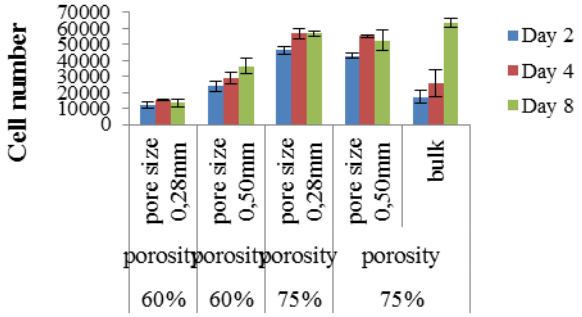

Figure 2: Cell viability and proliferation of pre-osteoblasts after 2, 4 and 8 days onto calcium phosphate samples.

Conclusion

Our results demonstrate an excellent cell adhesion and proliferation increase of pre-osteoblasts onto the high porous alumina and calcium phosphate ceramic samples and they could therefore be used for bone repair.

References

N. Michailidis, F. Stergioudi, D. N. Tsipas, Adv Eng Mater, 13:29-32, 2011.

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