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SHORT COMMUNICATION

Evaluation of 4 mm implants in mandibular edentulous patients with reduced bone height. Surgical preliminary results

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ABSTRACT

Aim Growing evidence has suggested the utility of short dental implants for oral reconstructive procedures in clinical situations of limited vertical bone height. The aim of this short communication was to evaluate the clinical use of implants < 10 mm in length and to determine short implant-supported prosthesis success in the atrophic jaw.

Materials and methods Six women and three men were recruited for the treatment of edentulous mandibles. A total of 6 implants were inserted in each patient: two anterior implants of conventional length and four posterior 4 mm Titanium Zirconium (TiZr) implants. The insertion torque and bone density were evaluated.

Results The mean insertion torque for the 4 mm implants was lower than for conventional ones, without any statistical difference. Moreover, most of the patients (88%) showed a D2 bone type.

Conclusion The provision of short implant-supported prostheses in patients with atrophic alveolar ridges appears to be a successful treatment option in the short term; however, more scientific evidence is needed for the long term.

KEYWORDS bone density, insertion torque, short implants, success rate.

INTRODUCTION

Rehabilitation of totally edentulous patients with conventional removable dentures could be unsatisfactory for patients due to instability, discomfort, nerve punching and affection of the ability to eat and speak. A complete

screw-retained implant-supported prosthesis may be a viable alternative in such cases. However, the lack of sufficient bone volume and close proximity to the inferior alveolar nerve may represent a difficult clinical situation for the placement of endosseous implants (1). By using short implants to circumvent these difficulties, the primary stability may be compromised due to the reduced contact area for osseointegration. Moreover, successful placement of short implants in dense bone may furthermore depend on an accurate surgical technique to prevent a loose fit and overheating of the bone site (2-3). Traditionally, clinicians have avoided the use of short-length implants in areas of compromised bone (e.g., posterior locations, low bone density, and thin ridges). With the introduction of new surfaces, the surgical and clinical performance of short-length implants may become very similar to that of standard length ones.

The main purpose of this short communication was to evaluate and report the surgical performance of novel short 4 mm implants made of Titanium Zirconium (TiZr) alloy with a hydrophilic surface.

MATERIAL AND METHODS

Six women and three men with a mean age of 64 (range 44–86) years were recruited for treatment of edentulous mandibles. Each individual was thoroughly informed of the overall requirements/procedures of the study after explaining the purposes of the study, the nature of the planned treatment and alternative procedures. Potential risks, possible complications, and benefits of the proposed treatment were explained to the study subjects and they all signed an informed consent. The inclusion and exclusion criteria were selected as follows.

- › Inclusion criteria: age >18 years; committed to participate up to 3 years follow-up; complete edentulism in the mandible to allow placement of 6 implants (two in the canines zone of 10 mm in length and four 4 mm implants placed in the resorbed sites behind the mental

nerve); full or partial dentition opposing the implants. The implant site had to be edentulous for >2 months and healed, with evidence of bone resorption and atrophy; the minimal residual bone height should be adequate in the canine zone, and at least 8 mm in the posterior zone.

- > Exclusion criteria: presence of blood, metabolic, endocrine, renal, or neoplastic disease; human immunodeficiency virus infection; smoking >10 cigarettes per day; alcoholism; any conditions that may prevent study participation or interfere with analysis of results; mucosal diseases; history of irradiation therapy; previous reconstruction, bone grafting, or failed GBR at



FIG. 1 Preoperative panoramic radiograph.



FIG. 2 Mucoperiosteal flap elevated before implant placement.



FIG. 3 Drilling sequence for 4 mm Standard Plus Implants: Lance-shaped drill (pointed drill designed to break the cortical bone); 2,2 mm drill (initial step for dental implant); Implant Depth Gauge; 2,8 mm drill; Implant Depth Gauge; 3,5 mm drill; Implant Depth Gauge.



FIG. 4 Six implants placed in edentulous mandible, two long implants of 10 mm length and 4 mm implants behind mental nerve in both sides.

the site of intended implant surgery; severe bruxism/clenching; inadequate oral hygiene or unmotivated for home care; lack of primary stability; insufficient bone or any abnormality that would contraindicate implant placement.

Pretreatment procedures

A clinical and radiological examination was carried out including panoramic x-rays (Fig. 1) (8000C Digital Panoramic and Cephalometric System, Carestream, Rochester, NY, USA) and Cone beam scan (CS 9300 System, Carestream, Rochester, NY, USA). Bone and non-bone voxels were segmented using a heuristic segmentation algorithm that was developed specially for bone tissue with highly nonhomogeneous CT attenuation density distributions (4).

Study design

Each patient received 6 implants: two anterior implants of 10 mm length and four posterior implants of 4 mm length with a hydrophilic surface (Tissue Level Standard Plus, RN, Roxolid, SLActive, diameter 4.1 mm, Institut Straumann AG, Basel, Switzerland) for a screw-retained fixed complete denture.

Surgical procedure

Implant placement was performed using single-stage surgery. Local anesthesia was achieved by inferior alveolar nerve block and administration of an appropriate dose of Articaine dental® 4% with epinefrine 1:100.000 (Inibsa, Barcelona, Spain). A midline incision was done at the alveolar crest from the distal surface of the missing first molar. Full thickness mucoperiosteal flaps were raised and the path of the mental foramen identified with two release incisions at the back (Fig. 2). The preparation of the implant sites was performed according to a precise sequence (Fig. 3). Immediately postoperatively, the initial implant stability was assessed by recording the insertion torque value of the 4 mm implants. Cover screws were placed on the implants and the flaps were repositioned and sutured (Fig. 4).

Antibiotics were prescribed at the discretion of the surgeon. Analgesics were given as required for pain control. The patients were instructed to rinse with a 0.12% chlorhexidine solution (Dentaid, Barcelona, Spain) twice a day for 1 or 2 weeks until suture removal. After suture removal, the patients were instructed in proper mechanical brushing of the implants using 1% chlorhexidine gel until placement of the final restoration. A removable temporary prosthesis was installed in the mandible by using provisional implants loaded with Structur (Voco GmbH, Cuxhaven, Germany), in order to avoid stress/load on the definitive implants during the healing phase. Panoramic radiographs were obtained before and after surgery (Fig. 5).

Statistical analysis

The statistical software used was StatXact (Cytel, Cambridge, MA, USA) and descriptive statistics by means of Excel (Microsoft, Redman, WA, USA). The patient was used as



FIG. 5 Postoperative radiograph after implant placement.

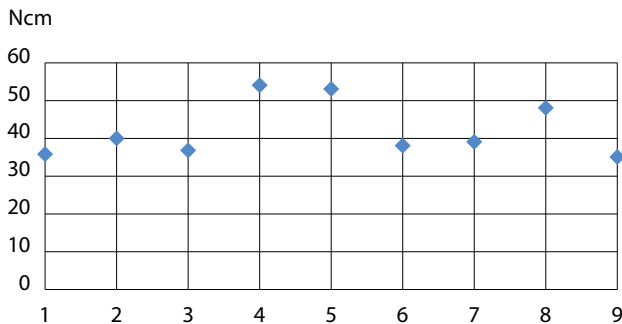


FIG. 6 Mean insertion torque values per patient, recorded during the insertion of the 4 mm implants.

PATIENT	P1	P2	P3	P4	P5	P6	P7	P8	P9
Ncm	35	41	36	54	52	39	39	48	36
SD	0	11	5.6	6.4	14	7.2	1.5	7.5	7.5

TABLE 1 Mean insertion torque values (Ncm) +/- standard deviation (SD) per patient (P1 to P9), recorded during the insertion of the 4 mm implants.

the unit of analysis in all tests. For continuous data, a mean value was calculated per patient. The paired two-sample t-test was used and the level of significance was set at 0.05.

RESULTS

All implants survived until one month after insertion. The mean insertion torque for the 4 mm implants was 38.1 ± 1.2 Ncm, while for the 10 mm implants was 42.4 ± 2.1 Ncm (table 1). Using a paired two-sample t-test, no significant difference between the average insertion torques was found ($p=0.005$) (Fig. 6).

Most of the patients had D2 bone (88%), while fewer patients had class D1 (8 %) or D3 (4 %) bone.

DISCUSSION AND CONCLUSION

Short implants should be used by experts with skillfull hands to avoid implant failures. The preliminary results of this study demonstrate that 4 mm long TiZr implants with an hydrophilic surface can be safely inserted in

resorbed mandibles with insertion torques comparable to longer implants, thereby avoiding vertical augmentation procedures. Unlike the mandible (McGill Consensus meeting, Montreal, 2003), there is no consensus today regarding the number of implants for a maxillary overdenture. However, a recent systematic review revealed that a maxillary overdenture, supported by six implants, connected with a bar, is the most successful treatment regarding the survival of both the implants and the overdenture (6). Four additional extrashort implants, as proposed by the present study, implicate an additional cost, although they may help the long implants, by increasing the stability of fixed resin prostheses, due to the wider spread of the implants within the arch. A second advantage might be that posterior bone resorption could be prevented, implicating less relinings of the prosthesis and avoiding mental nerve damage.

Pieri et al. suggested that even in quality IV bone, a successful treatment can be expected with two additional short implants, early loaded, supporting an overdenture (7). The lower bone quality/density in the posterior areas may be compensated by splinting of all implants with a cad-cam bar. The loading, in the present study, was avoided in the early stages and after the final restoration; moreover, unfrequent relining during the first weeks was performed to reduce crestal bone loss. Van Assche et al., studied the lack of information on the forces applied by different opposite arch conditions. Since the patient population of the study was limited, it was not possible to evaluate the influence of the applied forces of the opposing arch. They also showed that short implants can be a successful alternative to bone augmentation techniques for this treatment concept, also in type III or IV bone (8).

The provision of short implant-supported prostheses in patients with atrophic alveolar ridges appears to be a successful treatment option in the short term; however, more scientific evidence is needed for the long term.

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