Immediate transformation of full lower dentures into fixed implant-supported superstructures by intraoral welding

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ABSTRACT

Aim Intraoral welding has been introduced as a means to fabricate a rigid implant-splinting metal framework supporting immediate implant prostheses.
Methods This method can also be applied for the immediate transformation of a removable lower full prosthesis, with inadequate retention and stability, into a fixed implant supported rehabilitation. In this way it was possible to preserve the correct esthetic and occlusal parameters that had been previously established and to which the patient has been accustomed. The prosthesis is modified by removing the denture flanges. The remaining part of the denture teeth, are joined together with the acrylic resin representing the gingiva and forming a bare dental arch composition. After implant placement, the Ti framework is fabricated by initial intraoral welding, followed by extra-oral completion. The denture is then stabilized with acrylic resin onto the framework intraorally. The prosthesis is completed with additional acrylic resin in the laboratory, as hybrid prosthesis to be delivered to the patient.
Conclusion The procedure improves the quality of life of patients, is cost effective and is not time-consuming.

KEYWORDS Intraoral welding; Metal framework; Implant fixed restorations.

INTRODUCTION

The immediate delivery of implant-supported dental restorations, in combination with immediate loading of the supporting implants, has been documented both by laboratory and clinical scientific evidence (1-3). It is a technique that can be applied in every-day clinical practice, as long as two basic requirements are met:

a) Strong primary stability of the implants;
b) Lateral occlusal forces on the supra-structure bi-laterally balanced, as these forces can cause micro-movement of the healing implants (4).

In order to meet these requirements the restoration needs to solidly splint the implants, immediately after their placement. This can only be achieved if a metal framework is incorporated in the immediate prosthesis, passively fitting on the implant platforms and is screwed on them. It is thus recommended that the metal framework contained in the immediate prosthesis – that can also serve as the metal framework of the final restoration - is constructed and delivered with minimal delay after the implant insertion, before the expected decrease of their initial mechanical stability occurs during the healing process.
Often, a complete lower denture might be aesthetically acceptable but suffers from poor functional performance. The patients' request for a quick riddance of such a denture makes the classic method of constructing a new implant-supported restoration undesirably slow and costly. A prompt, simple and cost-effective solution to this issue is the immediate transformation of the existing full lower denture in an immediate fixed implant-supported restoration. Such an outcome can be accomplished by the immediate incorporation of a Ti metal framework constructed by intraoral welding (5) as described by M. Degidi (WeldOne) within the existing lower denture.
The purpose of this paper is to present the technique of intraoral welding and its application in the immediate transformation of malfunctioning removable full lower dentures into fixed implant-supported restorations.

MATERIALS AND METHODS

Immediate implant loading and immediate rehabilitation

Implant-bone relation requirements (4).

a) The presence of adequate bone width and height suitable to properly house and support implants of at least 3/4 mm diameter and 10 mm height. The density of the bone is also an important factor for primary stability and for this, the more anterior mandibular areas are preferred where bone density is better.
b) The use of wedge/self-tapping implants promotes strong primary stability at the moment of placement. The preferred implants are those that are root shaped and allow their placement in narrower bone preparations. Their shape compresses the bone in their periphery during insertion, thus creating a denser contact with the bone trabeculae.
c) Implants with etched surface are advantageous compared to the smooth surface implants, since they promote fast osseointegration. They present better wettability by the tissue fluids, owing their larger contact area (6-9).

Implants and the existing denture

Transformation of an existing denture into implant-supported overdenture.

A conservative and economical option to increase the retention of a lower denture can be attained by transforming it into an implant overdenture. This is achieved by the placement of two implants in the mental region of the mandible equipped with abutments bearing the male part of precision attachments. Respectively, the denture is modified in order to bear the female parts of the attachments (10).

This solution cannot be immediate. A time slot for osseointegration should precede loading, as the lateral force components on not splinted implants cannot be balanced and neutralized during the maturation process of the supporting bone. While the ovedenture attachment system provides retention for the denture and rigidly supports it anteriorly, the posterior part of the denture, being purely soft tissue bourne presents resiliency during function. Consequently, the rotational component of movement cannot be eliminated. Moreover, when such a prosthesis opposes a full denture in the maxilla, the subsequent reduction of its posterior occlusal support makes the occurrence of "combination syndrome" possible. Finally, the overdenture-implant system creates force vectors on and around the retainers acting as fulcrums that the weakened polymer material of the denture cannot withstand and fractures occur frequently. A metal reinforcing framework must be incorporated during the "transformation" process.

The immediate introduction of a bar attachment splinting the two overdenture implants can reduce the horizontal components of loading during healing and bone maturation. Nevertheless the rotational movement of the overdenture around the bar will equally be present, along with the already mentioned consequences.

Transformation of the removable denture into a fixed implant-supported prosthesis

The option of the immediate transformation of the lower full denture into a fixed multiple implant-bourn restoration presents the ideal solution both functionally and biologically. However, this approach is not possible by the traditional means, since the transformation requires the construction of a rigid metal framework in a series of appointments. The existing denture can be used as a provisional prosthesis, without framework reinforcement, while the metal framework is being build and a new final restoration is delivered. The necessary series of appointments demand time and the final outcome is a totally new prosthesis with its respective cost.

FIG. 1 Lateral cephalometric radiograph confirming an acceptable preoperative facial profile provided by the existing full denture with appropriate VDO and adequate lower facial third lip support.

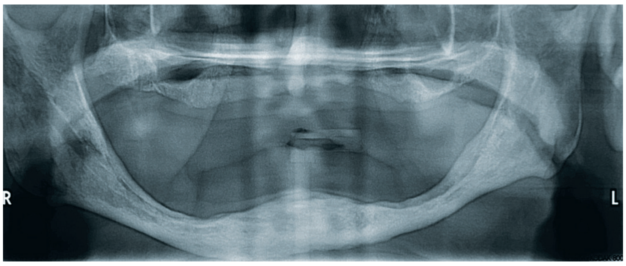

FIG. 2 Preoperative orthopantomogram.

Immediate transformation of a lower denture into a fixed implant-supported prosthesis

In order to consider the immediate transformation of a lower removable denture into a fixed implant-supported fixed prosthesis the original denture should contain a dental composition that adequately meets the necessary esthetic and occlusal requirements (Fig. 1). The original or improved vertical dimension of occlusion (VDO) is measured extraorally and the existing plane of occlusion confirmed as being correct. If needed, minor esthetic and functional adjustments are made prior to any alterations.

Radiographic control and treatment planning

The evaluation of the bone substrate and respectively the planning of the treatment is always done in relation to the antagonist dentition. The radiographic control is made with the help of a orthopanoramic image (Fig. 2)

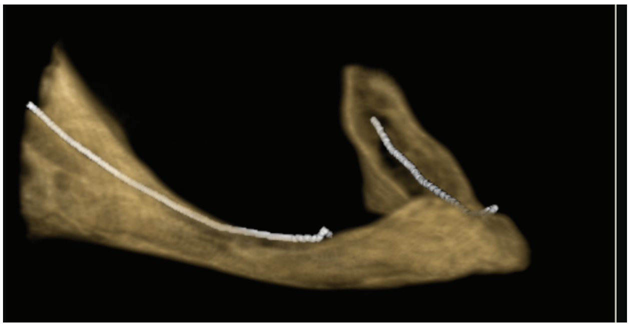

FIG. 3A

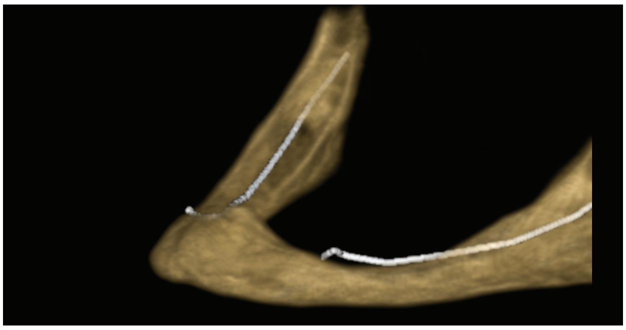

FIG. 3B

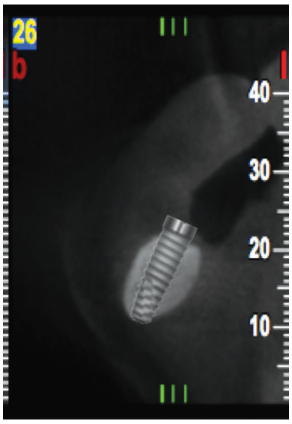

FIG. 3C

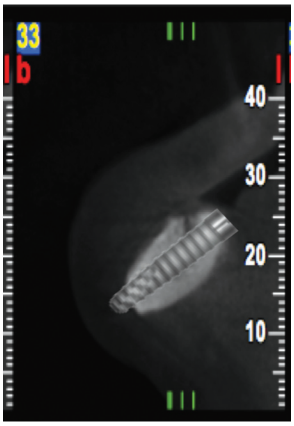

FIG. 3D

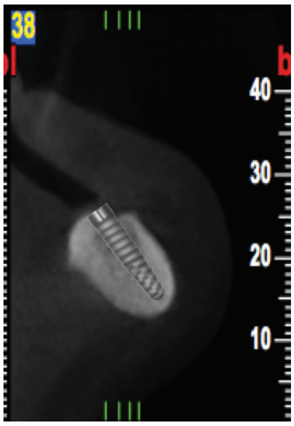

FIG. 3E

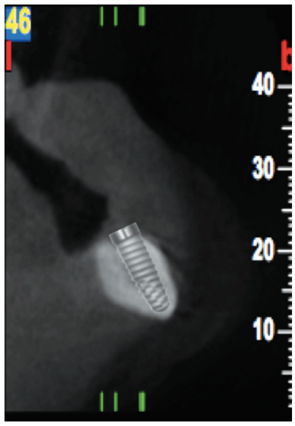

FIG. 3F

FIG. 3 Volumetric evaluation. 3A, 3B 3D mandibular reconstructions. 3C-F Lateral tomograms all presenting the visualized potential position length and inclination of the four implants.

and subsequently with volumetric tomography (Fig. 3).
Generally the treatment options are two:

a) the placement of four implants on the remaining ridge between the two mental foramen (Fig. 3a, 3b);
b) the placement of two to four implants on the remaining ridge between the two mental foramen and in addition, one implant distal to the mental foramen bilaterally, when adequate bone height and width exist.

The decision is also influenced by the presence of a maxillary natural dentition or a full denture, and by the relation of the two arches according to Angle's classification. These factors determine the area where the functional forces will be concentrated. The insertion of distal implants would minimize or even eliminate the presence of distal cantilevers on the superstructure and would help achieve a better load distribution.
The selected implant positions should allow adequate inter-implant space (>1,5 mm) thus facilitating the fabrication of the immediate framework. The number of the implants placed must be as limited as possible and the length of the cantilevers minimized (<1,5 mm).

Evaluation and alteration of the existing denture

The vertical dimension is measured by two facial marks with the existing denture in maximum intercuspation.

FIG. 4 The modified denture after removing most of the pink acrylic and eliminating the flanges in order to create space for the future metal framework.

If augmentation of the vertical dimension is required, the difference is added to the initial measurement. The denture then is altered to receive the metal framework. The flanges are eliminated by removing most of the pink acrylic, in order to create space for the metal framework (Fig. 4). The remaining part of the denture

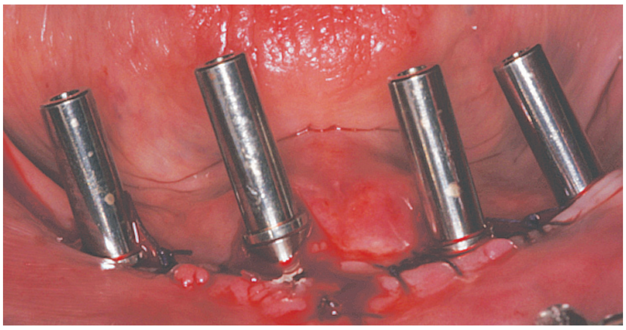

FIG. 5 The welding sleeves directly screw retained on the platforms of the one-piece transmucosal implants (Xive TG, Friedent, Dentsply, Germany), playing the role of copings of the future metal framework.

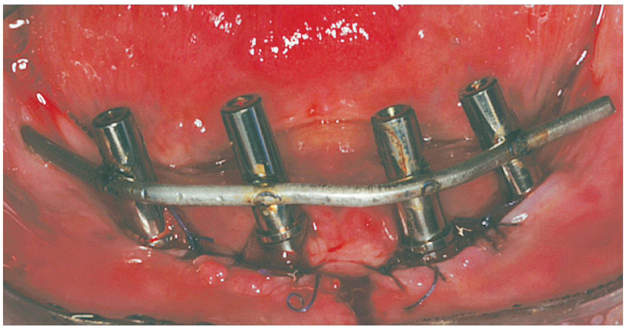

FIG. 6 The splinted Ti sleeves joined with the Ti bar-wire by intraoral welding. See the distal extensions of the wire bilaterally to support the cantilevers.

would consist of a bare dental arch composition of denture teeth joined together with the acrylic resin representing the gingiva.

Implant placement

One-piece implants (Xive TG, Friedent, Dentsply Germany) – with the smooth trans-mucosal abutment attached to the implant - are preferred as there is no interface between these two parts. Their placement is performed so that the border between the etched surface and the smooth mucosal part is about 2 mm below the bone level.
Parallel placement of the implants is preferred since it facilitates the passive fit of the framework and the fabrication of the immediate framework. However, tilting of the implants may be used as influenced by other factors such as the shortening of cantilevers. Such un-parallel placement does not create issues (within limits) since the path of insertion and the passive fit is achieved with external connections of conical morphology.

Intraoral welding of the metal framework

A rigid passively fitting metal framework, screwed on the implants or the implant abutments, is immediately constructed by Intraoral welding. This is a method that entails the welding of a titanium bar wire onto implant Ti tube sleeves.

Welding device

In the past several intra- or extra- oral devices have been applied clinically for orthodontics and laboratory procedures in prosthodontics. The WeldOne device, as it has been developed by Marco Degidi, is the evolution of the ones designed by Mondani & Mondani (1982) and Hruska (1987). The device comprises of a main body (Welding Unit) that generates electrical current of controllable magnitude and duration. The electric charge is transferred via cables to the copper poles located at the tips of a welding clamp. The clamp is equipped with a strong spring that assists to hold tightly in contact the Ti wire bar on the Ti implant sleeve during the electric discharge.

Welding sleeves and titanium bar/ wire complex

The welding sleeves consist of thick Ti tubes, suitable for welding. They are tall, cylindrical fixtures, screw retained either on the trans-mucosal abutments of the implants (Ankylos or Xive, Friedent, Dentsply, Germany) or directly on the platforms of the one-piece transmucosal implants (Xive TG, Friedent, Dentsply, Germany), thus by design assuming the role of copings of the future metal framework (Fig. 5). After the tight fixation of the welding sleeves on the implants, a 2 mm diameter Ti malleable wire bar is used to connect and splint them together. With the use of special wire bending and cutting pliers the titanium wire is bent according to the shape of the arch in order to achieve passive simultaneous contact with all the sleeves.

Intraoral welding

The welding process of the components proceeds in three stages.

a) Stabilization of the components in firm contact, which entails the application of the copper electrode tips of the welding pliers on the titanium wire and the abutment sleeve. The two components are held tightly in place with the help of a strong spring incorporated within the welding pliers.
b) The welding phase lasts 2-5 ms. The instant voltage difference that is created in the welding unit creates an electrical charge transferred by the connecting wires to the welding pliers and further more to the copper tips and through the Ti framework components. This event instantly increases the temperature in the contact points (1660 oC) and causes their fusion.
c) The cooling and crystallization phase is due to the vast difference in the thermal conductivity of the copper electrode tips (386) and the titanium components (19). The electrodes absorb the high temperature rapidly inducing cooling and crystallization of the fused titanium contact points without causing harm to the neighboring tissues.

Extraoral welding completion of the framework

At this point the sleeves are splinted by the Ti bar-

FIG. 7 The lower dental arch is stabilized in maximum intercuspation on the upper teeth with thermoplastic silicon.

FIG. 8 Additional acrylic resin completes the metal framework/altered denture complex at the laboratory thus finalized as a hybrid prosthesis.

wire and form a rigid arch (Fig. 6). The structure is unscrewed and checked for passive fit on the implants. Then the sleeves are shortened extraorally according to the patient's VDO. Smaller horizontal rods of 1,5mm diameter are used to reinforce the cantilever areas and vertical of 1mm diameter to provide the necessary support and retention for the teeth of the modified denture. The welding of these rods requires less current, since the fusing components are thinner.
The metal framework is tried-in intraorally with the dental arch of the modified denture in place and the correct VDO is confirmed. At this stage, the need for further lowering of the height of the sleeves is evaluated. Consequently the metal framework is sandblasted and is covered with an opaque resin (PMMA).

Stabilization of the maximum intercuspation and the registration

As the welded metal framework is tried in, the lower dental arch is stabilized in maximum intercuspation on the upper teeth with thermoplastic silicon (Fig. 7). The lower jaw is guided in centric relation at the predetermined vertical dimension. The adequacy of space and the support provided by the metal framework to the teeth is confirmed.
At the correct position, the metal framework / dental arch relationship is intraoraly stabilized with acrylic resin. Alternatively this relationship is recorded with registration material, and transferred on the articulator.

Laboratory finalization

The metal framework fixed with acrylic resin to the altered denture dental arch is completed with additional acrylic resin at the laboratory and is completed as hybrid prosthesis to be delivered to the patient (Fig. 8-10). When the relationship between the denture teeth and the Ti framework is registered with silicon putty, the whole complex is mounted on the articulator against the upper cast for completion and finishing.

FIG. 9 Intraoral picture of the transformed removable denture into a scew retained immediate prosthesis upon delivery.

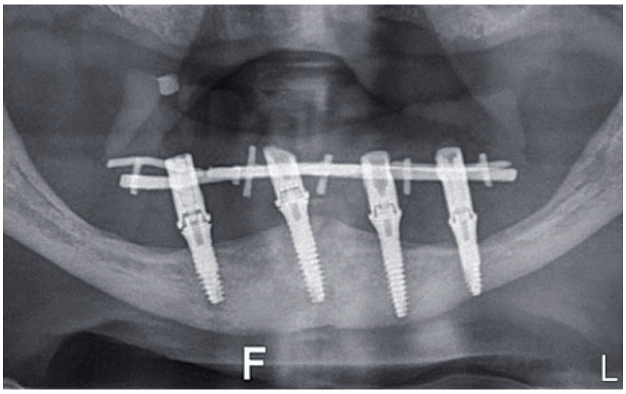

FIG. 10 Post-operative orthopantogram.

DISCUSSION

While immediate implant loading has been researched both experimentally and clinically and it has been confirmed as a viable clinical treatment option (11), it often presents a difficult task in the daily practice. The prerequisite of eliminating the lateral jiggling forces generating micro-movement of the immediately loaded and functioning implants during healing demands their immediate and rigid splinting (4). In full arch implant rehabilitation, this can be achieved at the same time only when a passively fitting metal framework connects and stabilizes the implants cross-arch. Yet, the fabrication of such metal framework implies a series of interchanging laboratory and clinical procedures imposing complexity in the "immediate" endeavor. The described technique of intraoral welding presents a simplified and clinically applicable approach. This technique can be applied seamlessly in the immediate transformation of full lower dentures into fixed implant-supported rehabilitations, satisfying both functional and esthetic demands immediately and efficiently.

The main functional improvement achieved by this method is the transformation of the removable character of a lower prosthesis, which introduces questionable retention and stability, into that of a fixed rehabilitation. If an upper full denture also exists its retention and stability will also improve by the increased posterior support provided by the fixed prosthesis in the lower arch, distributing the functional loads on the upper arch in a more favorable manner. When four anterior implants between the mental foramens are placed, the posterior occlusal support is provided in collaboration with distal cantilevers. In the case that the upper jaw presents full natural or fixed rehabilitated dentition, the treatment should include implants distal to the mental foramens in order to support the posterior occlusion and thus eliminating excessive loading on cantilevers.

An additional functional advantage to be considered is that the previously established parameters of occlusion that the patient has already been accustomed to, are maintained unaltered. The occlusal pattern of the denture, the preexisting occlusal plane and the horizontal and vertical overbite are directly incorporated into the new prosthesis. If needed, an alteration of the VDO can be considered and it is of course feasible.

Changes in dental esthetics are not a concern since this treatment is carried out provided that the dental composition of the existing lower denture teeth is esthetically acceptable for both the patient and the dentist. On the contrary, the esthetic advantage of this method is that the preexisting dental aspect remains unaltered. The only important esthetic change and improvement to be considered, is presented by the facial benefits that an increase of the VDO would offer if such an intervention were necessary.

The one-year postoperative follow-up of two cases thus delivered has confirmed the promised improvement of the quality of life of the patients. This outcome in combination with the quickness and cost effectiveness of such rehabilitation makes this method a treatment option of essential clinical interest.

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