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Case Series

INTRA-ORAL WELDING TECHNIQUE: THREE CASE REPORTS

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ABSTRACT

In recent years, an intra-oral welding technique (IOWT) was introduced to allow immediate implant loading and transform a removable denture into a temporary full-arch rehabilitation. It is an evolutionary solution for implant-supported dentures in terms of function and cost. IOWT lets rigid connections among fixtures occur immediately after implant insertion by welding a titanium bar to connect abutments. The removable denture is adapted to the patient's oral cavity according to height, chewing, and speech. The titanium framework is immersed in the denture's inner part by resin. Finally, abutments are unscrewed, the denture removed, polished, and screwed again onto implants. This way, it is possible to immediately deliver a full arch rehabilitation after free-hand placing implants and transforming the patient's removable denture into a temporary full arch rehabilitation. Here, a case series is reported, and the literature is reviewed.

KEYWORDS: *intra-oral, welding, removable, denture, full-arch, rehabilitation, prosthesis*

INTRODUCTION

Implant-supported dentures are a modern and effective dental restoration option designed to provide enhanced stability and functionality compared to traditional removable dentures (1). This treatment involves securing a denture onto dental implants surgically placed in the jawbone. In this type of prosthetic rehabilitation, the denture is securely attached to the dental implants, preventing slippage and providing increased stability during activities such as chewing and speaking. Traditionally, there are two implant-supported dentures: bar-retained and ball-retained, also called locator dentures. The first type is a removable denture that attaches to a metal bar connected to the implants. In contrast, the second utilizes ball-shaped attachments on the implants that fit into corresponding sockets on the denture. Several are the benefits of implant-supported dentures. Among them are enhanced stability, improved chewing function, jawbone preservation, and natural feel. In fact, unlike traditional dentures, implant-supported dentures are securely anchored to implants, minimizing movement and slippage. The stability provided by dental implants allows for better chewing efficiency, enabling a more varied diet. Dental implants stimulate the jawbone, preventing bone loss and maintaining facial structure over time. In addition, implant-supported dentures closely mimic the feel and function of natural teeth, providing a more comfortable and confident experience for the wearer. Implant-supported dentures are an intermediate clinical and cost solution between removable dentures and full arch rehabilitation.

One critical point in implant osteointegration is micromovement (2, 3). Implant micromovement refers to the subtle, microscopic movements between the implant and the surrounding bone tissue. While some degree of

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micromovement is inevitable, excessive (around 80-100 micro-m) or continuous micromotion can hinder osseointegration (i.e., the biological process by which living bone tissue forms a bond with the surface of an implant). Excessive micromovement can lead to fibrous tissue formation instead of the desired direct bone-to-implant contact.

The relationship between implant micromovement and osteointegration is inverse - excessive micromovement can compromise or delay the osteointegration process. To promote optimal osteointegration, minimizing micromovement during the initial stages of implant healing is essential. Proper implant design, surgical techniques, patient-related factors, and overall loading conditions often achieve this. Immediate or early loading of implants (i.e., loading implant during peri-implant bone healing) can impact micromovement and must be carefully considered in the treatment plan.

A rigid connection between implants is a generally accepted solution to reduce implant micromovement, especially during the peri-implant bone healing period (i.e., 3 months). Welded titanium framework is a well-known solution produced in a laboratory to strengthen prosthetic rehabilitation (4-8).

In recent years, an intra-oral welding technique (IOWT) was introduced to let immediate implant loading (9-26) and transform a removable denture in a temporary full-arch rehabilitation. It is an evolutionary solution for implant-supported dentures in terms of function and cost. IOWT lets rigid connections occur immediately after implant insertion by welding a titanium bar to connect the abutments. The removable denture is adapted to the patient's oral cavity according to height, chewing, and speech habits. The titanium framework is immersed in the denture's inner part by resin. Finally, abutments are unscrewed, dentures removed, polished, and screwed again onto implants. In this way, it is possible to immediately deliver a full arch rehabilitation after free-hand placing implants and transforming the patient's removable denture into a temporary full arch rehabilitation. Here, a case series is reported, and the literature is reviewed.

CASE REPORT

Case 1

The patient presented to our clinic complaining about his smile in 2021. She was 58 years old and was a smoker. At the clinical and radiological evaluation, she had severe atrophy due to endo-perio infections that caused resorption and dehiscence of the vestibular bone and multi-focal fenestrations in the upper jaw (Fig. 1). The patient asked for a definitive fixed solution with a pleasant aesthetic.

Fig. 1. *Orthopantomography.*

Multiple extractions and bone defects were cleaned using granulation tissue and granulomas. Thus, an alveolar ridge poor in hard tissue but free of infections was obtained (Fig. 2).

Fig. 2. *Surgical view of maxilla after teeth extraction.*

The two pterygoid implants were inserted, and thanks to the engagement of the laminae of the pyramidal process, a torque of 90N was obtained despite the alveolar bone's D4 quality.

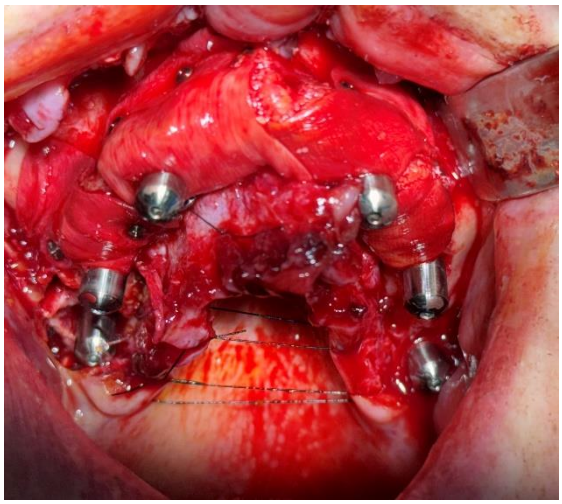

Fig. 3. *Implant insertion and bone regeneration.*

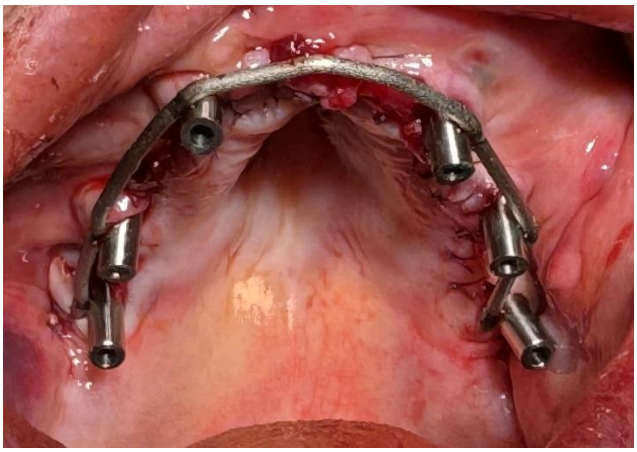

Fig. 4. *Titanium bar welded to abutments.*

Four implants were inserted in the premaxilla. After an abundant harvest of autologous bone, to create a 50/50 autologous/heterologous bone mix, GBRs were performed to repair bone defects, covering the exposed threads of the newly inserted implants. Titanium pins were positioned to create tension and stability of resorbable membranes that contain bone grafts. Mucosa was sutured by primary intention, and then intraoral welding was performed (Fig. 3, 4). An all-on-six in PMMA was delivered, with the structure welded inside (Fig. 5). At the end of the rehabilitation procedure, an X-ray check was performed (Fig. 6). The follow-up was uneventful; after 32 months, the patient had no complications.

Fig. 5. *Provisional rehabilitation.*

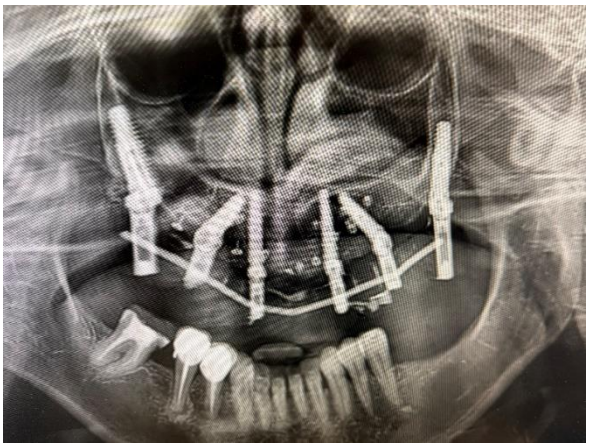

Fig. 6. *Post-surgical orthopantomography.*

Case 2

The patient presented to our clinic and complained about his chewing in 2021. He was 40 years old and was a smoker. At clinical and radiological evaluation, he has severe periodontitis and bone loss. He asked for an immediate prosthetic rehabilitation. A bi-max rehabilitation was planned by using 12 implants. Clinically, the transversal maxillary dimension was reduced due to bone defects, and a long cantilever would be necessary to give the patients 12 teeth per arch. The cantilever was avoided by planning two pterygoid implants, which reduced the stress of the distal implant in the premaxilla and gave the patient 14 teeth per arch. Primary stability was excellent. The heterologous graft was used just to fulfill post-extraction sockets. Immediate loading was done with no complications, and six months post-operative X-rays showed the bone defect correctly ossified around implants (Fig. 1-6. Definitive restoration was delivered after 6 months, and the 2-year follow-up X-rays showed good bone peak and corticalization of the inter-implant areas.

Fig. 1. *Pre-surgical orthopantomography.*

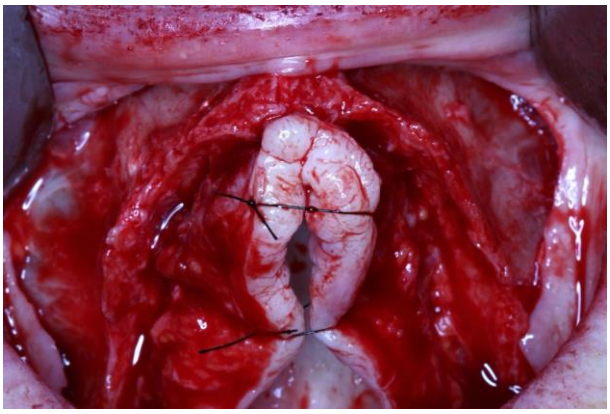

Fig. 2. *Surgical view of maxillary atrophy.*

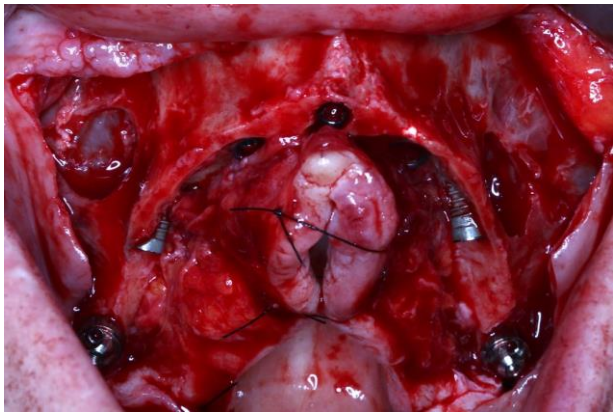

Fig. 3. *Implant inserted.*

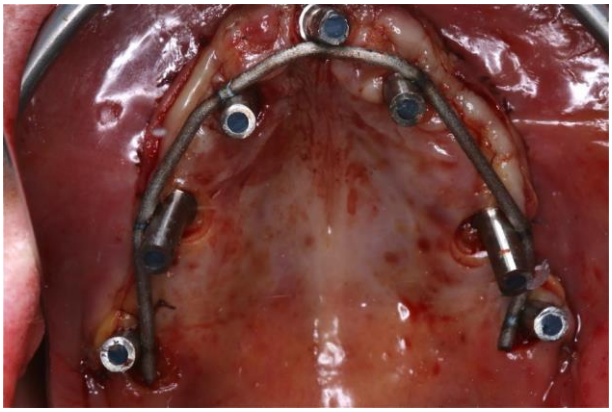

Fig. 4. *Titanium bar welded to abutments.*

Fig. 5. *Provisional Restoration.*

FIG. 6. *Post-surgical orthopantomography.*

Case 3

The patient, who was 75 years old and a nonsmoker, presented to our clinic in 2022 complaining about his chewing. At the clinical and radiological evaluation, he had severe bone ridge infections due to endo-perio diseases. In addition, radicular cysts and bilateral oro-antral communication were seen, as well as sinusitis of the right maxillary sinus (Fig. 1).

Surgically, after loco-regional anesthesia, extraction of teeth, and accurate cleaning of infected sockets and fenestrations, a full-thickness flap was elevated with two distal releases on the zygomatic pillar. Both sinuses were opened and cleaned from the infection, washed with Rifamicin 250mg, and the Schneiderian membrane was sutured with 6.0 resorbable stitches. Due to the reduced mouth opening of the patient, pterygoid implants were inserted as the first procedure. The right pterygoid implant was a trans-sinus fixture that engaged the tuberosity from the interior of the sinus

and then the pterygoid laminae. This implant was inserted 1 mm into the pterygoid bone crest, and it reached 70 N torque. No graft was placed in the right sinus due to the strong infection. Then, the left pterygoid fixture was inserted with no major difficulties. The left distal implant in the premaxilla was a trans-sinus. A vertical bone defect was fulfilled with a 50/50 heterologous/autogenous graft. Autologous bone and tuberosity were harvested from the zygomatic pillar. Here, there was an oro-antral communication without infection in the sinus. The remaining implants were inserted in the premaxilla, abutments were welded (Fig. 2), and an immediate loading was done (Fig. 3-5). The Toronto bridge did not have a ridge reconstruction to make the prostheses easily cleanable for the patient. A check done 3 weeks after surgery confirmed a good healing process. X-ray and clinical control after one year confirmed a follow-up without complications (Fig. 6, 7).

Fig. 1. *Pre-operative X-ray.*

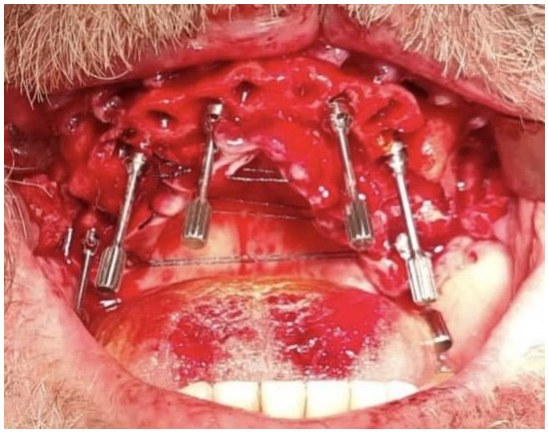

Fig. 2. *Implants position*.

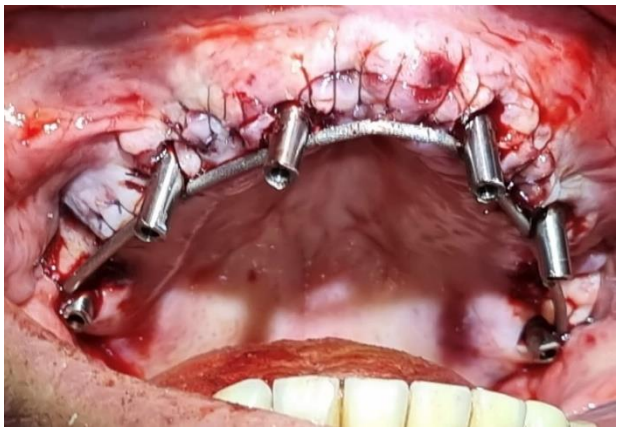

Fig. 3. *Intraoral welding*.

Fig. 4. *Occlusal view of provisional denture.*

Fig. 5. *Frontal view of the post-operative provisional denture.*

Fig. 6. *One-year follow-up.*

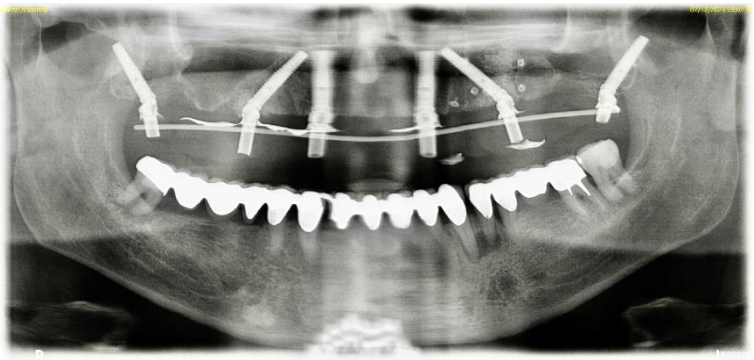

Fig. 7. *One-year X-ray.*

DISCUSSION

In the last decade of the 20th century, few articles have described the intra-oral welding technique (IOWT). Muratori (9) first reported an intra-oral welding technique. Then, Hruska et al. (10) reported using IOWT in more than 100 cases of non-submergible implants. The intra-oral welding was performed immediately after suture placement, with one or more connecting titanium wires as the splinting medium. This permits the patient to leave the office with a stable and retentive overdenture, resting securely on the newly created splint performed on the same day of surgery. This avoids the potentially troublesome problem of allowing the overdenture to be supported by the recently altered soft tissues. In addition, the patient otherwise would not use a denture during the bone-healing period, which creates an alteration in psychological and physiological status.

Several articles are available starting in 2010. Degidi et al. (11-15) did a series of reports on IOWT. In the first report (11), the authors evaluated thirty patients who received three axial and four tilted implants in the edentulous maxilla. Immediately after implant placement, definitive abutments were connected to the implants, and a titanium bar was welded to them using an intraoral welding unit. This framework was used to support the definitive restoration, which was attached on the day of implant placement. Since implant success rates of 97.8% for axial implants and 99.2% for tilted implants after 36 months of follow-up, they concluded that it is possible on the day of implant placement surgery to successfully rehabilitate the edentulous atrophic maxilla with a fixed, definitive restoration supported by an intraorally welded titanium framework attached to axial and tilted implants.

In the same year, Degidi et al (12), investigated rehabilitating edentulous mandibles using IOWT. Twenty patients with an edentulous mandible received four inter-foraminal, tapered connection implants. All implants were immediately loaded with a fixed restoration supported by an intra-orally welded titanium framework. Final abutments were connected to the implants, and a titanium bar was welded using an intra-oral welding unit. This framework was used to support the final restoration, fitted on the same day as the implant placement. All implants were osseointegrated, and a 100% implant survival rate was achieved during the 24-month follow-up.

In 2012, Degidi et al. (13) focused on osteointegration and crestal bone remodeling after 1 year around the implants for intraoral welded immediate full-arch prosthesis inserted with low insertion torque (i.e., ≤ 20 Ncm). Fifty-one implants presented an IT ≤ 20 Ncm. The survival rate after 1 year was 98% for the test, so the authors suggested that rigid framework splinting can be a viable technique to improve the success rate of implants with low primary stability using immediate loading protocols for full-arch prosthesis.

In the same year, Degidi et al. (14) investigated if IOWT is a suitable technique for fabricating a fixed restoration for the edentulous maxilla on the day of surgery using standard and zygomatic implants. Ten consecutive patients were involved in this study, each with an edentulous atrophic maxilla and receiving two standard and two zygomatic implants. All implants were loaded immediately with a fixed prosthesis supported by an intraorally welded titanium framework. Definitive abutments were connected to the implants, and a titanium bar was welded using an intraoral welding unit. This framework was used to support the definitive prosthesis, which was fitted on the day of implant placement. A total of 20 immediately loaded standard and 20 zygomatic implants were used. The cases included in this study achieved a 100% prosthetic success rate at the 12-month follow-up. In 2013, Degidi and Coll (15) evaluated the 6-year effectiveness of maxillary and mandibular full-arch immediately loaded prostheses fabricated using IOWT. One hundred forty-four

implants were placed in maxillary cases, and 112 implants were placed in mandible cases, which completed the planned 6-year follow-up. Fracturing of the composite resin superstructure was the most common adverse event. The authors concluded that after a 6-year follow-up, the IOWT proved a predictable technique for successfully rehabilitating the fully edentulous patient with a fixed and immediate prosthesis.

The concepts mentioned above were further developed by adding digital support by Albiero et al. (16-18). In the first report, Albiero et al. (16) combined computer-assisted surgery with the IOWT to obtain a precise passive fit of the immediate loading prosthesis. They reported a case of an edentulous maxilla rehabilitated with four computer-assisted implants welded together intraorally and immediately loaded with a provisional restoration. No complications were observed at the 1-year follow-up. Subsequently (17), Albiero et al. described a case series to verify if IOWT increases the predictability of immediately loaded implants supporting a fixed full-arch prosthesis after computer-guided flapless implant placement. A total of 60 implants were placed consecutively in 10 patients. No mechanical or biological complications were registered at the 1-year follow-up. The authors concluded that despite the inaccuracy registered, this guided-welded approach allowed the achievement of a passive fit of the full-arch prosthesis on the inserted implants on the same day of the surgery and provided a high implant and prosthetic survival rate at the 1-year follow-up.

In 2020, Albiero et al. (18) focused on the clinical outcome of the 2-year follow-up of immediately loaded combined screw- and conometric-retained implant-supported full-arch restorations virtually planned using digital scanning technology. A total of 72 implants were inserted. All implants were immediately loaded with a complete-arch restoration supported by an intraorally welded framework. Digital scanning technology was used to virtually plan a combined screw and conometric retention of the frameworks. The survival rate after 2 years was 98.6%, as one implant failed during the osseointegration period. No major prosthetic complications were observed, such as issues with mobility, unscrewed abutments, disconnected conometric copings, and prosthetic fractures. Only one patient registered the chipping of a prosthesis. The authors concluded that the use of combined screw and conometric retention for fixed immediate restorations properly planned using digital scanning technology seems to be a viable treatment alternative to screw or conometric retention alone for immediately loaded rehabilitations.

In addition, manuscripts of independent Authors reporting single cases (19-22) and case series (23-26) add additional strength to the feasibility of the IOWT technique.

CONCLUSIONS

In conclusion, IOWT allows immediate implant loading and transforms a removable denture into a temporary full-arch rehabilitation. It is an evolutionary solution with respect to implant-supported dentures, both in terms of function and cost. The reported case series adds additional strength to this technique. It is applied in selected cases and when the dental team is well-trained since it needs not only an expert surgeon but also a prosthodontist familiar with welding techniques.

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