R-2. Evaluation of Hydrothermally Converted Hydroxyapatite as a Bone Graft Substitute in Vivo

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Backgroud

Coralline calcium carbonate (CaCO3) with or without hydrothermal conversion into hydroxyapatite (HA) is currently used as an effective bone substitute to treat osseous defects in dental and orthopedic field. Recently avian eggshell, maily composed of CaCO3 in the form of calcite, has been introduced as a possible candidate of bone substitute in maxillofacial surgery. The purpose of this study was to evaluate the surface characteristics and bone forming ability of hydrothermally converted HA from hen's eggshell in rat calvarial defects.

Material & Methods

Hen's eggshell (ES) was particulated. They were soaked in NaOCl and then in NaOH solution. The samples were followed heat treatment at 300℃ for 24 h (ES-1). They were further treated in two different hydrothermal conditions as follows: 1. hydrothermally treated in phosphate buffered saline at 80℃ for 6 days (ES-2), 2. hydrothermally treated in 2% di-ammonium phosphate solution at 150℃ for 24 hrs (ES-3). The surface characteristics of surface modified ES were evaluated using SEM, EDS, XRD, and FTIR. In animal experiment, full thickness defects (5-mm diameter) were made on the calvaria of sixteen adult Sprauge-Dawley rats. Deproteinized ES (ES-1)(n=8), hydrothermally treated ES (ES-2, ES-3)(n=16) and bovine bone mineral(Bio-Oss®, Geistlich -Pharma, Switzerland)(n=8) were grafted. After 4 and 8 weeks of healing, animals were sacrificied and evaluated histologically and histomorphometrically.

Results & Conclusion

The surfaces of hydrothermally treated ES showed surface microstructures and increased surface area. Histologic observation showed better osteoconductive properties of hydrothermally treated ES compared to Bio-Oss®, more frequent direct

contact with mineralized bone tissue were observed in ES graft groups. The histomorphometric results showed greater new bone formation in ES grafted groups compared to Bio-Oss® grafted group at both 4 and 8 weeks of healing. Also, significantly greater new bone formation in interparticle space was shown in hydrothermally treated ES grafted groups compared to Bio-Oss® grafted group at both 4 and 8 weeks of healing($p<0.05$). Complete bony bridging were more frequently observed in hydrothermally treated ES grafted groups. In contrast, Bio-Oss® grafted group showed complete bony bridging only in one defect at 8 weeks of healing.

This study suggests that surface-modified ES powder using phosphate solution under relatively mild hydrothermal conditions, may be considered as effective osteoconductive bone grafting materials clinically available, but further studies are needed to assess long-term results.