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Effect of low-level laser therapy on bone metabolism and root resorption during tooth movement in rats

Suzuki SS[1], Garcez AS[2], Moon W[3], Ervolino E[4], Suzuki H[5], Ribeiro MS[1] - [1]IPEN - Center for Lasers and Applications Nuclear and Energy Research Institute, [2]São Leopoldo Mandic Dental Research Center - Department of Microbiology, [3]University of California, Los Angeles - Department of Orthodontics, [4]UNESP - Univ. Estadual Paulista Brazil - Department of Basic Sciences of Dental School, Araçatuba, [5]São Leopoldo Mandic Dental Research Center - Department of Orthodontics - Pos-graduation

The purpose of this study was to evaluate the effects of low-level laser therapy (LLLT) on the process of bone remodeling and root resorption, searching to correlate metabolic changes observed at cellular level in the initial days of tooth movement to tissue changes observed microscopically and both architecture and morphology of trabecular and cortical bone. Tooth movement was induced in upper first molars of sixty-eight male Wistar rats and divided into 2 groups: non-irradiated and LLLT (laser parameter of 810 nm wavelength, 100 mW power laser, 0.02cm^2 area, energy of 1.5J/point) and euthanized on days 3, 6, 9, 14 and 21. A negative control group (no movement) was also evaluated. Measurements of tooth movement and histomorphometric analysis were performed at all days. Immunohistochemistry analysis of RANKL, OPG and TRAP markers and scanning electron microscopy (SEM) were made on days 3, 6 and 9. Microcomputed tomography (MicroCT) scanning was performed on days 14 and 21. The results showed significantly greater tooth movement in the irradiated group (increasing 40% in average). Compression side showed higher expression of RANKL and TRAP-positive osteoclasts on days 3, 6 and 9, promoting significant bone resorption and decrease of alveolar bone area on days 6, 9 and 14, and leading to microstructural changes such as reduction of bone volume/total volume and bone mineral density at 14 days. On the tension side, there was an increase in expression of OPG after 9 days, a significant increase in alveolar bone area on days 14 and 21 and increase in bone mineral density and trabecular thickness after 21 days. Results of hyalinized areas at the periodontal ligamento showed significant reduction on days 3, 6 and 9 in irradiated groups, which explains the less odontoclasts on the root surface and a significant reduction of areas of root resorption observed in histology and by SEM images. Irradiated groups also showed less volume of root resorption lacunaes measured by MicroCT especially in the compression side. The study concluded that LLLT had an effect on bone remodeling, increasing osteoclast activity on the compression side, and stimulating bone formation in tension side, resulting in significant tooth movement acceleration and potentially reducing the areas of necrosis in the periodontal ligament and consequently the root resorption process.