A Six-Year Follow-up of Full-Arch Immediate Restorations Fabricated With an Intraoral Welding Technique

Marco Degidi, MD, DDS,* Diego Nardi, DDS,† and Adriano Piattelli, MD, DDS‡

Purpose: *The aim of this study was to evaluate the 6-year effectiveness of maxillary and mandibular full-arch immediately loaded prostheses fabricated using an intraoral welding technique.*

Methods: *All patients received the same day of surgery a fixed, full-arch prosthesis supported by an intraorally welded titanium framework created directly in the patient's mouth using a titanium bar. Life table analysis of implant survival, complications, and any other adverse events were recorded at yearly follow-up for a period of 6 years.*

Results: *One hundred twenty-four (86.11%) of 144 implants placed in maxillary cases and 87 (77.68%) of 112 implants placed in mandible cases completed the planned 6-year follow-up. At the 72-month follow-up, the accumulated mean marginal bone loss was, respectively, 1.39 mm (SD = 0.67) for the implants placed in the maxilla (n = 124) and 1.29 mm (SD = 0.71) for the implants placed in the mandible (n = 87). Fracturing of the composite resin superstructure was the most common adverse event.*

Conclusions: *After a 6-year follow-up period, the intraoral welding technique proved to be a predictable technique for successfully rehabilitating the fully edentulous patient with a fixed and immediate prosthesis. (Implant Dent 2013;22:224–231)*

Key Words: intraoral welding, immediate loading

Mondani and Mondani[1] were the first to introduce a time-effective technique for intraorally welding titanium implants and components to create a fixed prosthesis without the need for lengthy laboratory procedures. Hruska[2] further developed this concept and, in 2002, he published a clinical report regarding the immediate loading of 1301 implants, of which 436 were used to support partial or full-arch temporary prostheses that were relined over an intraorally welded framework.[3] The failure of 3 (0.7%) of these implants was reported in this article: 1 failed after 1 year of loading because its neck fractured, and 2 failed between the second and the third year after surgery because of periimplantitis. The authors noted that in cases involving extended reconstructions, intraoral welding had the advantage of simplifying the application of the fixed temporary prosthesis by overcoming the problem of abutment disparallelism. Furthermore, the welded framework acted as a mesostructure and reduced the risk of fracture or partial luting failure of the temporary prosthesis.

*Private Practice, Bologna, Italy.
†Private Practice, Bologna, Italy.
‡Full Professor, Department of Medical, Oral, and Biotechnological Sciences, University of Chieti-Pescara, Chieti, Italy.

Reprint requests and correspondence to: Adriano Piattelli, MD, DDS, Dental School, University of Chieti-Pescara, Via F. Sciucchi 63, 66100 Chieti, Italy, Phone: +39 0871 3554083, Fax: +39-0871-3554076, E-mail: apiattelli@unich.it

ISSN 1056-6163/13/02203-224
Implant Dentistry
Volume 22 • Number 3

DOI: 10.1097/ID.0b013e31829261ed

More than 20 years after the article by Mondani and Mondani,[1] Degidi et al[4] published a protocol for the immediate loading of multiple implants using a premanufactured titanium bar welded to implant abutments directly in the oral cavity to create a customized metal-reinforced provisional prosthesis. All the 192 rigidly temporized immediately loaded implants osseointegrated and an implant success rate of 100% was achieved over a postplacement period of 6 months. No fracture or luting cement failure of the provisional restoration occurred during the observation period. A finite element analysis of the provisional prostheses resulted in a significant reduction in deformation and strain within the metal-reinforced restoration in comparison with the ordinary nonreinforced acrylic restoration. The intraoral welding technique subsequently proved to be a highly successful option in the rehabilitation of the edentulous mandible with a fixed final restoration delivered on the same day as implant placement, using both butt-joint[5] and tapered[6] connection implants. The same positive outcomes were reported for the rehabilitation of the edentulous maxilla[7] and in cases involving partial posterior mandibular edentulism, using

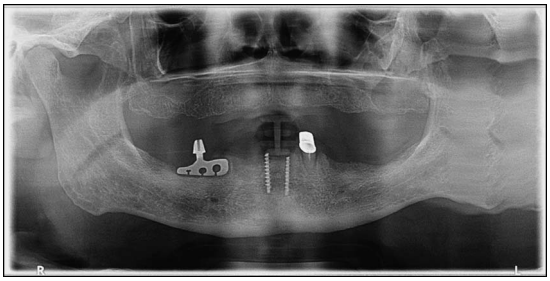

Fig. 1. Panoramic X-ray before surgery.

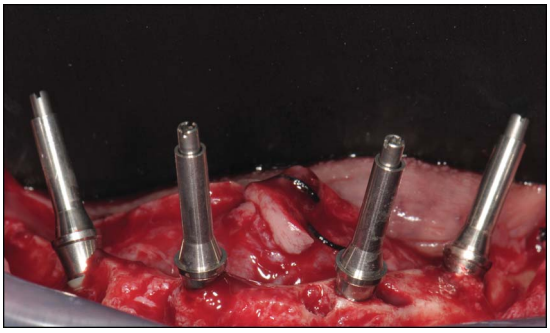

Fig. 2. Four implants with the welding abutments in place.

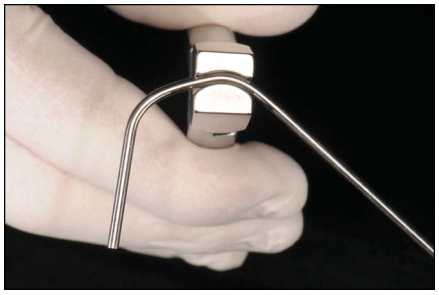

Fig. 3. Bar shaping with the purpose designed instrument.

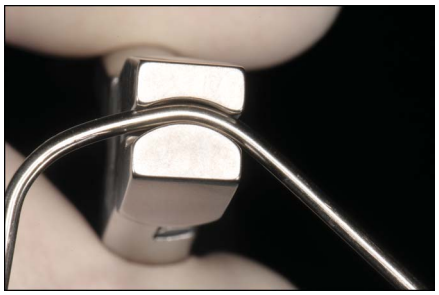

Fig. 4. Greater magnification of the instrument tip.

both immediately loaded and immediately restored implants.[8] Recently, Avvanzo et al[9] reported the immediate provisionalization of 48 dental implants placed in augmented sites and stabilized with an intraorally welded framework in a retrospective case series. Hruska et al[3] provided the longest follow-up available for the intraoral welding technique using blade-form titanium implants (Linkow, Oratronics, Hruska, and SteriOss), and root-form titanium implants (Garbaccio, Hruska, Pasqualini, SteriOss without hex-lock, and SteriOss with hexlock). To the best of the authors' knowledge, the longest available follow-up on implants in literature is 3 years for both partial[8] and full prostheses.[10]

The aim of this study was to evaluate the 6-year effectiveness of maxillary and mandibular full-arch immediate restorations fabricated using the intraoral welding technique.

MATERIALS AND METHODS

This prospective study involved patients with complete mandibular or maxillary edentulism with an age of 18 years or older. This study was designed and conducted in full accordance with the World Medical Association Declaration of Helsinki, as revised in 2002. All patients signed a specific written informed consent form. Patients were not accepted into the study if any of the following exclusion criteria were met: (1) active infection in the sites intended for implant placement; (2) systemic disease that could compromise osseointegration; (3) treatment with radiation therapy in the craniofacial region within the previous 12 months; (4) pregnancy or lactation; (5) bruxism; (6) unsuitable bone quantity in the surgery site or need of bone augmentation procedures before implant placement. All implants were placed in healed sites by a single experienced surgeon in a private dental office in Bologna, Italy. All patients were treated using 3.4- or 3.8-mm parallel screw, grit-blasted and acid-etched implants with an internal hexagonal connection (XiVE Plus; DENTSPLY-Friadent, Mannheim, Germany).

During the implant placement procedure, the insertion torque and the implant stability quotient (ISQ) were recorded using a surgical unit (FRIOS Unit E; W&H Dentalwerk GmbH, Buermoos, Austria) and a digital measurement probe (Osstell AB, Gamlestadsvägen 3B, Göteborg, Sweden). Patients were dropped from the study if any of the implants met one of the following exclusion criteria: (1) insertion torque <25 N·cm, (2) an ISQ of <60.

Preoperative analysis of anatomical features was performed using digital panoramic radiography. Impressions were made of the maxilla and mandible, and laboratory casts were made. The shades and prosthetic teeth molds were selected. The appropriate number of commercial highly wear-resistant composite denture teeth was chosen (Visio.lign; Bredent GmbH, Senden, Germany), and they were arranged on a cast mounted on a semiadjustable articulator and then joined with heat-polymerized resin. Antimicrobial prophylaxis was obtained with the use of 500 mg of beta-lactam antibiotics (Amoxicillin; Pfizer Manufacturing, Puurs, Belgium), twice daily for 5 days, starting 1 hour before surgery. All patients received detailed oral hygiene instructions. Local anesthesia (2% articaine/adrenaline

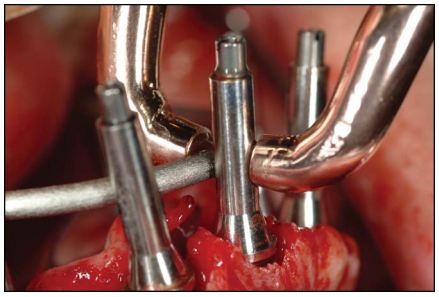

Fig. 5. Pressure applied with the clamp during the spot welding.

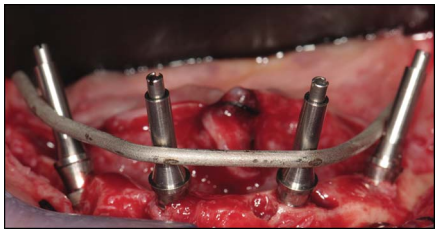

Fig. 6. The bar is welded to each abutment.

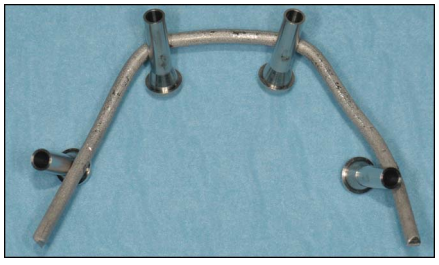

Fig. 7. The framework is removed.

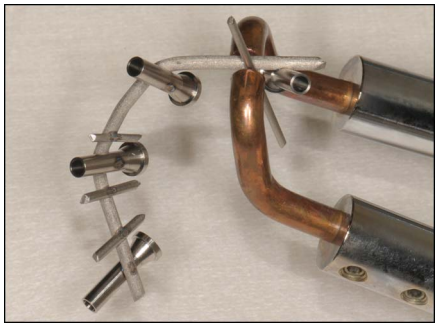

Fig. 8. Extraorally, the framework is reinforced and retentions are added.

1:100,000) was administered at the time of surgery. Surgery began with a midcrestal incision, a full-thickness flap was elevated, and in cases involving a knife-edge ridge, a mild osteoplasty of the ridge was performed under profuse irrigation with sterile saline solution. Depending on the site of surgery, sensitive anatomical features, such as the mental foramina, were located and secured. All implants were placed without the use of any surgical template, with the 0.4-mm polished collar above the healed alveolar crest. Implants with lengths from 11.0 to 15.0 mm were used. Bone density was recorded after the insertion of each implant using the Lekholm and Zarb classification.[11] No bone grafting material was used. The internal hexagonal connection of the implant was replaced by an abutment with an external circular and conic connection (MP; DENTSPLY-Friadent) to compensate for any possible lack of parallelism between the implants. These abutments were connected to the implants by fastening screws with 24 N·cm torque. A welding abutment (Passive Fit; DENTSPLY-Friadent) was then connected to each abutment with a long pin screw. Two-part abutments were used (abutment and retaining screw), so as to guarantee that the welded framework could be recovered after welding. A 2.0-mm-diameter bar (Bio-Micron s.a.s., Limbiate, Milano, Italy) made of commercially pure titanium (grade 2) was welded to the first abutment using the intraoral welding protocol.[4] The welding process is subdivided into 3 stages: preparation, welding, and cooling.

Preparation Stage

The 2 electrodes of the welding pincers are placed on either side of the bar and the abutment, both of which must be clean and free of any surface oxidation. The copper electrodes at the extremity of the pincers are gently put in contact with the parts to be welded and firm pressure is then applied. It is crucial to have complete contact between the curved bar and the welding abutment during the entire process. Firm and constant pressure must be applied to ensure a perfect joint between the parts to be welded. The presence of water or saliva does not compromise the quality of the welded joint. The surgical team and the patient must wear protective goggles during the whole process.

Welding Stage

An electrical charge from a previously unloaded capacitor is transferred to the copper electrodes of the welding pincers. Electrical current supplied to the electrodes instantly raises the temperature of the 2 titanium components to fusion point. The process takes only 2 to 5 ms to carry out and brings the core of the titanium parts to a temperature of nearly 1660°C. A barely perceptible clicking sound can be heard during this phase. Welding is performed without the use of filler metal.

Cooling Stage

Thanks to the different thermal conductivity of the titanium parts (19) and copper electrodes (386), the process is carried out without any discomfort whatsoever to the patient or damage to the surrounding tissue, as no heat is transmitted to the peri-implant area. The copper electrodes dissipate all the heat that is generated. During this stage, the titanium crystallizes and therefore the bar and the abutment must be kept under firm pressure.

The framework created by welding the titanium bar to the implant abutments was removed and the passivity of the whole structure was checked using the Sheffield 1 screw test. The framework was then sandblasted (Modulars 3; Silfradent, S. Sofia, Forli-Cesena, Italy) and opaqued (OVS 2 Opaker; Dentsply Trubyte, York, PA) to avoid metal light reflection through the acrylic resin. The soft tissue was positioned around the abutments and sutured into place. The opaqued framework was repositioned in the oral cavity and the hollowed restoration was relined over the titanium framework with a small quantity of cold-cured acrylic. The correct vertical length was checked and established using facial reference marks recorded before surgery. The restoration was then removed from the oral cavity and completely filled with heated pressure-processed acrylic. The restoration was trimmed, polished, and screw-retained the same day; the screws were inserted with 15 N·cm torque. Screw holes were closed with light-cured

Fig. 9. The framework is completed.

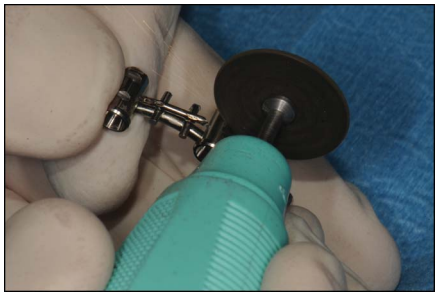

Fig. 10. Metal parts in excess are removed.

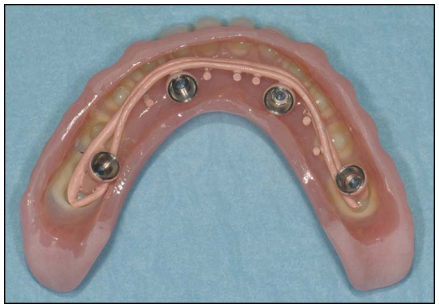

Fig. 11. The final framework is opaqued and the fitting is checked in the premanufactured hollowed restoration.

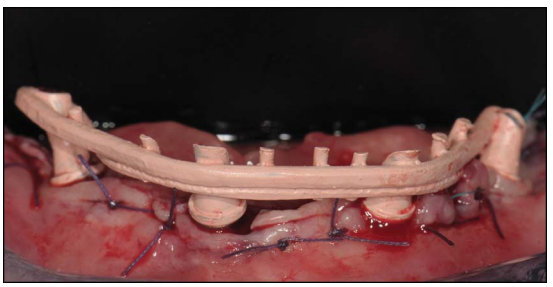

Fig. 12. The opaqued framework is placed on the abutments.

composite resin. All the immediate prostheses were subsequently under full occlusal load (Figs. 1–16).

The patients were recalled for a professional cleaning treatment by a dental hygienist every 6 months. Periapical radiographs taken with a customized positioning jig and a complete set of probing measurements were performed at each scheduled follow-up.

The following assessments were made:

- Life table analysis of implant survival, with implant survival defined as absence of implant mobility and swelling, including cases subject to more than 2.0 mm of peri-implant bone loss or positive outcome of treated mucositis or peri-implantitis.
- Changes in marginal peri-implant bone level, defined as modification of the distance between the implant-abutment junction and the highest coronal point of the supporting bone, were assessed using periapical radiographs taken with a customized positioning jig. Each periapical x-ray was digitized with a scanner (Epson Expression 1680 Pro; Epson Italia, Cinisello Balsamo, Milano, Italy) and analyzed with measurement software (Meazure 2.0 build 158; C Thing Software, Sunnyvale, CA) using platform height and implant length as double cross-references. The precision of the digital measurement was set at 0.1 mm.
- Biological or technical complications and any other adverse event, including incidence of mucositis and peri-implantitis, the need for any repair procedure, fracturing of the acrylic superstructure or the welded joints, speech problems and occlusion defects.

Follow-up frequency was:

- T0: after surgery and fitting of the immediate final prosthesis.
- T1: 6 months after surgery.
- T2: 1 year after surgery.
- T3: 2 years after surgery.
- T4: 3 years after surgery.
- T5: 4 years after surgery.
- T6: 5 years after surgery.
- T7: 6 years after surgery.

RESULTS

A total of 256 implants were consecutively placed in 52 patients in the period between February 2004 and March 2006. The mean age of the patients at the time of surgery was 62 years (SD = 10.2 years; minimum, 45 years; maximum, 79 years). One hundred twenty-six (49.22%) and 130 (50.78%) implants were, respectively, placed in female and male patients. One hundred forty-four (56.25%) implants were placed in 24 maxillary cases and 112 (43.75%) implants were placed in 28 mandible cases. All implants were placed in healed sites without the use of any bone grafting material. The details of the age and gender distribution and the smoking habits of the patients are displayed in Table 1. Average insertion torque, ISQ values, and bone quality assessments are listed in Table 2. At the 72-month follow-up, the accumulated mean marginal bone loss was, respectively, 1.39 mm (SD = 0.67 mm) for the implants placed in the maxilla (n = 124) and 1.29 mm (SD = 0.71 mm) for the implants placed in the mandible (n = 87) (Table 3).

A life table cumulative survival rate (CSR) of 90.31% was achieved by the implants in this study. More specifically, the implants placed in the maxillary sites achieved a CSR of 92.12% and the implants placed in the mandible sites achieved a CSR of 87.89%. Forty-two (16.4%) implants were lost because 9 (17.3%) patients

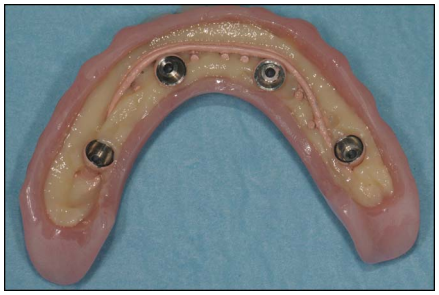

Fig. 13. The hollow restoration is relined intraorally on the framework.

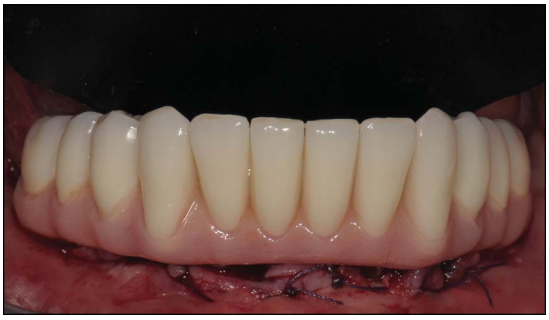

Fig. 15. Final restoration in place.

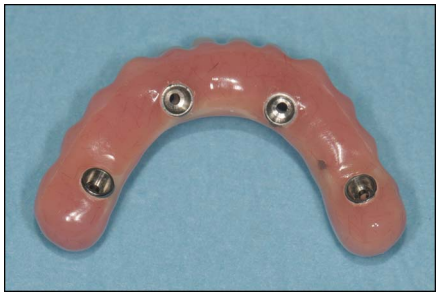

Fig. 14. After further packing and polishing, the restoration is completed.

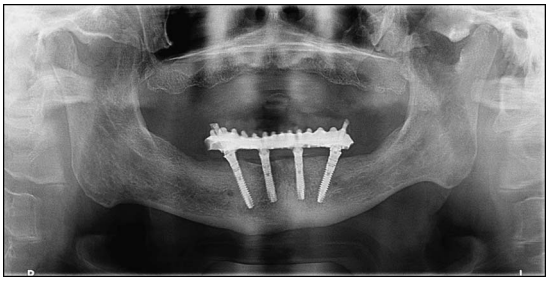

Fig. 16. Six-year follow-up.

were not traceable or refused to attend the scheduled follow-up (Table 4).

One implant placed in the maxillary lateral right incisor position and 1 implant placed in the right first bicuspid mandible area failed to osseointegrate. Two patients, a 69-year-old nonsmoking woman and a 72-year-old moderate smoking man, reported minor discomfort, pain, and moderate gingival bleeding. The prostheses were subsequently removed and the implants were found to be mobile. The implants were removed, and the prostheses were carefully relined and modified. Pain was immediately controlled with 1000 mg of paracetamol, and the patients underwent an antimicrobial cycle, consisting of 500 mg of beta-lactam antibiotics twice daily for 5 days. The modified prostheses were delivered to the patients 2 hours after implant removal. The failed implants were not replaced.

One of the implants, already treated because of peri-implantitis during the observation period, presented recurrent signs of infection 67 months after implant insertion. The restoration, a full-arch maxillary prosthesis, was removed and the implant was found to be mobile. The implant was removed, and the prosthesis was carefully relined and modified. Pain was immediately controlled with 1000 mg of paracetamol, and the patient underwent an antimicrobial cycle, consisting of 500 mg of beta-lactam antibiotics twice daily for 5 days. The modified prosthesis was put back in place 2 hours after implant removal.

One hundred twenty-four (86.11%) of 144 implants placed in maxillary cases and 87 (77.68%) of 112 implants placed in mandible cases were without problems at the 6-year follow-up. Signs of soft tissues' adverse events were present in a total of 32 (15.16%) of 211 implants at the end of the follow-up. There was inflammation of the mucosal cuff around the neck of the implant associated with edema, rubor, and bleeding on probing in the area around 25 (11.85%) implants. The implants were classified as positive for mucositis and were treated with weekly professional submucosal debridement sessions and home mouth rinses with 0.2% chlorhexidine until complete remission of the symptoms. Seven (3.31%) implants presented more important signs of infection, with purulence and peri-implant radiological translucency. The implants were then classified as positive for peri-implantitis.

Table 1. Age, Gender Distribution, and Smoking Habits

Age	Implants	Minimum	Maximum	Mean	SD
General	256	45	79	62.0	10.2
Mandible	112	47	77	61.6	9.8
Maxilla	144	45	79	62.4	10.7
Gender	Mandible	Maxilla	Total		
Male	64	66	130		
Female	48	78	126		
Smoking habits	Mandible	Maxilla	Total		
Nonsmokers	91	103	194		
Smokers	21	41	62		

Table 2. Average Insertion Torque (ISQ) and Bone Quality Values at Surgery

	Maxilla (n = 124)	Mandible (n = 87)
Torque (N·cm)	30.1 (7.2)	38.3 (9.1)
ISQ (T0, surgery)	69.9 (6.1)	71.5 (8.7)
Type D1	8	11
Type D2	57	29
Type D3	52	42
Type D4	7	5

Values are represented as average or mean (SD).

Table 3. Mean Measurements of Bone Loss Patterns

Follow-up Range	Maxilla (n = 124) (mm)	Mandible (n = 87) (mm)
T0–T1	0.45 (0.27)	0.59 (0.26)
T1–T2	0.17 (0.06)	0.20 (0.11)
T2–T3	0.11 (0.09)	0.15 (0.19)
T3–T4	0.22 (0.24)	0.09 (0.09)
T4–T5	0.13 (0.09)	0.11 (0.21)
T5–T6	0.23 (0.23)	0.15 (0.18)
T6–T7	0.08 (0.23)	0.07 (0.18)
T0–T7	1.39 (0.67)	1.29 (0.71)

Values are represented as mean (SD).

The prostheses were removed and a full-thickness flap was elevated. The bone defect and implant surface were deeply cleaned and debrided using carbon curettes. Local irrigation with 1 g of tetracycline was performed, and the soft tissues were sutured into place. Home mouth rinses with 0.2% chlorhexidine and local application of 1% chlorhexidine gel were prescribed until the complete absence of the symptoms.

One patient reported a persisting sensory disturbance immediately after the local anesthesia wore off 2 hours after surgery. The control periapical radiograph revealed a distance of more than 2 mm distal to the mental foramen. The patient was then recalled weekly for a mental nerve sensorial control until complete recovery, which was achieved 4 weeks after surgery.

Respectively, 1 and 2 weeks after surgery, 1 female and 1 male patient with maxillary prostheses reported discomfort associated with moderate chewing difficulties. The prostheses were carefully modified to reduce occlusal contact in both centric and lateral excursions.

Three patients fitted with maxillary prostheses and 2 patients with mandible prostheses (a total of 5 patients) reported small fractures of the acrylic resin superstructure. All prostheses were repaired with light-cured composite resin, polished, and screw-retained within 1 hour.

One patient, a 62-year-old nonsmoking man, reported a complete fracture of the resin portion of the distal cantilever up to the titanium joint 4 years after surgery. The patient had been fitted with a full-arch mandible prosthesis. The fractured portion included one first molar and nearly 13 mm of the resin body. The opposing dentition consisted of a full implant supported metal and ceramic bridge. The prosthesis was removed, repaired, and relined at the dental laboratory within 2 hours.

One patient, a 61-year-old light smoking woman, reported the fracture of the fixing screws of her full-arch mandible prosthesis during a car accident. After 2 weeks, a 2-week recovery period, implant stability was checked, new abutments fixing screws were tested, and the prosthesis was repaired and refitted.

In 9 patients, a minor relining procedure was required to close open spaces (4 cases), avoid food entrapment (3 cases), and fix speaking problems (2 cases). These procedures were performed at the 6-month follow-up and required a 2-hour appointment.

Table 4. Life Table Analysis

Months Since Implant Placement	Implants at Risk at the Beginning of Interval	Implants Failed During Interval	Implants Lost During Follow-up	Effective Sample Size	Survival Rate Within Period	CSR
Survival of 256 implants that fulfilled the inclusion criteria						
0–6	256	2	0	254	99.22	99.22
6–12	254	0	0	254	100.00	99.22
12–24	254	0	4	252	99.21	98.44
24–36	250	0	10	245	98.00	96.47
36–48	240	0	8	236	98.33	94.86
48–60	232	0	10	227	97.84	92.82
60–72	222	1	10	216	97.30	90.31
Survival of 144 implants placed in maxillary sites						
0–6	144	1	0	143	99.31	99.31
6–12	143	0	0	143	100.00	99.31
12–24	143	0	0	143	100.00	99.31
24–36	143	0	6	140	97.90	97.22
36–48	137	0	0	137	100.00	97.22
48–60	137	0	6	134	97.81	95.09
60–72	131	1	6	127	96.95	92.19
Survival of 112 implants placed in mandible sites						
0–6	112	1	0	111	99.11	99.11
6–12	111	0	0	111	100.00	99.11
12–24	111	0	4	109	98.20	97.32
24–36	107	0	4	105	98.13	95.50
36–48	103	0	8	99	96.12	91.79
48–60	95	0	4	93	97.89	89.86
60–72	91	0	4	89	97.80	87.89

DISCUSSION

The metal-reinforced acrylic restoration fabricated using the intraoral welding approach can be adapted chairside when the soft tissue support changes. This is the case of major surgical osteoplasty or aggressive surgery. A simple relining procedure can fix spaces that are too open or too closed, which may pose difficulties with cleaning access or with speech. Minor defects and early occlusal contacts can also be detected and removed with ease. None of the 211 titanium joints examined in this article evidenced radiological signs of fracture or impairment in the 6-year follow-up period after full occlusal load. This result had been assessed in the first intraoral welding studies[4] and firmly supports the conclusion that the stability of the joint in the medium term cannot be questioned. Indeed, the fracture of the resin superstructure is the most common adverse prosthetic event to be expected in the early-medium term when using the intraoral welding technique. The same outcomes were reported by Fischer and Stenberg[12] in their 10-year report on implant-supported full-arch maxillary prostheses. Most of the fractures assessed in our study were superficial chipping that were easily repaired with light-cured composite resin in less than 1 hour. Minor fractures seemed to chiefly occur in the vicinity of the holes provided for screws, where the reduced width of the resin creates a weak point. In one case, however, a complete fracture of the resin portion of the distal cantilever was reported 4 years after surgery and a major repair procedure was needed. Gillot et al[13] recently monitored 211 implants placed in edentulous maxillary patients and immediately restored using the Nobelguide (Nobel Biocare AB, Göteborg, Sweden) technique. The authors reported 10 fractures of the acrylic resin superstructure in the group of 33 patients treated in the 12- to 52-month follow-up period. The use of porcelain as veneer material does not seem to have completely eliminated this adverse event. Zurdo et al[14] reported after 5 years of follow-up that one of the 2 most common prosthetic complications for fixed implant-supported partial prostheses was indeed minor porcelain fracturing. To maximize tensile strength, the design of the titanium framework evolved from the first concept[4] to the one that uses composite instead of common acrylic resin and the application of secondary bars and additional titanium retentions.[15] Composite resin has a more rigid 3-dimensional structure and in clinical use has proved itself less prone to fracture than common acrylic.[15] Nevertheless, severe bruxism is currently the most common exclusion criteria for the use of the intraoral welding approach. In their 40-month analysis of 283 implants loaded with both single and partial prostheses, De Boever et al[16] concluded that bruxism seemed to play a significant role in the frequency of prosthetic adverse events and that longer elements seemed to be more prone to complications. Moreover, Zurdo et al[14] reported in their systematic review that the incorporation of cantilevers into implant supported prostheses may be associated with a higher incidence of minor technical complications. The only major prosthetic failure in this study was assessed in the cantilever area of a full mandible restoration.

The implant pool included in this study achieved a life table CSR of 90.31% after 7 years of full occlusal load. Although comparable with the recent 10-year assessments published by Fischer et al,[17] this result is greatly affected by the patient drop-out caused by the unwillingness of patients to attend the scheduled follow-ups.

The results of this study evidenced that the 15% of the implants included in the research protocol were associated with signs of soft tissue adverse events over the whole observation period. In a recent article, Corbella et al[18] monitored a group of 61 patients fitted with immediately loaded full-arch fixed prostheses for more than a 4-year follow-up period. At the 12-month follow-up, the authors reported a 1.4% implant loss incidence due to severe peri-implantitis. The adoption of a systematic hygiene protocol and the delivery of carefully relined and polished prostheses are mandatory to prevent plaque accumulation and reduce the incidence of mucositis and peri-implantitis. The bar is soldered directly in the mouth of the patients. This avoids many of the factors that can lead to a nonpassive structure, such as the impression procedure,[19] the fabrication of the master cast and the wax pattern,[20] and the casting of a traditional metal alloy framework.[21]

CONCLUSIONS

Within its limitations, this study has demonstrated that the intraoral welding technique is predictable to successfully rehabilitate the mandible and the maxilla of the fully edentulous patient with a fixed, final prosthesis for up to 6 years after surgery. Further studies should be undertaken to verify the long-term effectiveness of this approach.

DISCLOSURE

The authors claim not to have any financial interests in any of the products mentioned in this article.

REFERENCES

1. Mondani PL, Mondani PM. The Pierluigi Mondani intraoral electric solder. Principles of development and explanation of the solder using syncrystallization [in Italian]. *Riv Odontostomatol Implantoprotesi.* 1982;4:28–32.

2. Hruska AR. Intraoral welding of pure titanium. *Quintessence Int.* 1987;18:683–688.

3. Hruska A, Borelli P, Bordanaro AC, et al. Immediate loading implants: A clinical report of 1301 implants. *J Oral Implantol.* 2002;28:200–209.

4. Degidi M, Gehrke P, Spanel A, et al. Syncrystallization: A technique for temporization of immediately loaded implants with metal-reinforced acrylic resin restorations. *Clin Implant Dent Relat Res.* 2006;8: 123–134.

5. Degidi M, Nardi D, Piattelli A. Immediate rehabilitation of the edentulous mandible with a definitive prosthesis supported by an intraorally welded titanium bar. *Int J Oral Maxillofac Implants.* 2009;24:342–347.

6. Degidi M, Nardi D, Piattelli A. Prospective study with a 2-year follow-up on immediate implant loading in the edentulous mandible with a definitive restoration using intra-oral welding. *Clin Oral Implants Res.* 2010;21:379–385.

7. Degidi M, Nardi D, Piattelli A. Immediate loading of the edentulous maxilla with a final restoration supported by an intraoral welded titanium bar: A case series of 20

consecutive cases. *J Periodontol.* 2008; 79:2207–2213.

8. Degidi M, Nardi D, Piattelli A. A comparison between immediate loading and immediate restoration in cases of partial posterior mandibular edentulism: A 3-year randomized clinical trial. *Clin Oral Implants Res.* 2010;21:682–687.

9. Avvanzo P, Fabrocini L, Ciavarella D, et al. Use of intra-oral welding to stabilize dental implants in augmented sites for immediate provisionalization: A case report. *J Oral Implantol.* 2012;38:33–41.

10. Degidi M, Nardi D, Piattelli A. Immediate definitive rehabilitation of the edentulous patient using an intraorally welded titanium framework: A 3-year prospective study.*Quintessence Int.* 2010;41:651–659.

11. Lekholm U, Zarb GA. Patient selection and preparation. In: Brånemark PI, Zarb GA, Albrektsson T, eds. *Tissue-Integrated Prostheses: Osseointegration in Clinical Dentistry*. Chicago, IL: Quintessence; 1985:199–209.

12. Fischer K, Stenberg T. Prospective 10-year cohort study based on a randomized, controlled trial (RCT) on implant-supported full-arch maxillary prostheses. Part II: Prosthetic outcomes and maintenance. *Clin Implant Dent Relat Res.* 2011 Aug 11. doi: 10.1111/j.1708-8208.2011.00383.x. [Epub ahead of print].

13. Gillot L, Noharet R, Cannas B. Guided surgery and presurgical prosthesis: Preliminary results of 33 fully edentulous maxillae treated in accordance with the NobelGuide protocol. *Clin Implant Dent Relat Res.* 2010;12(suppl 1):104–113.

14. Zurdo J, Romão C, Wennström JL. Survival and complication rates of implant-supported fixed partial dentures with cantilevers: A systematic review. *Clin Oral Implants Res.* 2009;20(suppl 4): 59–66.

15. Degidi M, Nardi D, Sighinolfi G, et al. Immediate rehabilitation of the edentulous mandible using Ankylos SynCone telescopic copings and intraoral welding: A pilot study. *Int J Periodontics Restorative Dent.* 2012;32:e189–e194.

16. De Boever AL, Keersmaekers K, Vanmaele G, et al. Prosthetic complications in fixed endosseous implant-borne reconstructions after an observations period of at least 40 months. *J Oral Rehabil.* 2006;33:833–839.

17. Fischer K, Stenberg T. Prospective 10-year cohort study based on a randomized controlled trial (RCT) on implant-supported full-arch maxillary prostheses. Part 1: Sandblasted and acid-etched implants and mucosal tissue. *Clin Implant Dent Relat Res.* 2012;14:808–815.

18. Corbella S, Del Fabbro M, Taschieri S, et al. Clinical evaluation of an implant maintenance protocol for the prevention of peri-implant diseases in patients treated with immediately loaded full-arch rehabilitations. *Int J Dent Hyg.* 2011;9: 216–222.

19. Karl M, Rösch S, Graef F, et al. Strain situation after fixation of three-unit ceramic veneered implant superstructures. *Implant Dent.* 2005;14:157–165.

20. Del'Acqua MA, Arioli-Filho JN, Compagnoni MA, et al. Accuracy of impression and pouring techniques for an implant-supported prosthesis. *Int J Oral Maxillofac Implants.* 2008;23:226–236.

21. Ortorp A, Jemt T, Bäck T, et al. Comparisons of precision of fit between cast and CNC-milled titanium implant frameworks for the edentulous mandible. *Int J Prosthodont.* 2003;16:194–200.