EFFECT OF ONE-PIECE IMPLANT DIAMETER ON CLINICAL OUTCOME

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One-piece implants incorporate the trans-mucosal abutment facing the soft tissues as an integral part of the implant. The interface between the trans-mucosal component and the implant is generally located in the neighbourhood of the alveolar bone level. One-piece implant are usually welded together and immediately loaded. Since no report is available on the effect of fixture diameter on clinical outcome, a retrospective study was performed. Nineteen patients (10 females and 9 males) with a median age of 62 years (min-max 43-80) were enrolled. The mean follow-up was 7 months. A total of 176 one-piece implants (Diamond, BIOIMPLANT, Milan, Italy) were inserted. Implant' diameter was narrower than 4 mm, equal to 4 mm and wider than 4 mm in 12, 97 and 67 fixtures, respectively. Pearson Chi-Square test was used to detect if implant diameter has an impact both on failures (SVR, i.e. lost fixtures) and/or on success (SCR, i.e. crestal bone resorption around implants lower than 1.5 mm). In our series SVR and SCR were 93.75 and 97.57, respectively. Statistical analysis demonstrated that diameter has no direct impact on survival (i.e. lost implants) as well as on clinical success (i.e. crestal bone resorption). In conclusion one-piece implants are reliable devices for oral rehabilitation (since they have a SVR = 93.75 and a SCR = 97.57) and implant diameter does not have statistically significant impact on implant failures and crestal bone resorption.

One-piece implants became more and more popular in the last few years. They incorporate the trans-mucosal abutment facing the soft tissues as an integral part of the implant. The interface between the trans-mucosal component and the implant is generally located in the neighbourhood of the alveolar bone level. In a one-piece implant the implant immediately pierces the soft tissue's barrier (non-submerged fashion) according to a one-stage surgery, whereas a two-piece implant system is submerged under the soft tissues for a waiting period (two-stage surgery) (1).

Thus, with a 1- piece implant design, manipulation of the peri-implant soft tissue after initial healing can be avoided. The implant can be provided with a provisional restoration at placement, allowing for the mucosal epithelium and the connective tissue adhesion to form coronal to the alveolar crest (2). The preparable abutment portion of the implant makes it possible to create an individualized profile that follows the contour of the gingival margin without violating the soft tissue seal (1).

The surgical protocol for placement of this implant includes both flap and flapless procedures (3). However, avoiding separation of the periosteum from the underlying tissue may result in a better-maintained blood supply to the marginal bone, thus reducing the likelihood of bone resorption. So, decreased postoperative bleeding, less discomfort for the patient, shorter surgery time, and reduced healing time are reported advantages for the flapless procedure compared to that involving a flap (4, 5).

Since one-piece implants became more and more popular and no report is available on the effect of fixture diameter on clinical outcome we therefore decided to perform a retrospective study.

MATERIALS AND METHODS

A) Study design/sample

Key words: One-piece, implant, fixture, welding, bone, immediate loading.

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To address the research purpose, the investigators designed a retrospective cohort study. The study population was composed of patients at the Dental Clinic, University of Chieti, Italy for evaluation and implant treatment by S.F. between January and December 2010.

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, smoking more than 20 cigarettes/day, 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, distance between implants), implant (length and diameter), and prosthetic (welding procedure) variables.

Primary and secondary predictors of clinical outcome are used. The primary predictor is the presence/absence of the implant at the end of the observation period. It is defined as survival rate (i.e. SVR) that is the total number of implants still in place at the end of the follow-up period.

The second predictor of outcome is the peri-implant bone resorption. It 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 (6).

C) Data collection methods

Before surgery, radiographic examinations were done with the use of orthopantomographs and CT scans.

Peri-implant crestal bone levels were evaluated by the calibrated examination of 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' 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 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 100 mg Nimesulid twice daily for 3 days. Oral hygiene instructions were provided.

One-piece implants (Diamond, BIOIMPLANT, Milan, Italy) were inserted with a trans-mucosal approach. The implant neck was positioned at the alveolar crest level (fig. 1). Welding procedure was performed by using an intra-oral welding machine Dent Weld (Swiss & Wegman S.r.l., Ponte San Nicolò (PD) Italy). A provisional prosthesis was immediately provided and the final restoration was usually delivered within 8 weeks (fig. 2, 3). All patients were included in a strict hygiene recall.

E) Data analysis

Pearson Chi-Square test was used to detect if implant diameter has an impact both on failures (i.e. lost fixtures) and/or on success (i.e. crestal bone resorption around implants lower than 1.5 mm).

RESULTS

Nineteen patients (10 females and 9 males) with a median age of 62 years (min-max 43-80) have the inclusion criteria and were enrolled in the present study. The mean follow-up was 7 months.

A total of 176 one-piece implants (Diamond, BIOIMPLANT, Milan, Italy) were inserted, 83 in the maxilla and 93 in the mandible. Implants were inserted to replace 55 incisors, 32 cuspids, 53 premolars and 36 molars. Implant' length was shorter than 13 mm, equal to

Table I. *Distribution of the series by diameter and SVR (i.e. implants still in place at the end of the follow-up). p = 8.420*

DIAMETER	SVR		Total
	Valid	Failures	
Narrower than 4 mm	9	3	12
4 mm	91	6	97
Wider than 4 mm	65	2	67
Total	165	11	176

Table II. *Distribution of the series by diameter and SCR (i.e. peri-implant bone resorption). p = 3.664*

DIAMETER	SCR		Total
	Valid	Failures	
Narrower than 4 mm	8	1	9
4 mm	90	1	91
Wider than 4 mm	63	2	65
Total	161	4	165

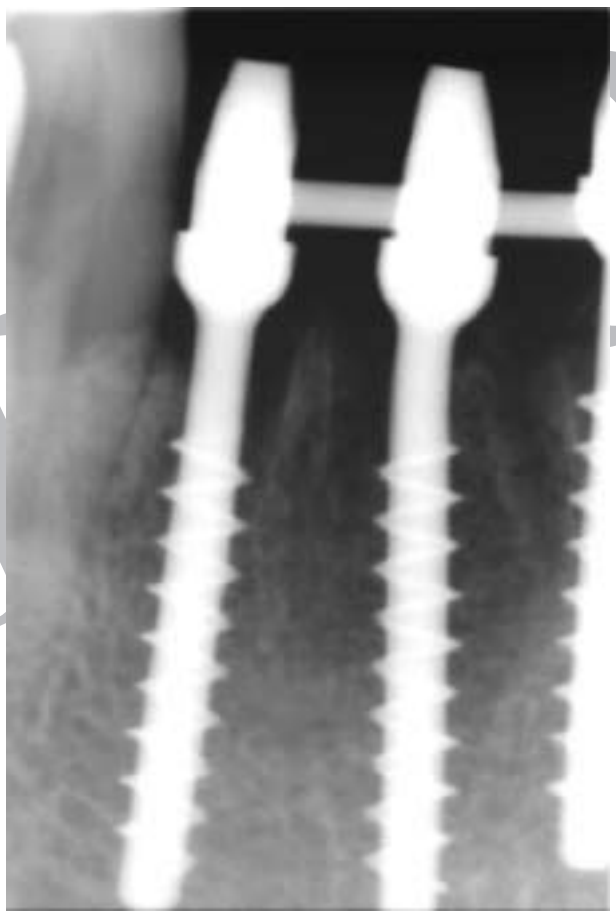

Fig. 1. *Intra-oral radiography showing fixtures.*

13 mm and longer than 13 mm in 40, 39 and 97 fixtures, respectively. Implant' diameter was narrower than 4 mm, equal to 4 mm and wider than 4 mm in 12, 97 and 67 fixtures, respectively. One hundred and thirty-eight implants were welded.

In 146 implants was calculated the distance between fixtures: the mean values was 3.9 ±1.8 mm (min/max 1.1/10 mm). Distance between fixtures was equal or narrower than 3 mm in 49 fixtures and wider than 3 mm the remaining 97 cases.

Peri-implant crestal bone resorption was recorded in 165 implants and has a mean values of -0.1 ± 0.7 mm (min/max -1.8/+2.1 mm). There was a bone regeneration around 65 implants (positive values).

Eleven implants were lost in the post-operative period (within 3 months), SVR = 93.75. Statistical analysis demonstrated that diameter has no direct impact on lost implants (Table I).

Then peri-implant bone resorption (i.e. delta IAJ) was used to investigate SCR in the remaining 165 implants. Four fixtures have a crestal bone resorption greater than 1.5 mm (SCR = 97.57) and thus were used for statistical purpose.

Pearson Chi-Square text demonstrated that implant diameter has not a direct impact on crestal bone resorption (Table II).

DISCUSSION

Narrow diameter implants (NDI) (i.e. diameter ‹ 3.75 mm) have specific indications. In fact, the choice of

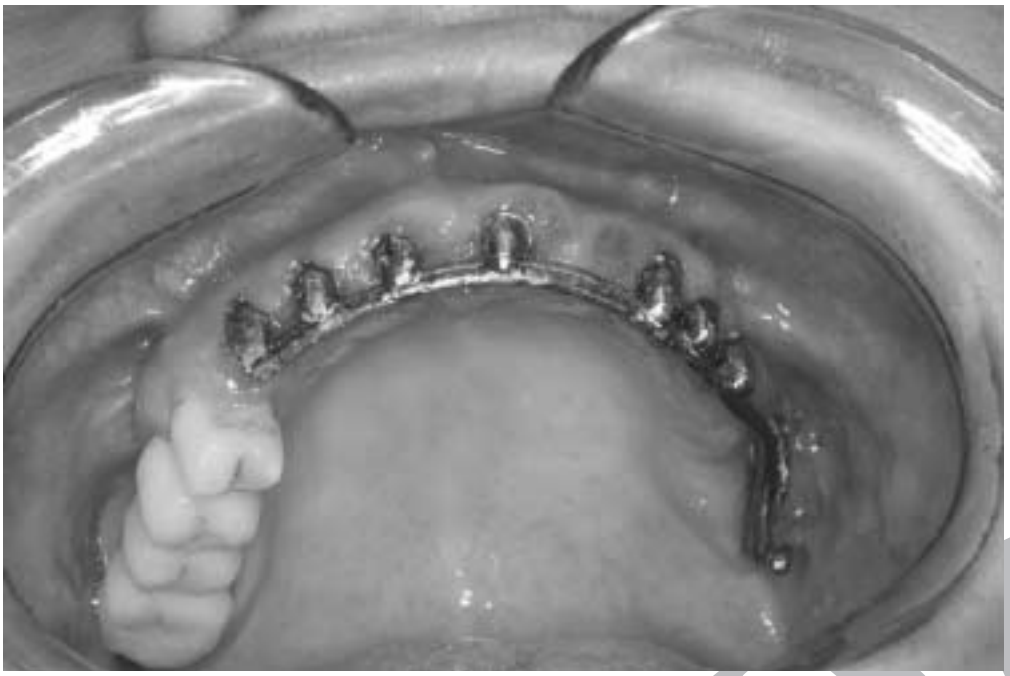

Fig. 2. *Implants welded together.*

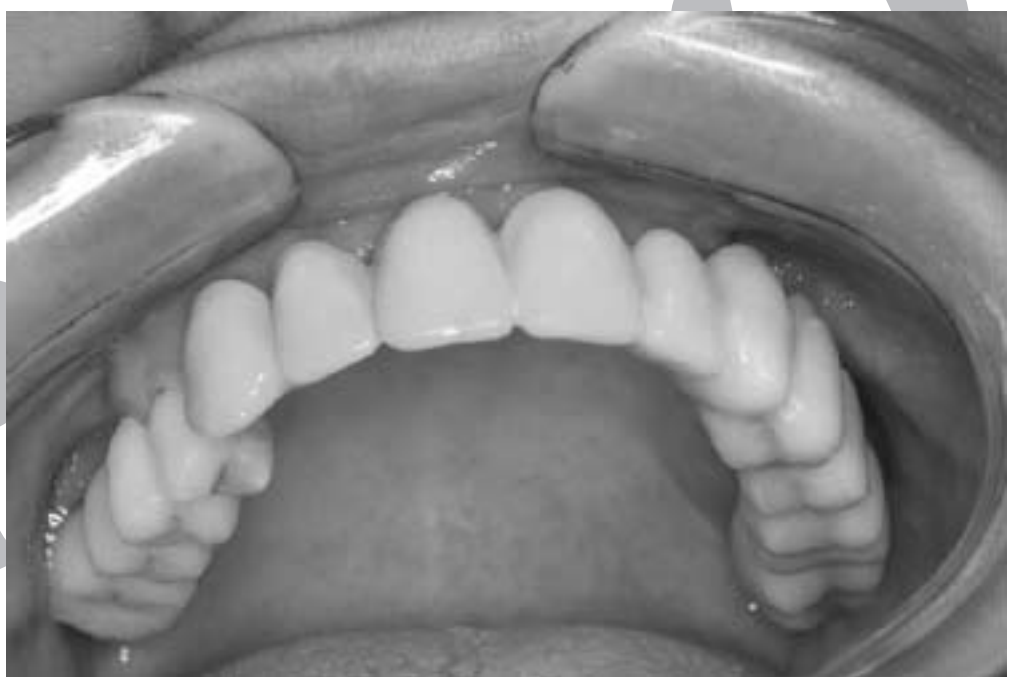

Fig. 3. *The final prosthetic restoration.*

implant diameter depends on the type of edentulism, the volume of the residual bone, the amount of space available for the prosthetic reconstruction, the emergence profile, and the type of occlusion. NDI are indicated where there is reduced inter-radicular bone or a thin alveolar crest, and for the replacement of teeth with small cervical diameter. In general, it seems that guidelines developed for surgical placements and prosthetic restoration of regular size implants (RDI) can be applied to NDI, but although NDI have been available since the nineties, few studies have

analyzed the clinical outcome of such implants (7-11). These reports show good medium and long-term results with two-stage surgical procedures (7-11).

In 2000, Vigolo and Givani presented a 5-year retrospective study on 52 mini-implants for single-tooth restorations (7). The NDI had a diameter ranging from 2.9 to 3.25 mm (3i/ Implant Innovation). Three implants were lost with a total SVR of 94.2%. In a subsequent report (10), Vigolo et al. studied 192 NDI for single-tooth or partial prostheses placed in 165 patients with a 7-year follow-up: the total implant SVR was 95.3%. Two-stage surgery was performed in both studies. The authors concluded that NDI have an SVR similar to those reported in previous studies of RDI and suggested that NDI can be successfully included in implant treatment.

Zinsli and coll. (9) reported on a total of 298 3.3-mm ITI implants inserted in 149 partially or completely edentulous patients evaluated over a 10-year period. After a standard healing period (3 to 6 months) the implants were restored with fixed restoration such as single crowns, fixed partial or complete prosthesis, or overdentures. Complete prostheses or overdentures in the edentulous jaw were the predominant types of restoration. The cumulative 5-year implant SVR was 98.7%; after 6 years, it was 96.6%. The authors concluded that: 1) the success of 3.3 mm ITI implants appeared to be predictable if clinical guidelines were followed and appropriate prosthetic restorations were provided; 2) failures of NDI were infrequent; 3) prosthetic complications were not dependent on the use of NDI. However fatigue fractures could occur after a long period of loading.

In 2005, Comfort et al. reported a 5-year prospective study on NDI (diameter = 3.3 mm) (11). Twenty-three implants were placed with an SVR of 96%.

Although the above mentioned studies reported a good clinical outcome, concerns may arise from the fact that reduced diameter means a reduction in the contact surface between the implant and the bone, and one might ask if, in this condition, osseointegration is sufficient to withstand the loading forces. Decreasing the diameter also means increasing the risk of implant fracture due to reduced mechanical stability, and increasing the risk of overload (7-11).

In implant dentistry, the use of RDI is generally recommended to ensure adequate bone to implant contact. Occasionally, the space available may be insufficient for the placement of RDI and, in these cases, an NDI can be an acceptable solution (8). NDI are used in areas where ridge dimension is narrow or space is limited. These conditions are frequently found in the maxilla, especially in situations where teeth are congenitally missing. Lack of sufficient space for an RDI is also common in the mandibular incisor, maxillary premolar and canine regions. Furthermore, the placement of NDI can be an alternative to bone augmentation surgery in patients with thin posterior mandibular ridges. Under these conditions, NDI have been successfully employed in delayed loading conditions (7-11).

Previously our group demonstrated that narrow (12) and wide (13) two-piece implants are reliable devices for oral rehabilitation.

Here we demonstrated that one-piece implants are reliable devices for oral rehabilitation (since they have a SVR = 93.75 and a SCR = 97.57) and implant diameter does not have statistically significant impact on implant failures and crestal bone resorption.

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