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Does increasing the number of short implants reduce marginal bone loss in the posterior mandible? A prospective study

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Abstract

Marginal bone loss is a concern in the long-term prognosis of short dental implants. The aim of this prospective cohort study was to evaluate the loss when variable numbers of short implants were used in the posterior mandible. The subjects were allocated into three groups according to the number of short implants. The first group was given two, the second three, and the third four. Each patient had radiographs taken immediately after loading and repeated 36 months later. Twenty- three subjects with 65 implants were entered in the three groups. The mean (SD) marginal bone loss was 0.49 (0.04) mm in the two implant group, 0.41 (0.25) mm in the three implant group, and 0.35 (0.25) mm in the four implant group. There were significant differences in marginal bone loss among the three groups ($p = 0.001$), in that the fewer the number of short implant-supported fixed prostheses in the posterior mandible, the greater the marginal bone loss. When we used more short implants the amount of marginal bone loss decreased.

Keywords: Short implant; Bone loss; Mandible; Fixed prosthesis

The posterior mandible is a challenging area in which to place dental implants when the alveolar ridge has resorbed severely and bone height is less than 10 mm from the inferior alveolar nerve canal.[1] Various treatments have been suggested to overcome this, including onlay bone graft using guided bone regeneration,[2] nerve transposition,[3] angulated implants,[4] distraction osteogenesis,[5] and short implants.[1]

The use of short implants to restore an atrophic mandible has been studied and confirmed.[6] Marginal bone loss is a major concern in the long-term prognosis of dental implants.[7] A systematic review of marginal bone loss around short dental implants (<10 mm) for implant-supported fixed prostheses showed that short dental implants (<10 mm) had similar peri-implant marginal bone loss as standard implants (≥10 mm) for implant-supported fixed prostheses.[8] It was suggested that short implants (6 mm long) had an acceptable outcome as also did wide diameter short implants(5 and 6 mm) which had less marginal bone loss than implants 4.2 mm in diameter.[9] Short implants (6 mm long) with a conventional diameter of 4 mm gave similar if not better results than longer implants placed in the posterior mandible a year after loading,[10] and might be preferable to bony augmentation, particularly in the posterior mandible, because the treatment is faster, cheaper, and associated with less morbidity. The amount of marginal bone loss with variable numbers of fixed short implants has not to our knowledge been studied.

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The purpose of this study was to answer the following question: does the amount of marginal bone loss differ between a single short implant and several fixed short implants? We hypothesised that the amount of marginal bone lost would be reduced when the number of short implants was increased. We have therefore compared the marginal loss of bone with variable numbers of short implants.

Materials and methods

We organised a prospective cohort study, the samples for which were derived from subjects who were referred the oral and maxillofacial department at the Shahidbeheshti University of Medical Sciences, Tehran, between 1September 2010 and 31March 2012. The research committee of the medical ethics group of the university approved the study. Subjects eligible for inclusion had an edentulous area in the posterior mandible with bone less than 9 mm high on cone-beam computed tomography (CT), and were candidates for a single or multiple implants.

Subjects were excluded from the study if they had untreated periodontal disease or abnormal or disordered function that could affect bony metabolism.

The subjects were allocated into one of three groups according to the number of short implants: the first group was given two short implants (the first and the second molar), the second group three short implants (the first and second molars and the second premolar), and the third group four short implants (the first and second molars and the first and second premolars) in the posterior mandible. The posterior mandible was defined as the area from the first premolar to the second molar. The length of crown was measured between the highest point of the cusps and the shoulders of the fixtures.

The fixtures were 4×6 mm (Osseo Speed surface with Micro-thread; Astra Tech, Molndal, Sweden). All patients' implants were loaded three months after insertion. None of the patients needed further manipulation of soft or hard tissue during follow-up. Cemented crowns were used in all subjects and crowns were splinted together. Each patient had radiographs taken immediately after, and 36 months after, loading. The method of assessing the bone resorption and marginal bone on the mesial and distal surfaces of the implants was a long-cone paralleling technique. The radiographs were taken with standard periapical film (no 2, type E) with exposure variables of 70 kV, 8 mA, and 0.25 seconds. To confirm the reproducibility of the radiographs (postoperatively and at follow-up), the radiographs were taken with individual bite blocks attached to the beam-guiding device (XCP, Rinn, Elgin, IL). To individualise the bite blocks, bite records were fabricated using silicone impression material (Polyvinylsiloxane, Kerr, Germany) and placed on the individual bite blocks.

The bony level was measured on the mesial and distal surfaces of each implant, and the fixture was measured on paired radiographs from the shoulder of the implant to the crest of the alveolar bone in the vertical dimension (Fig. 1). The level of bone at the time of loading of the implant was defined as the baseline for the evaluation of marginal bone resorption. Sex, age, height of crown, and site of implants were factors in the study, and marginal bone loss was the outcome.

Fig. 1. Measurement of marginal bone loss.

Surgical technique

After local anaesthesia with lignocaine 2% and epinephrine 1/80000 (1.8-2.7 ml) an incision was made on the alveolar crest slightly lingually, followed by subperiosteal dissection. The drilling protocol followed the manufacture's instructions. Fixtures were placed in bone level by a manual ratchet with 20-25 N. Cover screws were placed and the incision was closed primarily. All fixtures were exposed three months after insertion and a healing abutment inserted.

Statistical analysis

Statistical analyses were made with the aid of IBM SPSS Statistics for Windows (version 19, IBM Corp, Armonk, NY, USA). Analysis of variance (ANOVA) was used to compare marginal bone loss among the groups and implant sites. The chi square test was used to assess the significance of differences between the sexes. Pearson's correlation coefficient was used to assess whether there was any correlation between age, crown height, and marginal bone loss. The independent *t* test was used to asses the marginal bone loss between men and women.

Results

Twenty three subjects with 65 implants were studied in three groups (Fig. 2). The first group comprised 10 subjects with 20 implants. There were seven subjects with 21 implants in the second group and 6 subjects with 24 implants in the third group (Table 1). There were no significant differences among the studied groups for age and sex (Table 2). None of the implants failed during follow up. Marginal bone loss did not differ between the sexes ($p = 0.22$) (Table 3).

Six implants were placed in the second molar site, 13 in the first molar site, 23 in the first premolar site, and 23 in the