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Hydroxyapatite of Bovine Origin Strengthened with Bioglass

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Abstract – Autogenous bone grafts are considered the standard due to their chemical and biological characteristics. However, its use is limited by donor site morbidity, local and systemic complications, limited availability, uncontrolled resorption and pronounced volume loss of bone grafted. This study presents a new material based on bovine hydroxyapatite and niobo-phosphate bioactive glass, with resorption rate "in vivo" compatible with the rate of new bone formation. The expectation of this study is to indicate a viable way for the development of a new substitute to autogenous bone graft.

Autogenous bone is considered the standard among materials of choice for graft, due to its complete biocompatibility, which reduces considerably the possibility of complications and failure. Autogenous bone contains viable cells and proteins that induce bone growth. However, its use is limited by donor site morbidity, local and systemic complications, limited availability, uncontrolled resorption and pronounced volume loss of bone grafted [1]. These disadvantages have led many surgeons to opt for synthetic grafts such as calcium phosphates and bioactive glasses.

An important requirement for bone substitute is the possibility of absorption by cells, acting as temporary material, being gradually replaced by new bone. Calcium phosphate ceramics and bioactive glass are filler materials, largely used due to its high biofuncionality, mainly the ability of chemically bind to bone tissue and the ability to undergo dissolution and resorption. Among the calcium phosphates, hydroxyapatite (HA) has chemical and structural similarity with the mineral phase of bone tissue. Its use, as alloplastic bone substitutes, has grown significantly. The main sources of HA are analytical grade chemical reagents, bovine bone and coral.

The addition of small fractions of some bioactive glasses can induce decomposition of stoichiometric hydroxyapatite under heat treatment, with formation of α and β TCP phases. These phases are known to be more soluble than hydroxyapatite. A new bioactive glass, based on Nb_2O_5 (30% weight) and P_2O_5 (30% weight, was added to bovine hydroxyapatite in order to induce decomposition into tricalcium phosphate [2].

This study has the purpose to produce a hybrid bone substitute with with reabsorption rate "in vivo" compatible with the rate of new bone. The material proposed is a biphasic ceramics (HA + β TCP) or triphasic (HA + β + α TCP TCP), after sintering in the presence of liquid glassy phase. Despite the high crystallinity of the resulting phases, the process allows to obtain a ceramic material with degradation induced by the presence of soluble the phases α and β TCP.

References

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