Piezoelectric vs. conventional drilling in implant site preparation: pilot controlled randomized clinical trial with crossover design

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Abstract

Objective: To compare implant stability throughout osseointegration, peri-implant marginal bone loss, and success rates of implants placed with conventional and mixed drilling/piezoelectric osteotomy.

Materials and methods: A pilot randomized-controlled trial was performed on 15 patients. Each patient received two implants in the mandibular molar region. All sites were prepared with conventionally up to the 2.8 mm wide drill. Osteotomies were randomly finalized with a 3 mm diameter drill (control group) or with two consecutive ultrasonic tips (2.8 mm and 3 mm wide, respectively) (test group). Resonance frequency analysis measurements were taken at implant placement and after 1, 3, 8, and 12 weeks. Peri-implant marginal bone loss 12 months after loading was calculated using periapical radiographs. Wilcoxon test for related samples was used to study differences in implant stability and in peri-implant marginal bone loss between the two groups.

Results: Twenty-nine of 30 implants osseointegrated successfully (one failure in the control group). Stability was significantly higher in the test group at the 8th week assessment; differences were non-significant at all other time-points. Longitudinally, differences were observed between the patterns of implant stability changes: in the test group stability increased more progressively, while in the control group an abrupt change occurred between the 8th and 12th weeks assessments. No difference was found in peri-implant marginal bone loss between the groups. All 29 implants were functionally successful at the 15-month visit.

Conclusions: Within the limit of this pilot study (small sample size, short follow-up), data suggested that implant stability might develop slightly faster when implant site osteotomy is performed with a mixed drilling/ultrasonic technique.

Successful osseointegration is defined as the direct structural and functional connection between living bone and the surface of a functionally loaded implant. It is well known that implant stability (lack of mobility) during the bone healing period is a fundamental prerequisite to achieve osseointegration (Brånemark et al. 1977). Implant stability involves two different stages: primary and secondary stability. Primary stability results from mechanical engagement between the fixture and the bone walls of the implant bed. Secondary stability is the progressive increase in stability achieved through bone neo-formation and remodeling in contact with the implant surface during the healing period (Brunski 1992, Meredith 1998).

Several non-invasive diagnostic devices based on modal analysis [in other words, a vibration analysis] are available to clinically monitor implant stability throughout the healing period, such as Periotest® (Siemens AG, Bensheim, Germany), Dental Mobility Checker® (J. Morita, Suita, Japan), and Osstell Mentor® (Ostell AB, Göteborg, Sweden). Periotest® has been criticized for insufficient sensitivity to measure implant mobility. Dental Mobility Checker® applies a small force with a mallet, which may jeopardize the process of osseointegration in a recently placed implant (Atsumi et al. 2007). Osstell® Mentor is an extended system to monitor implant stability based on resonance frequency analysis [RFA], which uses a transducer fixed to the implant and a resonance frequency analyzer. This method assumes that an implant and the surrounding bone function as a single unit; thus, a change in