Cytokines and Growth Factors Involved in the Osseointegration of Oral Titanium Implants Positioned Using Piezoelectric Bone Surgery Versus a Drill Technique: A Pilot Study in Minipigs

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Background: Most dental implants are positioned using a drilling surgery technique. However, dentistry recently experienced the implementation of piezoelectric surgery. This technique was introduced to overcome some of the limitations involving rotating instruments in bone surgery. This study used biomolecular and histologic analyses to compare the osseointegration of porous implants positioned using traditional drills versus the piezoelectric bone surgery technique.

Methods: Porous titanium implants were inserted into minipig tibias. Histomorphology and levels of bone morphogenetic protein (BMP)-4, transforming growth factor (TGF)-β2, tumor necrosis factor-alpha, and interleukin-1β and -10 were evaluated in the peri-implant osseous samples.

Results: Histomorphological analyses demonstrated that more inflammatory cells were present in samples from drilled sites. Also, neo-osteogenesis was consistently more active in bone samples from the implant sites that were prepared using piezoelectric bone surgery. Moreover, bone around the implants treated with the piezoelectric bone surgery technique showed an earlier increase in BMP-4 and TGF-β2 proteins as well as a reduction in proinflammatory cytokines.

Conclusion: Piezoelectric bone surgery appears to be more efficient in the first phases of bone healing; it induced an earlier increase in BMPs, controlled the inflammatory process better, and stimulated bone remodeling as early as 56 days post-treatment. *J Periodontol 2007;78:716-722.*

KEY WORDS

Bone morphogenetic proteins; cytokines; dental implants.

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To enhance peri-implant osteogenesis and reduce the bone healing time after implant site preparation, the biologic factors that are involved in these processes must be evaluated. Literature supports the hypothesis that a porous implant surface is more effective in stimulating peri-implant osteogenesis than is a machined one using traditional drilling.[1-5] When bone formation was evaluated by histologic analysis,[5] levels of biologic factors, bone morphogenetic protein (BMP)-4 and transforming growth factor (TGF)-β, increased earlier around porous implants.

BMP-4 contains several proteins that have bone-inducing capacities. BMPs are key regulators of osteoblast and chondrocyte differentiation during skeletal development and of osteogenic differentiation in healing fractures.[6-9] TGF-β stimulated bone formation in vivo,[10,11] which may have resulted from the stimulated proliferation of osteoblast precursors rather than stimulated osteoblastic differentiation.[12] Thus, it may be postulated that TGF-β could stimulate BMP activity in the early phases of bone healing, just before the BMPs exert their effects.

Dental implants are positioned most commonly using a surgery technique

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