

Enhanced Bone Formation by Low Intensity Pulsed Ultrasound in Posterior Spinal Fusion with Hydroxyapatite/ Tricalcium Phosphate Implant

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Low intensity pulsed ultrasound (LIPUS) was reported to increase the fusion rate of spinal fusion with autograft. The aim of the study was to investigate the effect of LIPUS on posterior spinal fusion implanted with synthetic hydroxyapatite/tricalcium phosphate (HA/TCP) bioceramics.

The HA/TCP bioceramics was implanted onto decorticated L5 and L6 transverse processes in adult rabbit. The LIPUS was applied for seven weeks post-operation while animal without treatment acted as sham group. After harvesting samples, undecalcified histology was performed. The inter-process distance and bone volume/tissue volume ratio of fusion mass was evaluated in micro-radiography. Hematoxylin & eosin as well as safranin O staining were performed for histological analysis.

LIPUS treatment group was observed to have smaller fusion gap and more fusion mass in micro-radiograph. It was further verified by significant decrease of inter-process distance in LIPUS treatment group (29%, $p=0.006$). Furthermore, the

bone area ratio of fusion processes in LIPUS group was 50% greater than sham group ($p=0.007$).

The histology of LIPUS group showed high cellularity in the large area of whole fusion bed and especially in newly formed bone while sham group showed less area near newly formed bone area of transverse processes. Moreover, the proteoglycan rich cartilage stained by safranin O was observed near the newly formed bone area in LIPUS treatment group while very less or even no cartilage tissue in samples of the sham group.

LIPUS exerted micro-mechanical stress on fusion bed in spinal fusion model. Mesenchymal stem cells, osteoblasts and chondrocytes were reported to be stimulated by LIPUS *in vitro*. They all involve in decorticated spinal fusion. The enhancement of both intramembranous and endochondral bone formation by LIPUS treatment was clearly demonstrated in this study. Thus LIPUS treatment is feasible to promote bone regeneration in posterior spinal fusion with biomaterials.