Journal of Clinical Laser Medicine & Surgery

Effects of Pulse Frequency of Low-Level Laser Therapy (LLLT) on Bone Nodule Formation in Rat Calvarial Cells

Objective: The purpose of this study was to determine the effect of pulse frequencies of low-level laser therapy (LLLT) on bone nodule formation in rat calvarial cells in vitro. Background Data: Various photo-biostimulatory effects of LLLT, including bone formation, were affected by some irradiation factors such as total energy dose, irradiation phase, laser spectrum, and power density. However, the effects of pulse frequencies used during laser irradiation on bone formation have not been elucidated. Materials and Methods: Osteoblast-like cells isolated from fetal rat calvariae were irradiated once with a low-energy Ga-Al-As laser (830 nm, 500 mW, 0.48-3.84 J/cm2) in four different irradiation modes: continuous irradiation (CI), and 1-, 2-, and 8-Hz pulsed irradiation (PI-1, PI-2, PI-8). We then investigated the effects on cellular proliferation, bone nodule formation, alkaline phosphatase (ALP) activity, and ALP gene expression. Results: Laser irradiation in all four groups significantly stimulated cellular proliferation, bone nodule formation, ALP activity, and ALP gene expression, as compared with the non-irradiation group. Notably, PI-1 and -2 irradiation markedly stimulated these factors, when compared with the CI and PI-8 groups, and PI-2 irradiation was the best approach for bone nodule formation in the present experimental conditions. Conclusion: Since low-frequency pulsed laser irradiation significantly stimulates bone formation in vitro, it is most likely that the pulse frequency of LLLT an important factor affecting biological responses in bone formation.

Yuji Ueda
Department of Orthodontics, Nihon University School of Dentistry at Matsudo Chiba, Japan
Noriyoshi Shimizu
Department of Orthodontics, Nihon University School of Dentistry, Tokyo, Japan