OsteoBiol® by Tecnoss

In Vitro And In Vivo Characterization Of Graphene Oxide Coated Porcine Bone Granules

IN VITRO
EXPERIMENTAL STUDY

096

ABSTRACT

Graphene is a two dimensional allotrope of carbon with extraordinary high mechanical stiffness and thermal and electrical conductivity. This is why Graphene can be used as coating of materials that usually lack these properties. As heterologous materials used for bone replacement and bone regeneration are brittle and characterized by low fracture toughness, the Authors thought to improve pre-formed porcine bone (PB) granules features by using Graphene with the aim to improve the mechanical stiffness and strength of PB and to use Graphene as an osteoinductive factor.

PB granules (OsteoBiol® *Apatos Cortical,* Tecnoss®, Giaveno, Italy) were coated with Graphene Oxide (GO) homogeneously distributed on the biomaterial surface in order to confer it an increased resistance to fracture load and improve its chemical, physical, biological and mechanical features. The GO coating was realized by using aqueous GO solutions of different concentrations. After an in vitro evaluation, a preliminary experiment on a sheep model was undertaken to investigate in vivo behavior of GO-coated PB granules. The histomorphometry showed in the control samples 42.8% of newly formed bone, 19.3% of marrow spaces and 37.8% of residual biomaterial; regarding the test samples newly formed bone was 32.1%, marrow spaces 20.2%, residual biomaterial 33.9% and graphene remnants 13.8%.

With reference to mechanical characterization, the GO-coating on PB granules led to a composite scaffold with an increased fracture resistance under compressive strain of 35%, with respect to the pure PB counterpart. Biological analyses evidenced no toxic effects of GO-coated PB samples on primary human gingival fibroblasts, and no inflammatory response around the grafted particles. The obtained GO-coated biomaterial demonstrated to be stable over time.

CONCLUSIONS

The aim of the present study was to set up an easy and inexpensive protocol for the preparation of GO-coated PB granules and to characterize the obtained material through the investigation of the chemical, physical, biological and mechanical features that the GO coating could confer to pre-formed PB granules.

In the Authors' opinion, the protocol proposed could represent a model to be applied in order to improve the performance of other biomaterials. They concluded that *"the in vivo analysis on a larger number of animals will allow investigating the samples in terms of inflammation response and bone regeneration potential in order to tune the proper GO concentration able to exert osteoinductive properties with no toxic effects"*.

V Ettorre[1]
P Marco[1]
S Zara[1]
V Perrotti[2]
A Scarano[2]
A Di Crescenzo[1]
M Petrini[2]
C Hadad[3]
D Bosco[4]
B Zavan[5]
L Valbonetti[6]
G Spoto[2]
G Iezzi[2]
A Piattelli[2]
A Cataldi[1]
A Fontana[1]

1 | Department of Pharmacy, University "G. d'Annunzio", Via dei Vestini 31, 66100 Chieti, Italy
2 | Department of Medical, Oral and Biotechnological Sciences, University "G. d'Annunzio", Via dei Vestini 31, 66100 Chieti, Italy
3 | Center of Excellence for Nanostructured Materials (CENMAT), INSTM, Department of Chemical and Pharmaceutical Sciences, University of Trieste, Piazzale Europa 1, 34127 Trieste, Italy
4 | Molecular Genetics Institute, CNR Unit of Chieti, 66100, Italy
5 | Department of Biomedical Sciences, University of Padova, Via Ugo Bassi, 58/B, 35121 Padova, Italy
6 | Department of Comparative Biomedical Science, University of Teramo, Piazza Aldo Moro 45, 64100 Teramo, Italy

ORIGINAL ARTICLE
Carbon
July 2016, Volume 103, Pages 291–298
Available online 14 March 2016

Grafted with

BONE SUBSTITUTE
OsteoBiol® *Apatos*

LAB

EXP