Intra-oral welding of temporary implant abutments with a pre-fabricated titanium bar: A new technique for accelerated rigid splinting of immediately loaded implants

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_Introduction

Although initial considerations in implant dentistry have claimed that the process of osseointegration requires on average an undisturbed healing of three months in the mandible and six months in the maxilla [1-3], an increasing interest has been noticed with regard to early and immediate loading of implants to expedite the restorative outcome. Donath et al. reported that load exerted at the implant interface may interfere with the process of bone healing and lead to fibrous encapsulation.[4] However, clinical and experimental animal trials have shown that long-term success of removable and fixed prostheses of immediately loaded dental implants can be achieved.[5-21] In a clinical study involving the analysis of a substantial number of implants, Degidi et al. demonstrated the predictability and high success rates of immediate functional and non-functional loading.[22] Recently published results of a 7-year follow-up of immediately loaded implants revealed comparable outcomes for delayed loaded implants with a satisfactory level of osseointegration and high success rates. In addition, initial implant mobility does not inevitably prevent osseointegration.[24] In general, micromotion at the implant interface has to be distinguished from uncontrolled masticatory forces. The peri-implant bone adjusts its architecture according to its capacity to withstand functional loading. Consequently, the strains induced by these loads affect the bone remodeling process. It has been suggested in the literature that the magnitude of the load forces between the implant and the bone determines the implant success.[25] Therefore, one key to the success of titanium implants seems to be the adequate bone remodeling at the periphery of the implant.[26] Microstrain may be a favourable stimulus during the healing period of implants resulting in an increased bone density.[27-33] According to Brunski et al. implants can be loaded early or immediately, if micromovements above a threshold of 100 µm can be avoided during the healing phase.[34-37] Stronger movements would lead to soft tissue ingrowth at the interface rather than to the desired bone apposition. Cameron et al. reported that osseointegration can be achieved even with micromovements, but not with so-called macromovements.[38] In spite of the lack of a consistent terminology on the definition of micro- and macromovements, it has been suggested that a movement of 30 µm or less has no adverse effect on integration, while a movement of 150 µm or more results in soft connective tissue apposition to the implant.[39-41] In this context, it can no longer be assumed that immediate loading per se leads to the fibrous encapsulation of implants.[42]

A successful, accelerated protocol for implant rehabilitation depends upon several interactive factors: Beside accurate pre-surgical diagnostics and treatment planning, implant macro- and microdesign, the adequate fixation and immobility of the implant are of utmost importance to prevent the risk of micromovements related to the surrounding bone. Rigid splinting seems to have a significant impact on the peri-implant tissue response since it is able to reduce the mechanical stress exerted on each implant. A high predictability of immediate implant loading with fixed provisional restorations has been shown in several reports.[16,17,46] This indicates that rigid acrylic resin provisional restorations are able to confine the occlusal forces applied to the bone-to-implant interface to a physiological range. Material stability and fracture strength are essential in maintaining the rigidity of provisional restorations on immediately loaded implants over a longer period of time. However, long-span acrylic resin restorations are subject to flexion and fracture under occlusal forces. This applies in particular for a cross-arch stabilization of multiple implants in the edentulous mandible. All previously described techniques for reinforcement of acrylic resin provisional restorations involve either the use of a thin wire or fibers throughout the span, or a time consuming fabrication of a cast metal framework in the laboratory that covers the facial and/or lingual surfaces of the provisional restoration.[26,49-53] The objective of this article was to introduce a prosthetic concept for an accelerated rigid splinting of multiple implants for same-day immediate loading with metal-reinforced acrylic resin provisional restorations by utilizing the Syncrystallization technique.

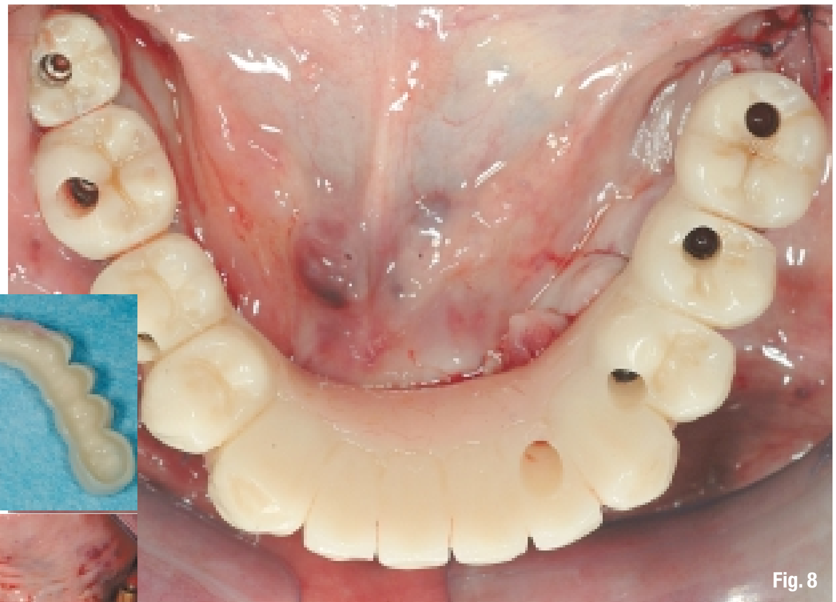
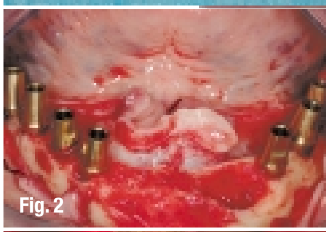


Fig. 8


Fig. 1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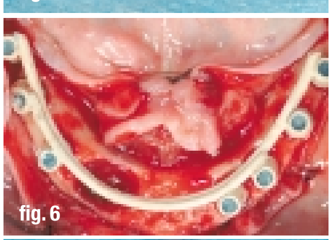
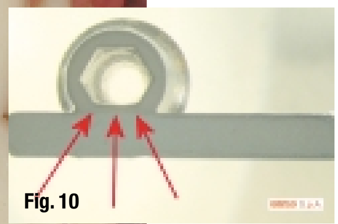
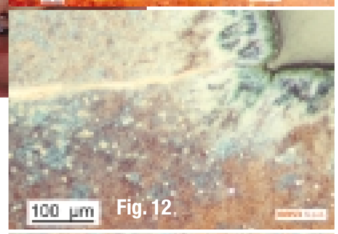


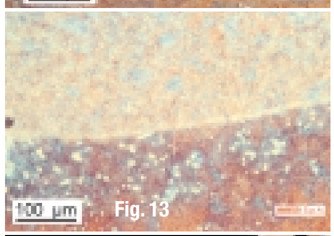
fig. 6

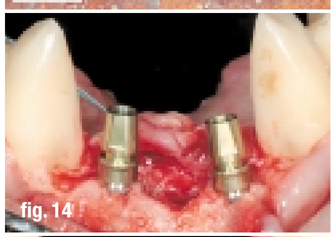

fig. 7

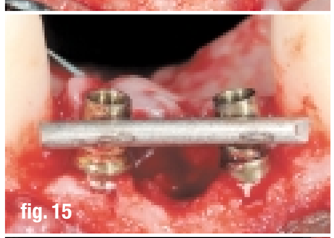
Fig.1_ Hollow acrylic resin provisional restoration prior to relining.
Fig. 2_ Clinical view after immediate extraction and immediate implant placement (Maestro® Biohorizons).
Fig. 3_ Occlusal view of intraoral welding process: Syncrystallization welding-clamps (System Argon Control®, IMPLAMED) holding implant abutment and titanium bar
Fig. 4_ Intraorally welded titanium bar.
Fig. 5_ Extraoral view of welding spot
Fig. 6_ Try-in of welded abutment-bar construction after opaque was applied.
Fig. 7_ Provisional metal reinforced restoration after relining, trimming, and polishing ready to be delivered 2 hours later.











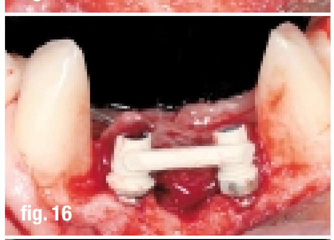


Fig. 8_ Occlusal view of screw-retained mandibular metal-reinforced provisional restoration in situ.
Fig. 9_ Labial view of maxillary prosthesis and mandibular provisional restoration.
Fig. 10_ Cross section of a welding joint at magnification. Temporary abutment (round section above) and titanium bar (straight section below).
Fig. 11_ Metal-graphic optical microscope picture (MOMP) of complete welding joint without defects.
Fig. 12_ Marginal part of welding joint by MOMP: Note interface of titanium oxide.
Fig. 13_ Central part of welding joint by MOMP: No titanium oxide interface present. Joint is complete (Syncrystallization).
Fig. 14_ Placement of two implants (XiVE®, DENTSPLY Friadent) after extraction of all lower incisors.
Fig. 15_ Temporary abutments and bar after intra-oral welding.
Fig. 16_ Framework after sandblasting and opaque appliance.
Fig. 17_ Temporary restoration relined with framework in situ.

_Clinical and Laboratory Procedure

A mucoperiosteal flap is elevated after crestal incision. Implants are placed following the respective manufacturers' instructions. A minimum insertion torque of 30 Ncm is used for all implants to assure clinical stablility. First, a face-bow transfer and centric relation record is utilized to mount the diagnostic casts on a semiadjustable articulator. Subsequently, a diagnostic wax-up for a preliminary provisional fixed restoration is fabricated and converted to autopolymerizing resin. After surgical placement of the implants, temporary titanium abutments are connected to them. If implants with an internal hexagon are used, the connection should be rounded before the welding process, avoiding a non-retrievability of the welded piece in case of pronounced disparallelism. The abutments used consisted of two parts (abutment and retaining screw) in order to ensure the retrievability of the welded piece. A pre-existing or prepared flat surface area served as the welding point. A titanium bar is shaped following the curvature of the implants positioned. At this point, temporary titanium implant abutments are welded with the titanium bar in the oral cavity, using the Syncrystallization Unit (System Argon Control, IMPLAMED, Cremona, Italy). The welding process is electrical and protected by an argon gas supply (Syncrystallization). The equipment allows the welding of metallic elements directly in the mouth. The two elements to be welded are placed between the two electrodes of a welding clamp. The energy contained in a previously unloaded battery of capacitors is transferred to the electrodes of the welding clamp. Current flowing through the contact points, being in contact with the parts to weld, warms up to the point of fusion, achieving a solid, welded junction. The welding cycle is subdivided in three stages: Pre-gas-, welding, and post-gas phase. While the pre-gas phase allows an oxygen-free welding point prior to the actual fusion, the post-gas phase ensures the absence of oxygen and subsequent oxidation during cooling. A barely perceptible sound can be perceived during use of the Syncrystallization Unit. Welding of the pieces takes only a fraction of a second. The process is carried out without producing any heat, causing no discomfort to the patient or damage to surrounding tissues. Finally, the prosthetic framework, created by welding the titanium bar to the implant abutments is removed and opaque is applied, in order to avoid metal shining through the acrylic resin. The provisional restoration is relined, trimmed, polished and screw-retained the same day. Occlusal contact is avoided in centric and lateral excursions.

_Conclusion

Prosthodontic challenges in fixed immediate temporization of multiple implants can be both safely and predictably addressed when using the Syncrystallization technique. In addition to rigid implant splinting, the provisional restoration serves as a guide for the final superstructure while esthetics and phonetics are evaluated for patient acceptance. The temporization procedure can be significantly accelerated and causes minimal discomfort or interruption in function and cosmetics for the patient. In comparison to mere acrylic superstructures, a significant reduction of deformation and strain within metal-reinforced provisional restorations could be detected. The advantages of the new technique are: (1) reduction of treatment time for immediate temporization at stage one surgery; (2) predictable fixation and immobility of implants in the early stages of bone healing; and (3) less time spent for repairing provisional restorations as a result of no or less frequent fracture._

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implants

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Rigid temporization has been recognized to have a significant impact on the peri-implant tissue response in immediate implant loading since it reduces the mechanical stress exerted on each implant. The objective of this article was to introduce a prosthetic concept for an accelerated rigid splinting of multiple implants for same-day immediate loading with metal-reinforced provisional restorations using a novel technique (Syncrystallization) of welding temporary implant abutments with a pre-fabricated titanium bar directly in the oral cavity.