論 文 要 旨

Enhanced bone formation of calvarial bone defects by low-intensity pulsed ultrasound and recombinant human bone morphogenetic protein-9: a preliminary experimental study in rats

（低出力超音波パルスとヒト組換え骨形成タンパク質-9 による頭蓋骨骨欠損部の骨形成促進: ラットを用いた予備実験）

今藤　隆智

Abstract

Objectives

The aim of this study was to evaluate the combined effects of recombinant human bone morphogenetic protein-9 (rhBMP-9) loaded onto absorbable collagen sponges (ACS) and low-intensity pulsed ultrasound (LIPUS) on bone formation in rat calvarial defects.

Materials and Methods

Circular calvarial defects were surgically created in 18 Wistar rats, which were divided into LIPUS-applied (+) and LIPUS-non-applied (-) groups. The 36 defects in each group received ACS implantation (ACS group), ACS with rhBMP-9 (rhBMP-9/ACS group), or surgical control (control group), yielding the following six groups: ACS (+/-), rhBMP-9/ACS (+/-), and control (+/-). The LIPUS-applied groups received daily LIPUS exposure starting immediately after surgery. At 4 weeks, animals were sacrificed and their defects were investigated histologically and by microcomputed tomography.

Results

Postoperative clinical healing was uneventful at all sites. More new bone was observed in the LIPUS-applied groups compared with the LIPUS-non-applied groups. Newly formed bone area (NBA)/total defect area (TA) in the ACS (+) group (46.49±7.56%) was significantly greater than that observed in the ACS (-) (34.31±5.68%) and control (-) (31.13±6.74%) groups ($p < 0.05$). The rhBMP-9/ACS (+) group exhibited significantly greater bone volume, NBA, and NBA/TA than the rhBMP-9/ACS (-) group (2.46±0.65 mm^3 vs., 1.76±0.44 mm^3, 1.25±0.31 mm^2 vs., 0.88±0.22 mm^2, and 62.80±11.87% vs., 42.66±7.03%, respectively) ($p < 0.05$). Furthermore, the rhBMP-9/ ACS (+) group showed the highest level of bone formation among all groups.

Conclusion

Within their limits, it can be concluded that LIPUS had osteopromotive potential and enhanced rhBMP-9-induced bone formation in calvarial defects of rats.