IMPACT OF ONE-PIECE IMPLANT LENGTH ON CLINICAL OUTCOME

S. FANALI[1], F. CARINCI[2], I. ZOLLINO[2], G. BRUNELLI[3], R. MONGUZZI[2]

[1]Department of Oral Science, Nano and Biotechnology, University "G. D'Annunzio", Chieti, Italy
[2]Department of D.M.C.C.C., Section of Maxillofacial and Plastic Surgery, University of Ferrara, Ferrara, Italy
[3]Department of Dentistry and Maxillofacial Surgery, Don Orione Institute, Bergamo, Italy

One-piece implants became incorporate the trans-mucosal abutment 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 length 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' length was shorter than 13 mm, equal to 13 mm and longer than 13 mm in 40, 39 and 97 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 length 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 length does not have statistically significant impact on implant failures and crestal bone resorption.

Primary stability was always considered fundamental in order to acquire osteointegration. To facilitate the immediate loading protocol, the implant stability at the time of placement is essential (1) and implant surface modifications have significant role in measuring the success of osteointegration (2) (3).

The original Brånemark concept of osteointegration (4) advocated a 2-stage surgical procedure. The implant was inserted into the bone after raising a soft tissue flap, which was subsequently repositioned to cover the implant during healing. Following a healing period, a second surgical intervention took place. A new flap was raised and a trans-mucosal abutment was screwed onto the implant to allow the prosthesis to be connected (5).

Today it has, however, been demonstrated that the 2-stage procedure with a submerged healing period may not be necessary. Implants can be placed with an immediate prosthetic loading protocol with high success rates without compromising osteointegration, provided occlusal loads are controlled and the implants are placed with primary stabilization (6). Moreover, immediate implant placement in extraction sites may preserve alveolar bone height and width and allow for optimal soft tissue aesthetics (5).

A 1-piece implant design, which incorporates the trans-mucosal abutment facing the soft tissues as an integral part of the implant, eliminates the structural weakness built into a 2-piece implant system. The interface between the trans-mucosal component and the implant is generally located in the neighbourhood of the alveolar bone level. However, in a one-piece implant the implant immediately pierces the soft tissue's barrier (non-submerged fashion) according to a one-stage surgery, when a two-piece implant system is submerged under the soft tissues for a waiting period (two-stage surgery) (7).

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

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

Corresponding author: Prof. Francesco Carinci, M.D
Department of D.M.C.C.C Section of Maxillofacial and Plastic Surgery University of Ferrara
Corso Giovecca 203, 44100 Ferrara ITALY
E-mail: crc@unife.it Web: www.carinci.org
Phone: +39.0532.455874
Fax: +39.0532.455876

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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 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 (8).

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) (fig 2 and 3). A provisional prosthesis was immediately provided and the final restoration was usually delivered within 8 weeks (fig 4). All patients were included in a strict hygiene recall.

E) Data analysis

Pearson Chi-Square test was used to detect if implant length 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 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

Table I. *Distribution of the series by length and SVR (i.e. implants still in place at the end of the follow-up). p = 1.923*

LENGTH	SVR		Total
	Valid	Failures	
Shorter than 13 mm	37	3	40
13 mm	35	4	39
Longer than 13 mm	93	4	97
Total	165	11	176

Table II. *Distribution of the series by length and SCR (i.e. peri-implant bone resorption). p = 1.134*

LENGTH	SCR		Total
	Valid	Failures	
Shorter than 13 mm	36	1	37
13 mm	35	0	35
Longer than 13 mm	90	3	93
Total	161	4	165

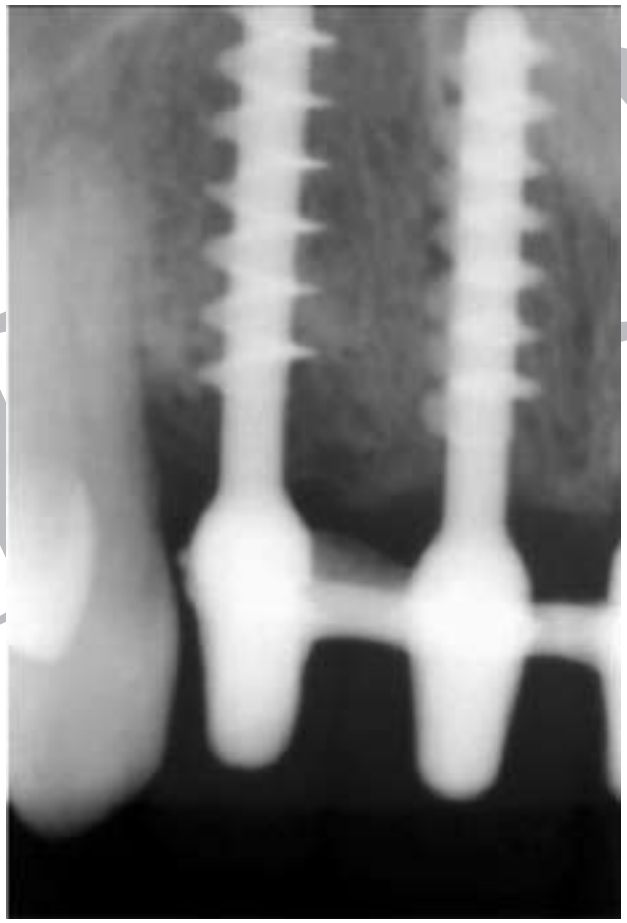

Fig.1. *Intra-oral radiograph*

around 65 implants (positive values).

Eleven implants were lost in the post-operative period (within 3 months), SVR = 93.75. Statistical analysis demonstrated that implant length has not a direct impact on lost fixtures (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 length has not a direct impact on crestal bone resorption (Table II).

DISCUSSION

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. length ≤ 10 mm) may be selected in these situations. They have several advantages: (1) it is possible to reduce the need for sophisticated and expensive surgical procedures like sinus lift, bone grafting, and mandibular nerve transposition; (2) it is possible to place short-span dentures; and (3) it is possible to avoid cantilevers in the posterior regions. However, the limited surface area of short implants can be a potential disadvantage as it has less resistance to occlusal forces. Because of the above-mentioned reasons, in the last decade several authors have focused their studies

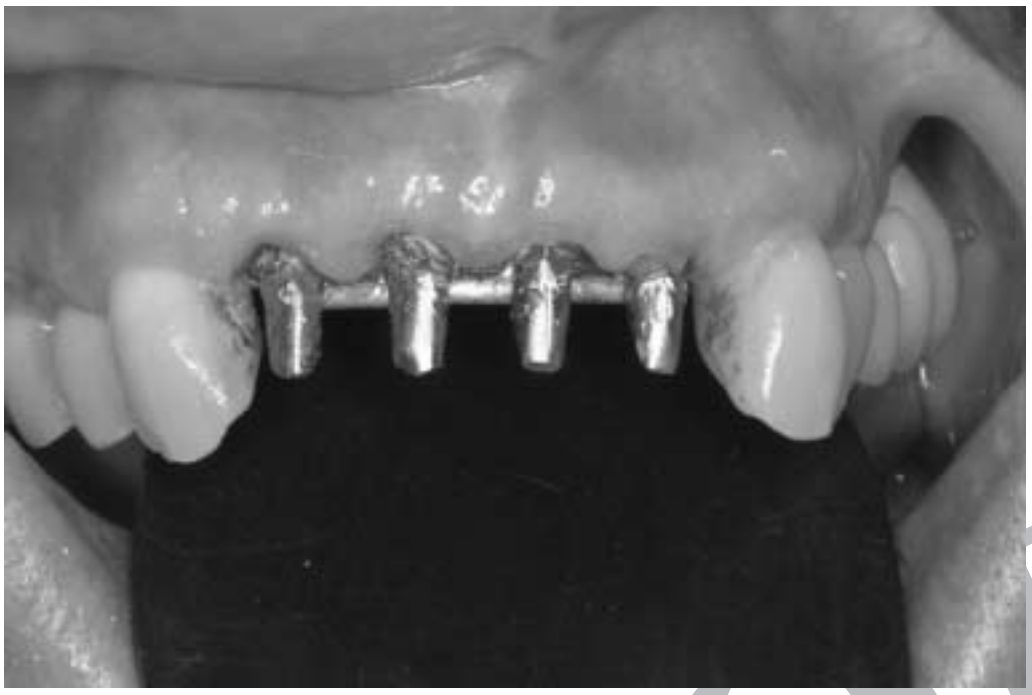

Fig.2. *Buccal view of implant welded together*

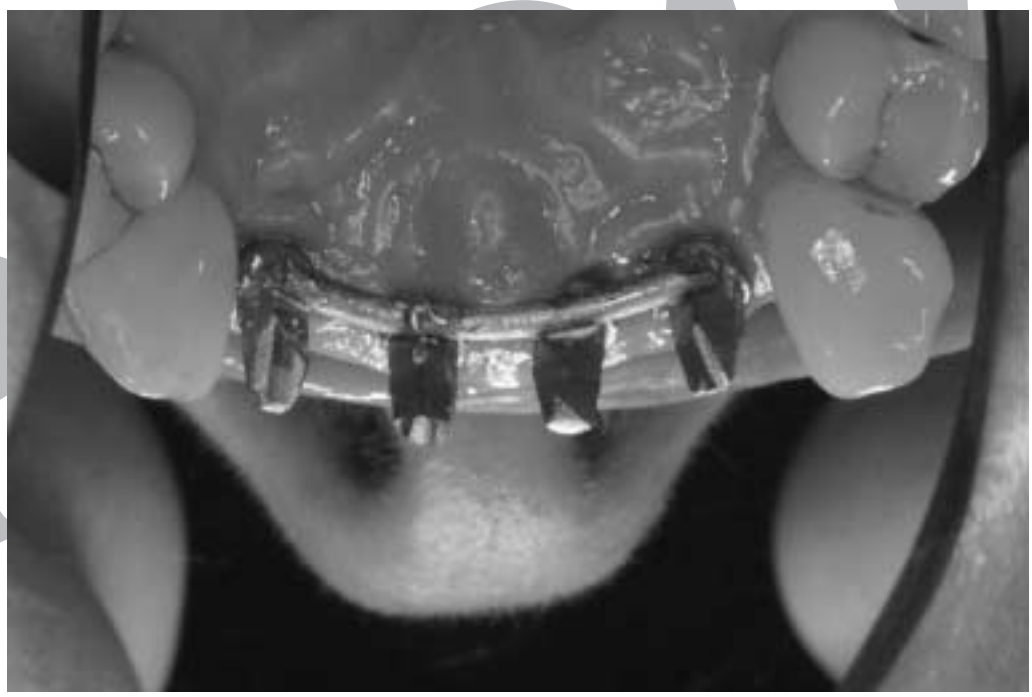

Fig.3. *Palatal view of welded fixtures*

on short implants, reporting good results on a medium-/long term period. In 1998 ten Bruggenkate et al. (9) performed a multicenter study on 253 short ITI implants (length = 6 mm). Seven implants (2.8%) were lost in a follow-up period ranging from 1 to 7 years. Friberg et al. (10) investigated the long-term outcome of patients

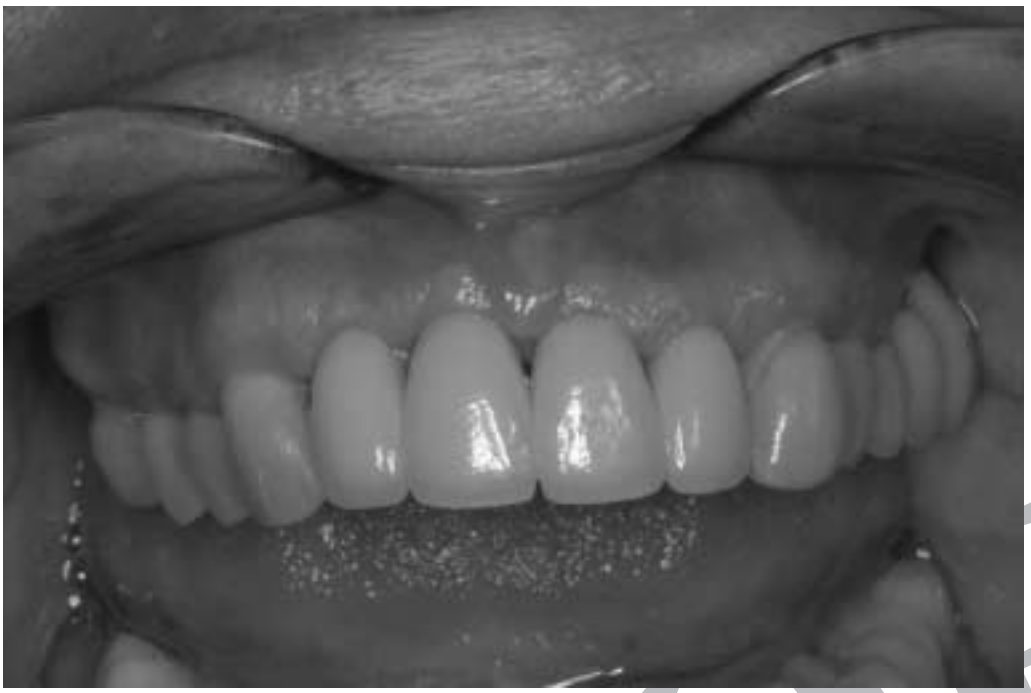

Fig.4. *The final prosthetic restoration*

with severely resorbed edentulous mandibles rehabilitated with short (6- to 7- mm) Brånemark implants. A total of 247 standard (7-mm-long, 3.75-mm-wide) and 13 wide (6-mm-long, 5-mm-wide) implants were inserted. The patients were followed for a mean of 8 years. Seventeen implants failed during the study period with a cumulative implant survival rate of 95.5% at the 5-year follow-up and 92.3% at the 10-year follow-up.

In 2005 Goene et al. (11) analyzed 311 short (i.e. 7- and 8.5-mm) Osseotite implants in a retrospective multicenter study. During 3 years of follow-up, 13 implants failed, yielding a cumulative success rate of 95.8%. The same year Renouard and Nisand (12) reported a retrospective study on the survival rates of 6- to 8.5-mm-long implants in the severely resorbed maxilla. The study included 96 short (6- to 8.5-mm) Brånemark implants. A one-stage surgical protocol with delayed loading was used. The patients were followed for at least 2 years after loading. Five implants were lost during the first 9 months, and four implants were lost later in the follow-up. The cumulative survival rate was 94.6%. Rokni et al. (13) compared short (i.e. 5- or 7-mm) and "long" (i.e. 9- or 12-mm) sintered porous-surfaced dental implants. One hundred ninety-nine implants were analyzed. It was found that "long" implants had greater crestal bone loss (0.2 mm more) than short porous-surfaced implants.

das Neves et al. (14) performed a Medlinedatabase meta-analysis on short implants. They included implants 10 mm long or shorter. The studies included 16,344 implants with 786 failures (4.8%). Implants 3.75 mm wide and 7 mm long failed at a rate of 9.7%, compared to 6.3% for 3.75 3 10-mm implants. The analysis revealed that among the risk factors, [redacted] bone quality in association with short implants was relevant to implant failure. Instead, the use of implants 4 mm in diameter minimized failure in these situations.

Previously our group demonstrated that standard (15), short (16) and long (17) 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 length does not have statistically significant impact on implant failures and crestal bone resorption.

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