Implants Inserted with Low Insertion Torque Values for Intraoral Welded Full-Arch Prosthesis: 1-Year Follow-Up

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ABSTRACT

Objectives: The aim of the present study is to evaluate the osteointegration and crestal bone remodeling after 1 year around implants for intraoral welded immediate full-arch prosthesis inserted with low insertion torque (IT) values.

Material and Methods: The study was conducted from June 2008 to September 2010. Patients were eligible for the study if they needed an immediate intraoral welded implant-supported full-arch fixed prosthesis and received three or more implants with an IT ≤20 Ncm and two or more implants with IT ≥25 and ≤50. For each implant, peak IT was recorded during insertion surgery; periapical x-rays were taken at the time of surgery and again after 12 months. Finally, it was recorded whether an implant was lost or removed (within 12 months from insertion surgery).

Results: Thirteen patients were included in the study; the prosthesis presented the following number of implants: nine with six implants and four with seven implants. A totand al of 82 implants were inserted: 51 implants presented an IT ≤20 Ncm (test group), 31 implants presented an IT ≥25 and ≤50 Ncm (control group). Each prosthesis presented at least three test implants and two control implants. The survival rate after 1 year was 98% for the test and 100% for the control group. The mean distance between the fixture-abutment junction and the bone crest was 0.1 ± 0.8 mm for test and 0.2 ± 0.5 mm for control group at implant insertion. After 12 months, it was 0.7 ± 0.9 mm for test group and 0.8 ± 0.6 mm for control group. The differences were not statistically significant.

Conclusions: Within the limitations of this study, the results suggested that rigid framework splinting can be a viable technique to improve success rate of implants with low primary stability using immediate loading protocols for full-arch prosthesis.

KEY WORDS: immediate loading, insertion torque, intraoral welding, primary stability

INTRODUCTION

The evolution of implant dentistry brought an increasing interest in immediate loading and esthetic replacement of missing teeth. In the traditional protocols, the osteointegration of implants was obtained before the exposition to occlusal forces.[1] More recent protocols reduce healing period and, in the case of immediate loading for a full-arch replacement, expose immediately the implants to occlusal and muscular forces. The exposition to these mechanical stresses before biological integration may lead to the implant micromovements and finally to an early implant failure.[2,3] In order to avoid this kind of complication, the achievement of high primary stability was often suggested, in particular inserting implants with a high insertion torque (IT).[4,5] As a consequence, modified drilling guidelines to undersize the preparation and new implant designs were introduced for the improvement of primary stability. Nevertheless, it is still quite common to insert implants with low IT values, especially in the presence of poor bone quality:[6] in these cases, different authors suggested to splint several implants together, ensuring the control of micromovements.[7–9] Degidi and colleagues recently published several papers to describe the intraoral welded bar technique that seems to offer a solution for the stabilization of the implants placed with low IT values.[10–12]

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The aim of the present study is to evaluate the osteointegration and crestal bone remodeling after 1 year around implants for intraoral welded immediate full-arch prosthesis inserted with low IT values.

MATERIALS AND METHODS

The study was conducted from June 2008 to September 2010 at a private practice in Bologna (Italy). Patients were eligible for the study if they needed an immediate implant-supported full-arch fixed prosthesis and if they fulfilled the following inclusion criteria: no need for bone augmentation procedures prior to implant placement; minimum bone width and height necessary to insert an implant with at least 11 mm of length and 3.4 mm of diameter; three or more implants with an IT ≤20 Ncm and two or more implants with IT ≥25 and ≤50 Ncm; good oral hygiene. Exclusion criteria were as follows: a high degree of bruxism; smoking more than 20 cigarettes per day and excessive consumption of alcohol; localized radiation therapy of the oral cavity; antitumor chemotherapy; liver pathologies; hematic nephropathies; immunosupressed patients; patients taking corticosteroids; pregnant women; inflammatory and autoimmunity diseases of the oral cavity.

The implants used were XiVE implants (Dentsply Friadent, Mannheim, Germany): these implants are based on a cylindrical core with a self-tapping thread; the thread depth increases from the crestal region to the apex, with the thread pitch remaining equal; the external diameter remains constant.

The surgical procedure was the following: antimicrobial prophylaxis was obtained with 500 mg of amoxicillin twice daily for 5 days starting 1 hour before surgery. Local anesthesia was induced by infiltration with articaine/epinephrine. After a crestal incision, a mucoperiosteal flap was elevated. All the implants were inserted in healed sites by a single oral surgeon according to a strict protocol following the manufacturer's instructions.

For each implant, peak IT was recorded by means of an electronic instrument (FRIOS Unit E, W&H Dentalwerk GmbH, Buermoos, Austria) during low-speed insertion.

After the insertion of the implants, first multipurpose and then welding abutments (Dentsply Fiadent, Mannheim, Germany) were connected; a 2-mm diameter titanium bar was then shaped following the line of the implants inserted and welded to the abutments in the oral cavity by means of an intraoral welding unit (Aptiva NS1100, EnneServizi, Lusiana, Vicenza, Italy): when necessary, an additional 1.5-mm titanium bar was welded to increase mechanical retention.

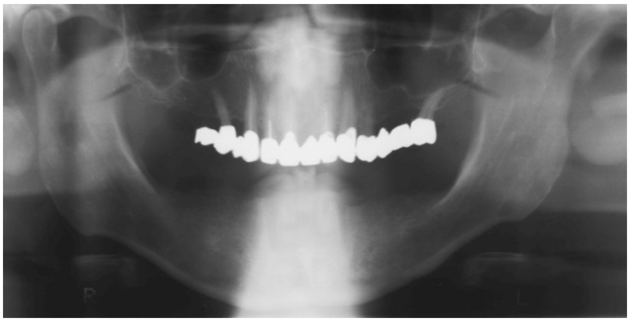

Figure 1 Presurgery OPG (orthopantomography).

The metallic framework was removed, sandblasted and opaqued; then the framework was embedded in the temporary acrylic cross arch restoration hollowed in advance for this purpose. The restoration was relined, trimmed, and polished.

Finally, the temporary prosthesis was connected to the abutments by fastening titanium retaining screws. The soft tissues were positioned around the abutments and sutured into place. Screw holes were filled by light-cured composite resin. The prostheses were designed in a light centric occlusion. The procedure is illustrated in Figures 1–12.

Postsurgical analgesic treatment was performed using 100 mg of nimesulid twice daily for 3 days. Oral hygiene instructions were provided. The sutures were removed 14 days after surgery. Patients had a soft diet for 4 weeks after surgery.

After 6 months, the temporary prostheses were substituted by definitive ones. Periapical x-rays were taken at the time of surgery and after 12 months.

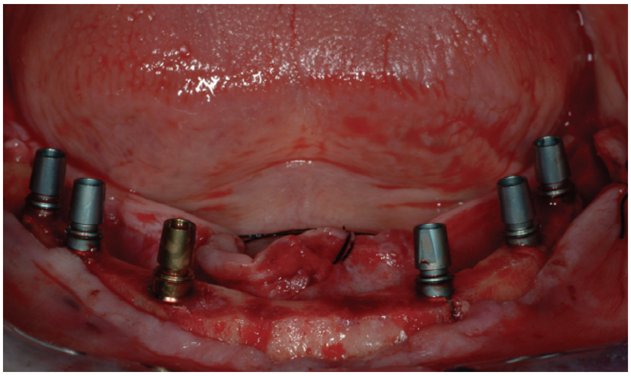

Figure 2 Six implants are placed in position.

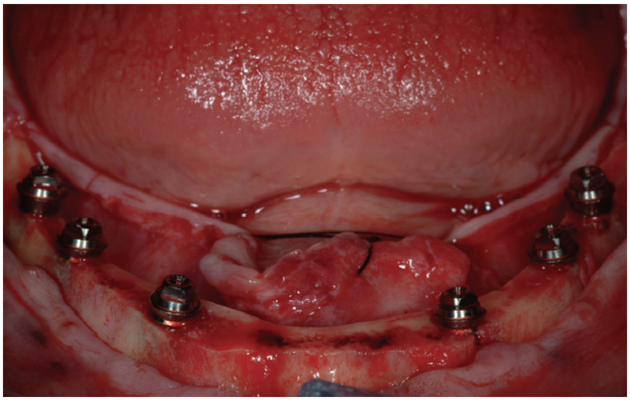

Figure 3 Multi-purpose abutments connected to the implants.

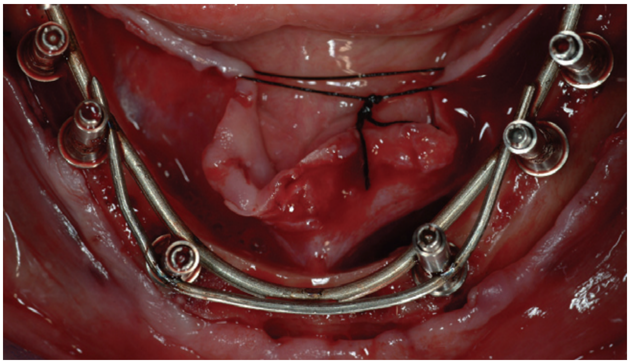

Figure 6 Intraorally welded framework, primary and secondary bars.

For each implant, peri-implant crestal bone level was evaluated by calibrated examination of periapical x-rays. Measurements were recorded after surgery and after a 12-month time period. The measurements were carried out mesially and distally to each implant, calculating the distance between the edge of the implant 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. A peak Scale Loupe (GWJ Company, Hacienda Heights, CA, USA) with a magnifying factor of seven times and a scale graduated in 0.1 mm was used.

Finally, it was recorded whether an implant was lost or removed (within 12 months from insertion surgery).

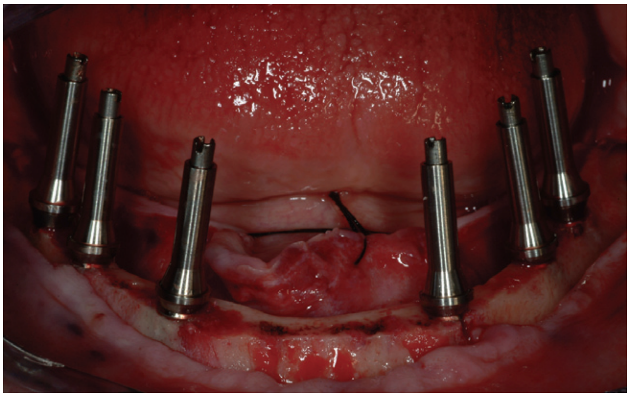

Figure 4 Welding abutments in position.

Figure 7 The titanium framework immediately after retrieval.

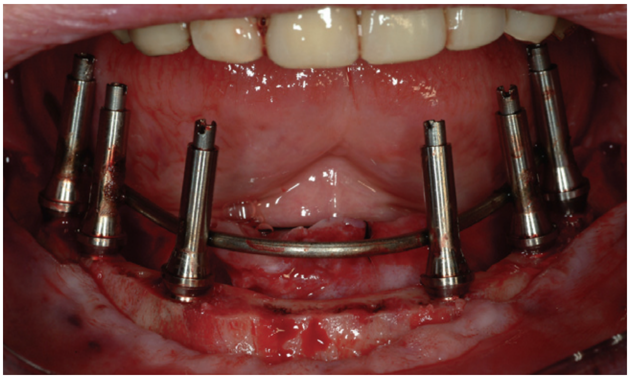

Figure 5 Intraorally welded framework, primary bar.

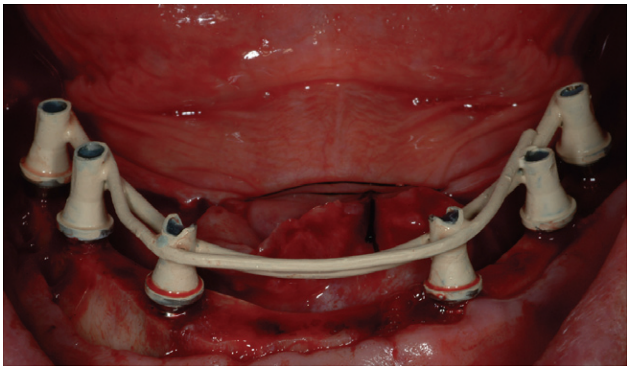

Figure 8 Opaqued framework repositioned in the oral cavity.

Figure 9 Trimmed and polished restoration.

Figure 11 Screw-retained restoration, frontal view.

Implants were considered failed and thus removed according to the clinical criteria of mobility, pain, and gingival inflammation.

The protocol was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2000. The subjects provided informed consent to participate in the study.

STATISTICAL ANALYSES

After a descriptive data analysis, Kolmogorov–Smirnov test was used to test the distributive normality. Mann–Whitney test was used to compare mean values. Spearman tests and eta squared index were used to explore possible association between the studied variables. A further analysis with chi-squared test was performed to investigate the significance of the differences between the variables studied. A p value <0.05 was considered significant.

RESULTS

Altogether, 13 patients (four males, nine females, age ranging from 42 to 81) were included in the study; the prostheses presented the following number of implants: nine prostheses with six implants and four prostheses with seven implants. For the 13 prostheses, a total of 82 implants were inserted: 51 implants presented an IT ≤20 Ncm (test group); 31 implants showed an IT ≥25 and ≤50 Ncm (control group). Each prosthesis presented at least three test implants and two control implants.

The implants were distributed as follows: in the test group, seven in the anterior maxilla, 37 in the posterior maxilla, and seven in the posterior mandible; in the control group, three in the anterior maxilla, 14 in the posterior maxilla, and 14 in the posterior mandible. The exact position of implants with low IT is presented in Table 1.

Diameter and length of the implants used are shown in Tables 2 and 3.

The situation of antagonistic dentition was as follows: four natural teeth dentition, four full-arch prostheses supported by natural teeth, three overdentures supported by four implants connected with a bar, and two full-arch prostheses supported by implants.

Figure 10 Screw-retained restoration, occlusal view.

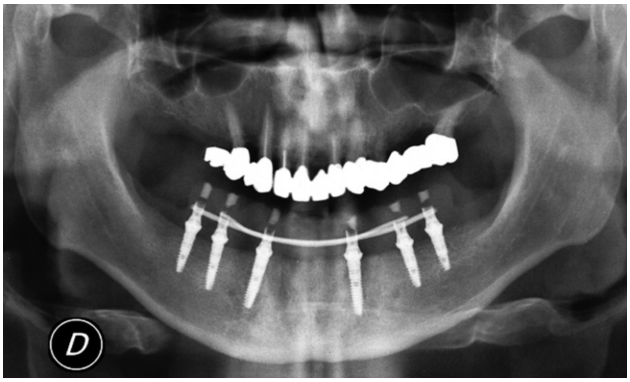

Figure 12 Final OPG (orthopantomography).

TABLE 1 Position of Implants with Low Insertion Torque

17	16	15	14	13	12	11	21	22	23	24	25	26	27
3*	10	6	—	1	1	1	1	1	2	—	7	9	2
—	2	—	1	—	—	—	—	—	—	1	—	2	1
47	46	45	44	43	42	41	31	32	33	34	35	36	37

*Position of the failed implant.

TABLE 3 Length of the Implants Used in Test and Control Groups

Length	Test Group	Control Group
11	11	6
13	9	4
15	21	16
18	10	5

Temporary prosthesis did not present any complication, excluding small chipping of the acrylic.

The survival rate after 1 year of follow-up was 98% for the test group, as one implant failed and was removed before definitive restoration delivery; all implants in the control group were successfully osteointegrated. The difference was not statistically significant.

The mean IT in the test group was 12.6 ± 3.6. In the control group, the mean IT was 35.4 ± 7.3.

The mean distance between the fixture/abutment junction and the bone crest was 0.1 ± 0.8 mm for test group and 0.2 ± 0.5 mm for control group at implant insertion. After 12 months, it was 0.7 ± 0.9 mm for test group and 0.8 ± 0.6 mm for the control group. The mean bone loss was thus calculated as 0.6 ± 1 mm in the test group and 0.5 ± 0.8 mm for the control group. The difference was not statistically significant.

DISCUSSION

Primary stability was always considered fundamental in order to acquire osteointegration, and recently it is even more important for immediate loading protocols; the reliability of this technique was demonstrated by a good number of papers, but the stiffness of the bone/implant/crown system has to be assured.[13] A common technique for evaluating primary stability is the recording of IT on the surgical drill unit; several authors indicated the minimal amount of IT to obtain good survival rate when using immediate loading protocol: in his paper about single-tooth replacement, Wöhrle[4] indicated a minimum of 45 Ncm as inclusion criteria for immediate loading. In another paper about single tooth immediate restoration, Hui and colleagues[14] reported very good results (95.6% of success rate after 1-year follow-up) for implants inserted with an IT range of 40 to 50 Ncm. Finally, for similar clinical situations, Norton[15] indicated 25 Ncm as IT threshold.

In a more recent paper on bovine bone, Trisi and colleagues[5] demonstrated that in increasing peak IT up to over 70 Ncm, the level of implant micromotion induced by lateral forces was reduced; similar conclusions were presented by Ottoni and colleagues in a clinical study where an increase in the peak IT significantly improved the clinical success rate of immediately loaded implants.[16] Calandriello and colleagues[17] described the following IT threshold to obtain good results with immediate loading protocols: 60 Ncm for single implants, 45 Ncm for partial restorations; and 32 Ncm for full-arch restorations.

Recommendations from all the cited studies seem to suggest that, whenever immediate loading has to be performed on single implants, IT values have to be generally high; on the other hand, partial and full-arch immediate restorations can be performed with lower IT threshold, thanks to the implant splinting provided by the provisional prosthesis.

The present study shows the results after 1-year follow-up of implants inserted with low IT values (mean IT of 12.6 Ncm), but splinted together with other implants which presented good values of the same parameter (mean IT of 35.4 Ncm). The success rate and the crestal bone remodeling were very similar between test and control groups without statistically significant differences, showing that even implants without good primary stability can achieve and maintain osteointegration with an immediate loading protocol when splinted to implants with good IT values. A similar

TABLE 2 Diameter of the Implants Used in Test and Control Groups

Diameter	Test Group	Control Group
3.4	30	24
3.8	10	7
4.5	9	1
5.5	1	—

result is reported for one single implant with an insertion torque of 15 Ncm splinted to more stable implants in the already cited paper of Calandriello and colleagues.[17]

Implant splinting with a rigid framework in immediate load protocols was already recommended by different authors[7,8,18,19] to limit micromovement and minimize the risk of early implant failure; nevertheless, in their paper, Nikellis and colleagues consider the threshold of 32 Ncm for the implants inserted to be sufficient to use a provisional restoration without a rigid metal reinforcement. The other cited papers do not report IT values or IT thresholds for the implants inserted. The results of the present study seem to suggest that rigid framework splinting, in this case obtained by the intraoral welded technique, can limit the micromovements in immediate loading protocols at least for full-arch prosthesis. In fact, this "primary stabilization" seems to reduce micromovements of weaker implants, increasing the success of their osteointegration; the reason for this can be found in a reduction of the effect of the lateral forces and in a better distribution of the occlusal load, which in full-arch prosthesis cannot be eliminated. Furthermore, the passive fit of this kind of metallic framework, which is welded directly on the provisional abutments connected to the implants, can be another important reason of the good results reported for the implants with low IT values.[9] The present paper shows results obtained with full-arch prosthesis supported by six or seven implants; further studies evaluating full-arch prosthesis supported by five or even four implants presenting one or more implants inserted with low IT would be of great interest.

CONCLUSIONS

Within the limitations of this study, the results suggested that rigid framework splinting can be a viable technique to improve success rate of implants with low primary stability using immediate loading protocols for full-arch prosthesis; nevertheless, prospective long-term studies are necessary to confirm these results.

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