RELIABILITY OF SHORT IMPLANTS IN ORAL REHABILITATION

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Implant prostheses are often used to restore partially or completely edentulous patients but limited bone height, especially in the posterior mandible, may restrict the use of dental implants. Short implants (i.e. x ≤ 10 mm) may be selected in these situations. They have several advantages: 1 - restricting the need for sophisticated and expensive surgical procedures like sinus lifting, bone grafting and mandibular nerve transposition, 2 - placing short-span dentures and 3 - avoiding cantilevers in the posterior sextants. The limited surface area of SIs, conversely, can be a potential disadvantage as it has less resistance to occlusal forces. Since no report is available on a new type of implants, a retrospective study was performed. A total of 148 short (i.e x ≤ 10 mm) two-piece implants (FMD srl, Rome, Italy) were inserted, 91 in female and 57 in males. The median age was 58 ± 12 (min-max 25-80 years). Implants were inserted 68 in the maxilla and 80 in the mandible. One implant was lost, survival rate = 98.52%. Among the studies variables post-extractive implants on single tooth rehabilitations (p=0.043) was the only significant variable. Then peri-implant bone resorption (i.e. delta IAJ) was used to investigate SCR. Among the remaining 147 implants, 18 fixtures have a crestal bone resorption greater than 1.5 mm (SCR = 87.75). Statistical analysis demonstrated that only diabetes has a negative impact on peri-implant crestal bone resorption (p=0.016). In conclusion FMD implants are reliable devices for oral rehabilitation with a very high SCR and SVR.

The use of short diameter implants (SDIs) ranging from 6.5 to 8.5 mm has historically been related with low implants survival success rates (1). However, current data suggest that the same level of clinical success may be reached for SDIs compared to longer implants (2). In fact, survival rates from 88% to 100% have been reported for the atrophic mandible, whereas rehabilitation of partial edentulism and severely resorbed maxillae with SDIs leads to survival rates around 95% (3).

Sometimes, in patients with advanced levels of alveolar bone resorption, the provision of dental implants is often problematic and may require additional surgical intervention to augment bone levels. This is, in particular, the case of the posterior mandibular and maxillary regions, where there is a risk of involving the inferior alveolar nerve or penetrating the maxillary sinus during implant placement when alveolar bone is deficient. Particularly, the posterior maxilla presents difficult and challenging access, limited visibility, reduced space, and poor bone quality. Moreover, the resorption of the alveolar ridge and the high occlusal forces might jeopardize the survival of the implant (4). Therefore, in all these conditions, SDIs have widened the options for implant installation.

Usually, to consider as a good outcome the placement of this kind of implants several characteristics should be considered (5):

- Implant survival: this refers to the presence of an implant with or without complications. Failure was defined as removal of the implant;
- Implant biological success: this refers to the presence of an implant in the absence of complications of a biological nature (i.e., persistent pain, neuropathy and/ or loss of function, persistent uncontrolled peri-implant inflammation and/ or infection, persistent peri-implant radiolucency, implant mobility;
- Radiographic peri-implant marginal bone loss: this was studied as a measure to evaluate progressive bone loss or increased probing depths;

Key words: Two-pieces, implant, fixture, bone, loading.

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- Implant biomechanical success: this refers to the presence of an implant in the absence of complications of a biomechanical nature (i.e., prosthesis instability, fractured occlusal materials, fractured or loosened prosthetic components, implant fracture).

It must also be said that even if a pilot randomized clinical trial suggested (6) that SDIs may be a preferable alternative to various bone augmentation procedures in posterior atrophic areas because the treatment is faster, cheaper, and associated with less morbidity, no data have yet been published comparing these two treatment approaches with an observation period longer than 1 year. Thus, medium or long-term follow-up studies are needed to draw definitive conclusions.

Here we analyses a large series of two-pieces implants (FMD srl, Rome, Italy) in order to evaluate their survival (i.e. total number of fixtures still in place at the end of the follow-up) and success rate (i.e. peri-implant bone resorption).

MATERIALS AND METHODS

A) Study design/sample

To address the research purpose, the investigators designed a retrospective cohort study. The study population was composed of patients admitted at the private practice for evaluation and implant treatment by M.A.L. and M.A.B. between January 1996 and October 2011.

Subjects were screened according to the following inclusion criteria: controlled oral hygiene and absence of any lesions in the oral cavity; in addition, the patients had to agree to participate in a post-operative check-up program.

The exclusion criteria were as follows: bruxists, consumption of alcohol higher than 2 glasses of wine per day, localized radiation therapy of the oral cavity, antitumor chemotherapy, liver, blood and kidney diseases, immunosupressed patients, patients taking corticosteroids, pregnant women, inflammatory and autoimmune diseases of the oral cavity.

B) Variables

Several variables are investigated: demographic (age and gender), anatomic (tooth site, jaws), implant (length, diameter and type), related pathologies (diabetes, smoke, periodontal disease, edentulness), surgical (surgeon, post-extraction, guided bone regeneration - GBR), and prosthetic (immediate loading, number of crowns) variables.

The predictors of outcome are the percentage of implants still in place at the end of the follow-up period (i.e. survival rate – SVR) and the peri-implant bone resorption. The latter is defined as implant success rate (SCR) and it is evaluated according to the 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 (7)

C) Data collection methods

Before surgery, radiographic examinations were done with the use of intra-oral radiographs and orthopantomographs.

Peri-implant crestal bone levels were evaluated by the calibrated examination of intra-oral radiographs and orthopantomograph x-rays after surgery and at the end of the follow-up period. The measurements were carried out medially and distally to each implant, calculating the distance between the implant's neck and the most coronal point of contact between the bone and the implant. The bone level recorded just after the surgical insertion of the implant was the reference point for the following measurements. The measurement was rounded off to the nearest 0.1 mm. The radiographs were performed with a computer system (Gendex, KaVo ITALIA srl, Genova, Italia) and saved in uncompressed TIFF format for classification. Each file was processed with the Windows XP Professional operating system using Photoshop 7.0 (Adobe, San Jose, CA), and shown on a 17" SXGA TFT LCD display with a NVIDIA GÈ Force FX GO 5600, 64 MB video card (Acer Aspire 1703 SM-2.6). By knowing dimensions of the implant, it was possible to establish the distance from the medial and distal edges of the implant platform to the point of bone-implant contact (expressed in tenths of a millimeter) by doing a proportion.

The difference between the implant-abutment junction and the bone crestal level was defined as the Implant Abutment Junction (IAJ) and calculated at the time of operation and at the end of the follow-up. The delta IAJ is the difference between the IAJ at the last check-up and the IAJ recorded just after the operation. Delta IAJ medians were stratified according to the variables of interest.

D) Surgical protocol

All patients underwent the same surgical protocol. An antimicrobial prophylaxis was administered with 1g Amoxycillin 875 mg + Clavulanic acid 125 mg twice daily for 5 days starting 1 hour before surgery. Local anesthesia was induced by infiltration with articaine/epinephrine and post-surgical analgesic treatment was performed with 600 mg Ibuprofen twice daily for 3 days. Oral hygiene instructions were provided.

Two-piece implants (FMD srl, Rome, Italy) were inserted with a flap elevation approach. The implant neck was positioned at the alveolar crest level. Guided bone regeneration could be performed in the same surgical step. A second operation was then performed after four months to loading by means a provisional prosthesis. The final restoration was usually delivered within 8 weeks. All patients were included in a strict hygiene recall.

E) Data analysis

Pearson-chi square test was used to detect those variables statistically associated to SVR and SCR.

RESULTS

A total of 148 short (i.e $x \leq 10$ mm) two-piece implants (FMD srl, Rome, Italy) were inserted, 91 in female and 57 in males. The median age was 58 ± 12 (min-max 25-80 years). Implants were inserted 68 in the maxilla and 80 in the mandible; they replaced 11 incisors, 6 cuspids, 47 premolars and 84 molars. Implant' length was $x \leq 10$

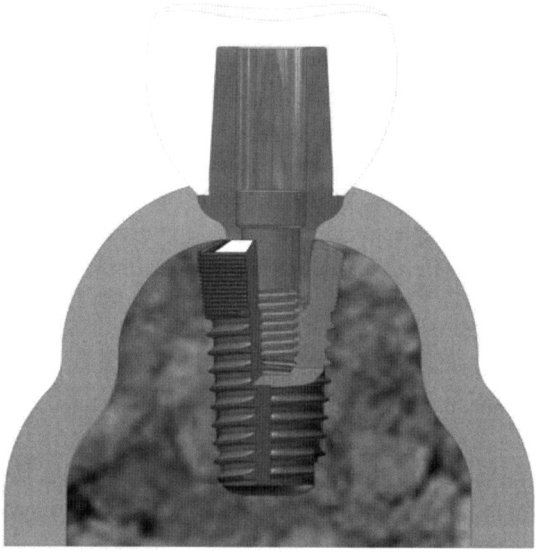

Fig. 2. *Rx image of the inserted implant*

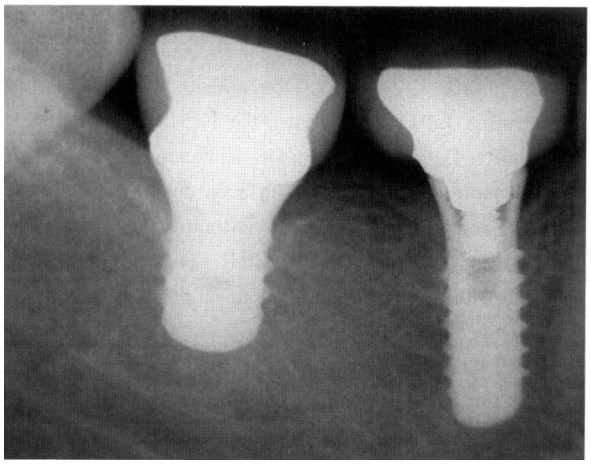

Fig. 1. *Dental implant*

mm. Implant' diameter was narrower than 3.5 mm, e1ual to 3.8 mm and wider than 4.0 mm in 17, 12, 119 cases, respectively. There were 19, 56, 72 and 1 Elisir, I-fix, Shiner, and Storm implant types. All the implant bodies received the same surface treatments (i.e. sand blasting and acid etching) while the neck was left smooth in Elisir, Shiner, storm types. I-fix received the same surface treatment involving the neck too.

Twenty three diabetic patients were enrolled, 93 had periodontal disease and 65 were smokers. Two surgeons performed operation. Fixtures were placed in 7 totally edentulous patient, 1 single missing teeth and 140 partially edentulous subjects. Six implants were placed in post-extraction sockets; GBR was performed onto 26 fixtures and none was immediately loaded. There were 53 single crowns, 92 implants bearing 2 or greater bridges and 2 removable dentures.

The overall mean follow-up was ±63 months.

One implant was lost, survival rate = 98.52%.

Among the studies variables post-extractive implants on single tooth rehabilitations (p=0.043) was the only significant variable.

Then peri-implant bone resorption (i.e. delta IAJ) was used to investigate SCR.

Among the remaining 147 implants, 18 fixtures have a crestal bone resorption greater than 1.5 mm (SCR = 87.75).

Statistical analysis demonstrated that only diabetes has a negative impact on peri-implant crestal bone resorption (p=0.016).

DISCUSSION

Reduced alveolar bone height is very common in the posterior jaws. The clinical use of endosseous oral implants of different length designs has become highly predictable in recent decades. However, their use may be restricted where there are limitations imposed by the geometry and volume of the alveolar bone. These restrictions are more common in the posterior regions of the maxilla and the mandible. The biomechanical rationale behind the use of SDIs is that the crestal portion of the implant body is the most involved in load-bearing, whereas very little stress is transferred to the apical portion and the increase of implant length from 7 to 10 mm did not significantly improve its anchorage. It may be speculated that improvements in implant design and surface characteristics, which guarantee higher primary stability and wider bone-to-implant contact, as well as the elaboration of focused surgical protocols and adapted prosthetic restorations, have increased the clinical performance rates of SDIs (8).

Implant osseointegration is dependent upon various factors, such as bone quality and type of implant surface. It is also subject to adaptation in response to changes in bone metabolism or transmission of masticatory forces. Particularly, it has been reported that the primary stability and survival rate of implants could be affected by the bone quality, which is lowest at the posterior maxillae. Felice et al. (9) investigated whether SDIs could be an alternative to standard implants placed in posterior mandibles. They concluded that there were no significant differences in bone loss, but the augmentation procedure required a longer healing time, further technical skills, and augmented costs and caused post-operative paresthesia of the alveolar inferior nerve in a highly statistically significant manner.

The surgery for placing SDIs is very simple, particularly compared with the bone augmentation techniques. Moreover, because of the scant depth of

implantation and the easy and direct irrigation access, the risk of bone overheating is lower (10). However, some disadvantages of SDIs include an unfavorable crown/implant ratio, supporting of excessive forces, and a lesser implant surface amenable to osteointegration. The risk of mandibular fracture in a case of edentulous patient with very severe resorption has been reported as a major complication of short implants (3).

Proper pre-surgical evaluation of the available bone density and volume, i.e. ridge width and height, and cases selection are necessary when using SDIs. Moreover, a reduction of the lateral occlusal forces upon the SDIs is recommended because more favorable bone strain and implant stress can be obtained (11).

An extensive review of the literature that is available for SDIs indicates that although they are commonly used in areas of the mouth under increased stress (posterior region), their success rates mimic those of longer implants when careful case selection criteria have been used. The available studies and case-series offer a valid rationale for placement of SDIs so long as one understands the limitations, indications, risk factors, and limited studies that actually follow-up success rates of SDIs for over 5 years(12).

In the present report only one implant was lost, survival rate = 98.52%. Among the studies variables post-extractive implants (p=0.043) was the only significant variable.

Then peri-implant bone resorption (i.e. delta IAJ) was used to investigate SCR.

Among the remaining 147 implants, 18 fixtures have a crestal bone resorption greater than 1.5 mm (SCR = 87.75). Statistical analysis demonstrated that only diabetes has a negative impact on peri-implant crestal bone resorption (p=0.016).

In conclusion FMD implants are reliable devices for oral rehabilitation with a very high SCR and SVR.

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