SHORT VERSUS STANDARD LENGTH IMPLANTS: A CASE SERIES ANALYSIS

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The use of short implants (SIs) has had a great success, particularly in posterior jaws, because SIs avoid the need of alveolar crest reconstruction or sinus lifting. The aim of this study is to perform a retrospective study on 808 SIs to evaluate their survival rate. In the period between January 2008 and December 2013, 877 patients (498 females and 379 males) were operated at the BDD private Practice Clinic (Milan, Italy). The mean post-surgical follow-up was 30±17 months (max – min, 84 – 1). Eight hundred and eight implants (EDIERRE Implant System SpA, Genoa, Italy) were included in the present study, 119 (14.7%) 9.0 mm (i.e. short) and 689 (85.3%) 11.0 mm long. All patients underwent the same surgical protocol and agreed to participate in a post-operative check-up program. SPSS program was used for statistical analysis. Survival rate (SVR) was 97.4% since only 21 fixtures were lost from a total of 808 implants. Cross-tabulation between failures and immediate loading had a statistical significant value (p= 0.006) in respect to delayed loading. There were 10 failures out of 161 immediate loaded implants compared to 11 failures out of 626 delayed loaded fixtures. SIs are reliable devices for oral rehabilitation.

Dental implant is one of the most frequently used treatments in the replacement of missing teeth. Osseo-integrated dental implants play an important role in restorative dentistry but the long-term stability of dental implants depends above all on the integration between the biomaterials used and the surrounding tissues. The clinical success and longevity of dental implants, such as load bearing abutments, are controlled largely by the mechanical setting in which they function. The treatment plan is responsible for the design, number and position of the implants. In biomechanically compromised environments, such as poor quality bone, strain to the crestal bone can be reduced by placement of longer implants and maximizing the number of implants (1-4). Limitations regarding the volume and geometry of the alveolar bone are common in the posterior maxilla and mandible at the time of rehabilitation with dental implants. Thus, the use of short implants has been considered a therapeutic alternative in cases of unavailable bone height, since short implants adapt to the rehabilitated site anatomy and exclude the need for reconstructive surgical procedures. This approach also reduces the occurrence of surgical complications, morbidity, costs of the treatment, and treatment time (5).

Short implants are defined as implants with a length of less than 10 mm (6-8). The use of short implants substantially simplifies the restoration of posterior segments of dentition and minimizes the incidence of complications associated with advanced and complex interventions before or simultaneous

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with the installation of long implants (5).

Short implants have been used with success in posterior arch regions where significant alveolar ridge resorption has occurred. Nevertheless, many clinicians are reluctant to use them regularly, if at all. Key factors for success include implant surface roughness, surgical placement methods, and, possibly, implant diameter (6). Along with their simplicity, short-length implants allow for less expensive and faster treatment with reduced morbidity (7). However, both survival rate and indications are still controversial. In the past, short-length implants were often associated with increased failure rates (8) which were explained by reduced implant primary stability and bone-to-implant contact, as well as by unfavourable crown-to-implant ratios. As a consequence, the use of short-length implants was mainly restricted to rescue situations (9, 10).

Since implant dentistry has become a widely used procedure for the rehabilitation of edentulous patients, a retrospective study on 119 short and 689 standard length implants (EDIERRE Implant System SpA, Genova, Italy) was performed.

MATERIALS AND METHODS

Patients

In the period between January 2008 and December 2013, 877 patients (498 females and 379 males) were operated at the BDD private Practice Clinic (Milan, Italy). The mean post-surgical follow-up was 30±17 months (max – min, 84 – 1). Eight hundred and eight implants were included in the present study, 119 (14.7%) 9.0 mm and 689 (85.3%) 11.0 mm long. All patients underwent the same surgical protocol and agreed to participate in a post-operative check-up program.

Subjects were screened according to the following inclusion criteria: controlled oral hygiene, absence of any lesions in the oral cavity, sufficient residual bone volume in order to receive implants of at least 3.3mm in diameter and 9 mm in length.

The exclusion criteria were as follows: insufficient bone volume, a high degree of bruxism, smoking more than 20 cigarettes/day and excessive consumption of alcohol, localized radiation therapy of the oral cavity, antitumor chemotherapy, liver, blood and kidney diseases, immunosupression, corticosteroid treatment, pregnancy, inflammatory and autoimmune diseases of the oral cavity, poor oral hygiene.

Data collection

Before surgery, radiographic examinations were carried out with the use of orthopantomograph and CT scan.

The implant survival rate (SVR) was evaluated according to the following criteria: (i) absence of persisting pain or dysesthesia; (ii) absence of peri-implant infection with suppuration; (iii) absence of mobility; and (iv) absence of persisting peri-implant bone resorption greater than 1.5 mm during the first year of loading and 0.2 mm/years during the following years.

Surgical protocol

All patients followed the same surgical protocol. The anaesthesia of the jaw was obtained by the injection of articaine and post-surgical analgesic treatment was performed with 100 mg of ketoprophene 3 times a day if necessary. An antimicrobial prophylaxis was administered with 500 mg Amoxicillin twice daily for 5 days starting 1 hour before surgery. Fixtures were inserted in both jaws. Three surgeons (U.D.D., W.B. and G.C.) inserted all implants. Patients agree to follow a strict oral hygiene protocol and recall (Fig. 1 to Fig. 3).

Implants

A total of 808 implants were inserted: 343 (42.5%) in the mandible and 465 (57.5%) in the maxilla. One hundred and nineteen (14.7%) implants were 9.0 mm whereas 689 fixtures (85.3%) were 11.0 mm long. There were 21, 419, 230, 95, and 43 implants with a diameter of 3.3, 3.75, 4.2, 4.5 and 5.0 mm, respectively. One hundred and seventy-one were immediate loaded whereas 258, 217, 135, and 27 were loaded after 3, 4, 6, 8 months, respectively. Implants were inserted to replace 34 incisor (4.2%), 14 cuspids (1.7%), 263 premolars (32.5%) and 497 molars (61.5%). Six hundred and seventy-eight fixtures were inserted with 35 N torques whereas the remaining 130 with a lower torque.

Statistical analysis

SPSS statistical program was used. Cross tabulation between variables and failures was performed and Pearson *Chi*-square test was used to detect those variables potentially associated with lost implants.

RESULTS

Survival rate (SVR) was 97.4% since only 21 fixtures were lost from a total of 808 implants. Cross-tabulation between failures and immediate loading had a statistical significant value ($p = 0.006$) in respect to delayed loading. There were 10 failures over 161 immediate loaded implants compared to 11 failures over 626 delayed loaded fixtures. Implants were

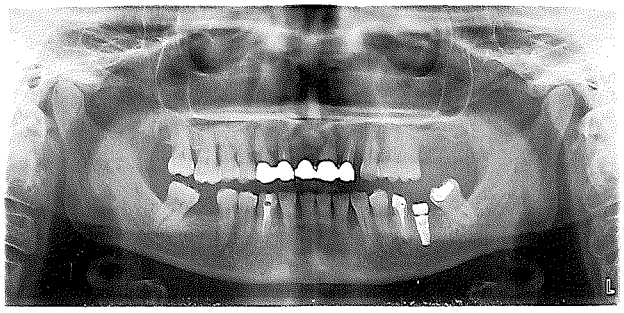

Fig. 1. *Pre-surgical radiograph.*

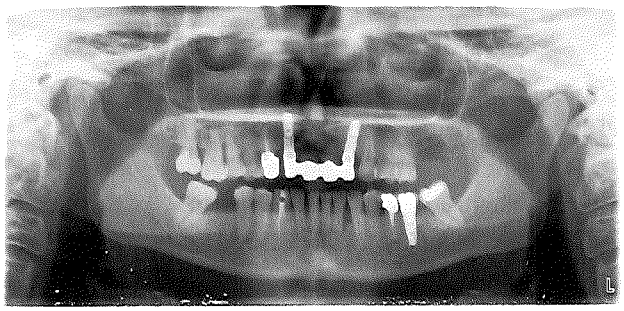

Fig. 2. *X-ray after 1 year.*

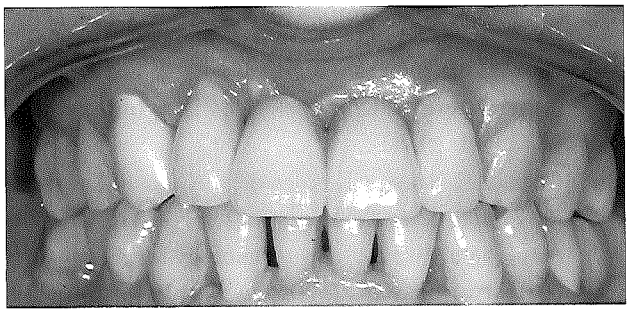

Fig. 3. *Frontal view of oral prosthetic rehabilitation after one year.*

lost for peri-implantitis (11, 12), caused by the same bacteria of periodontitis (13-15). Immediate loading in respect to delayed did not influence SVR (16).

DISCUSSION

Implant success was defined as suggested by Buser et al. (17), including absence of any complaints, such as pain, dysesthesia, or paresthesia at the implanted area; absence of recurring implant infection and or suppuration, absence of perceptible mobility of implant, absence of radiolucencies at the implant-bone junction.

When residual bone height over the mandibular canal is 10 mm, short implants could be an interesting alternative to vertical augmentation in posterior atrophic mandibles since the treatment is faster, cheaper and associated with less morbidity. Longer follow-ups may still be needed to confirm these results, however the medium-term prognosis (5 years after loading) of short implants is at least as good as those of longer implants placed vertically in augmented mandibles (18).

Short implants demonstrated a high rate of success in the replacement of missing teeth in especially atrophic alveolar ridges. The advanced technology and improvement of the implant surfaces have encouraged the success of short implants to a comparable level to that of standard implants (19).

Others studies have shown that short implant indication is based on the principle that the transmission of biomechanical forces to the implants is concentrated in the cervical area (20, 21).

Thus, implant length could not be a significant factor in stress distribution. However, some trials show lower survival rates for shorter implants (22, 23). Generally, these studies showed that short implants resulted in higher stress shear than long implants did, regardless of the type of loading. Conversely, other factors such as prosthetic crown height of fixed prostheses or implant macrostructure did not influence the stress distribution when the entire data were considered.

Whereas most publications devoted to short-length implants used a conventional loading protocol, Rossi et al. (7) performed a prospective case series study, in which 40, 6-mm-long implants were loaded with a single crown, 6 weeks after placement. The authors reported a cumulative survival rate of 95%, 2 years after loading (7). A similar loading protocol was also used by Van Assche et al. (24) in the rehabilitation of edentulous maxilla using four long implants and two distal 6-mm-long implants to support an overdenture. Similar outcomes were reported in this study for long and short implants, 2 years after loading. This finding may be related to the reduced surface area of the short implants, which can lead to greater stress concentration even with fixed prostheses, as used in this study (25). In addition, bone quality, a host-

related factor, is believed to be one of the strongest predictors of implant outcome (26, 27). It is well known that the mandible has better bone quality than the maxilla, and this fact is probably the reason why several reports are available regarding implant immediate loading in the mandible.

Our results give additional strength to the fact that short implants can be successfully used in posterior jaws and that the devices of EDIERRE Implant System SpA, Genova, Italy are reliable for oral rehabilitation. Particular attention should be given in case of immediate loading since there is a higher risk of short-term failures.

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REFERENCES

1. Deporter D. Short dental implants: what works and what doesn't? A literature interpretation. Int J Periodontics Restorative Dent 2013; 33(4):457-464.
2. Danza M, Lauritano D, Carinci F. Successful rehabilitation of partial edentulous maxilla and mandible with new type of implants: molecular precision implants. Case Rep Med 2014; 2014:307364.
3. Fogli V, Camerini M, Lauritano D, Carinci F. Success and high predictability of intraorally welded titanium bar in the immediate loading implants. Case Rep Dent 2014; 2014:215378.
4. Jemt T, Lekholm U. Implant treatment in edentulous maxillae: a 5-year follow-up report on patients with different degrees of jaw resorption. Int J Oral Maxillofac Implants 1995; 10(3):303-311.
5. Renouard F, Nisand D. Impact of implant length and diameter on survival rates. Clin Oral Implants Res 2006; 17 Suppl 2:35-51.
6. ten Bruggenkate CM, Asikainen P, Foitzik C, Krekeler G, Sutter F. Short (6-mm) nonsubmerged dental implants: results of a Multicenter clinical trial of 1 to 7 years. Int J Oral Maxillofac Implants 1998; 13(6):791-798.
7. Rossi F, Ricci E, Marchetti C, Lang NP, Botticelli D. Early loading of single crowns supported by 6-mm-long implants with a moderately rough surface: a prospective 2-year follow-up cohort study. Clin Oral Implants Res 2010; 21(9):937-943.
8. Esposito M, Pellegrino G, Pistilli R, Felice P. Rehabilitation of postrior atrophic edentulous jaws: prostheses supported by 5 mm short implants or by longer implants in augmented bone? One-year results from a pilot randomised clinical trial. Eur J Oral Implantol 2011; 4(1):21-30.
9. Esposito M, Cannizarro G, Soardi E, Pellegrino G, Pistilli R, Felice P. A 3-year post-loading report of a randomised controlled trial on the rehabilitation of posterior atrophic mandibles: short implants or longer implants in vertically augmented bone? Eur J Oral Implantol 2011; 4(4):301-311.
10. Wyatt CC, Zarb GA. Treatment outcomes of patients with implant-supported fixed partial prostheses. Int J Oral Maxillofac Implants 1998; 13(2):204-211.
11. Brunelli G, Carinci F, Zollino I, Candotto V, Scarano A, D. L. Peri-implantitis: a case report and literature review. European Journal of Inflammation 2012; vol.10:1-5.
12. Brunelli G, Carinci F, Zollino I, Candotto V, Scarano A, D. L. Sem evaluation of 10 infected implants retrived from man. European Journal of Inflammation 2012; vol. 10:7-12.
13. Carinci F, Scapoli L, Girardi A, Cura F, Lauritano D, Nardi GM, Palmieri A. Oral microflora and periodontal disease: new technology for diagnosis in dentistry. Ann Stomatol (Roma) 2013; 4(2):170-173.
14. Scapoli L, Girardi A, Palmieri A, Testori T, Zuffetti F, Monguzzi R, Lauritano D, Carinci F. Microflora and periodontal disease. Dent Res J (Isfahan) 2012; 9(Suppl 2):S202-206.
15. Scapoli L, Girardi A, Palmieri A, Carinci F, Testori T, Zuffetti F, Monguzzi R, Lauritano D. IL6 and IL10 are genetic susceptibility factors of periodontal disease. Dent Res J (Isfahan) 2012; 9(Suppl 2):S197-201.
16. Scarano A, Murmura G, Carinci F, D. L. Immediately loaded small-diameter dental implants: evaluation of retention, stability and comfort for the edentulous patient. European Journal of Inflammation 2012; vol. 10:19-24.
17. Tettamanti S, Millen C, Gavric J, Buser D, Belser UC, Bragger U, Wittneben JG. Esthetic Evaluation of

Implant Crowns and Peri-Implant Soft Tissue in the Anterior Maxilla: Comparison and Reproducibility of Three Different Indices. Clin Implant Dent Relat Res 2015.

18. Arlin ML. Short dental implants as a treatment option: results from an observational study in a single private practice. Int J Oral Maxillofac Implants 2006; 21(5):769-776.
19. Maestre-Ferrin L, Boronat-Lopez A, Penarrocha-Diago M, Penarrocha-Diago M. Augmentation procedures for deficient edentulous ridges, using onlay autologous grafts: an update. Med Oral Patol Oral Cir Bucal 2009; 14(8):e402-407.
20. Lum LB. A biomechanical rationale for the use of short implants. J Oral Implantol 1991; 17(2):126-131.
21. Rieger MR, Mayberry M, Brose MO. Finite element analysis of six endosseous implants. J Prosthet Dent 1990; 63(6):671-676.
22. Bahat O. Treatment planning and placement of implants in the posterior maxillae: report of 732 consecutive Nobelpharma implants. Int J Oral Maxillofac Implants 1993; 8(2):151-161.
23. Winkler S, Morris HF, Ochi S. Implant survival to 36 months as related to length and diameter. Ann Periodontol 2000; 5(1):22-31.
24. Van Assche N, Michels S, Quirynen M, Naert I. Extra short dental implants supporting an overdenture in the edentulous maxilla: a proof of concept. Clin Oral Implants Res 2012; 23(5):567-576.
25. Lederer SR, Riedelsdorf G, Schiffl H. Nasal carriage of meticillin resistant Staphylococcus aureus: the prevalence, patients at risk and the effect of elimination on outcomes among outclinic haemodialysis patients. Eur J Med Res 2007; 12(7):284-288.
26. Lauritano D, Palmieri A, Vinci R, Azzi L, Taglabue A, Carinci F. Adipose derived stem cells: basic science fundaments and clinical application. An update. Minerva Stomatol 2014; 63(7-8):273-281.
27. Sollazzo V, Carinci F, D. L. The biophysical stimulation of osteogenesis: a review. Eur J Inflamm 2012; vol. 10:65-70.