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Hydroxyapatite-Ideal Material for Regeneration?

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Abstract:- Periodontal therapy has newer dimension with the advent of the most advanced regenerative materials leading to the desirable results in the form of regeneration. It is never the less a challenging task to obtain an ideal regenerative material that can be clinically and economically feasible. Constant efforts are the need of the hour to obtain the most effective product that can satisfy both the clinical and the economic criteria.

I. INTRODUCTION

The treatment of periodontal disease is evolved from just fighting the bacteria to the reconstitution of the lost periodontal tissues.The success of the novel surgical techniques combined with various superior synthetic regenerative materials with the bio active components has taken the periodontal therapy to the newer heights.Nonetheless there are limitations in regard to the materials available presently in the form of biologic acceptability,regenerative ability, availability in the required quantities, clinical efficacy and the cost.The demand of the industry presently is to find an ideal biologic material which meets the required criteria.

The periodontal tissue engineering has found the eggshell derived hydroxyapatite particles as a viable alternative for the implantable biomaterial for the tissue regeneration.It is a calcium phosphate ceramics material used since long for the replacement and the augmentation of the lost bone tissue. The osteophilic nature of the particles and its inherent ability to incorporate into the bone tissues makes the hydroxyapatite scaffold have a significant effect on angiogenesis, cell adhesion and multiplication desired for the positive outcome in terms of bone regeneration.The smaller particle size ,biologic acceptability and non toxicity makes eggshell derived hydroxyapatite particles to be considered as an ideal regenerative material.

The researchers have identified various ways of production of hydroxyapatite particles from the eggshell.The most important ones are [1] Hydrothermal method [2] microwave irradiation and [3] High energy mechanochemicalactivation.The hydrothermal method is the most convenient and commonly used method of producing the hydroxyapatite particles from the eggshells.This method uses Ca[OH]2 and CaH Po4.2H2O as the starting materials.The identification and characterisation of the hydroxyapatite particles is done through X-ray powder diffraction[XRD] and confirmed using Fourier transform infra red spectroscopy.[FTIR].The particle size and morphology are determined by applying scanning electron microscopy[SEM] and transmission electron microscopy[TEM].The particles generated by the hydrothermal method display a high quality of homogeneity and crystallinity due to the high pressure and temperature used in the method.This is the only direct method of obtaining hydroxyapatite particles and the results are excellent in the form of bonded particles but the drawbacks are labour involved and the time factor.

The microwave irradiation is the indirect method where the calcium precursors are processed from the eggshells with the help of diamine tetra acetic acid as a chelating agent.The product thus obtained are then subjected to the X-ray powder diffraction.The final product in the form of hydroxyapatite are said to have a better adaptability at higher temperatures and also a better morphology and osteoblast cell adhesion.

High energy mechanochemical activation method comprises of the two mechanochemical activation processes attrition milling and ball milling respectively.The higher mechanochemical activation leads to better crystallinity of the hydroxyapatite particles. The product formed by this method is found to be more homogenous due to the compact morphology and the grainsize in the range of25 nm.Large amount of hydroxyapatite particles can be produced by this method and also is cost effective.

The eggshell based hydroxyapatite particles produced by any of the above methods demonstrates excellent biocompatibility and mechanical strength which are ideal characteristics for the tissue repair and regeneration.The eggshell hydroxyapatite particles are similar to the crystalline hydroxyapatite particle structures found in the natural bone in terms of physical shapes and also contain traces of sodium and magnesium and can contribute to the process of regeneration in a constructive method.

The nanohydroxyapatite crystals of average size of 5-90 nm can also be obtained by a simple sol-gel precipitation method .The nano crystals thus obtained have shown to have a much higher biocompatibility than the coarser counterparts.

II. CONCLUSION

Hydroxyapatite particles derived from the eggshell has shown to be an ideal bone graft material as it displays the characteristics similar to the natural bone ,relatively easy to synthesize and most importantly is economically viable being derived from the biowaste.

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