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The Syncrystallization Technique: Expediting Rigid Splinting of Immediately Loaded Implants

According to **Peter Gehrke, DMD**, rigid temporization can have a significant impact on the peri-implant tissue response in immediate implant loading. He explains, "Rigid temporization reduces the mechanical stress exerted on each implant." In this issue of *Dental Implantology Update*, Gehrke describes a prosthetic concept for an accelerated rigid splinting of multiple implants for same-day immediate loading with metal-reinforced provisional restorations using a technique called "Syncrystallization": welding temporary implant abutments with a pre-fabricated titanium bar directly in the oral cavity. He notes that although initial considerations in implant dentistry claimed that the process of osseointegration required on average an undisturbed healing of three months in the mandible and six months in the maxilla,[1-3] early and immediate loading of implants to expedite the restorative outcome has received increasing interest.

Early Loading of Implants

Some researchers have noted, says Gehrke, 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 also shown that long-term success of removable and fixed prostheses of immediately loaded dental implants can be achieved.[5-23]

"In addition," he explains, "Initial implant mobility does not inevitably prevent osseointegration."[24] Gehrke notes that, generally, micromotion at the implant interface has to be distinguished from uncontrolled masticatory forces. He says, "The peri-implant bone adjusts its architecture according to its capacity to withstand functional loading, so the strains induced by these loads affect the bone remodeling process." The literature suggests 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] In fact, asserts

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Gehrke, "Microstrain may be a favorable stimulus during the healing period of implants, resulting in an increased bone density."[27-33]

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.

Additionally, Gehrke notes, 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 micromovements and macromovements, a movement of 30 µm or less appears to have 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, Gehrke concludes, "It can no longer be assumed that immediate loading per se leads to the fibrous encapsulation of implants."[42]

Osseointegration and Accelerated Protocol

A successful, accelerated protocol for implant rehabilitation depends upon several interrelated factors. Beside accurate pre-surgical diagnostics and treatment planning, as well as implant macrodesign 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. Due to its ability to reduce the mechanical stress exerted on each implant, rigid splinting seems to have a significant impact on the peri-implant tissue response.

Gehrke notes that a high predictability of immediate implant loading with fixed provisional restorations has been shown in several reports.[16,17,43] "This predictability," Gehrke maintains, "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." He goes on to say that material stability and fracture strength are essential in maintaining the rigidity of provisional restorations on immediately loaded implants over a longer period of time.

He cautions, however, that long-span acrylic resin restorations are subject to flexion and fracture under occlusal forces. This consequence applies in particular for a cross-arch stabilization of multiple implants in the edentulous mandible. 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.[26,44-48]

While some researchers have reported a method to reduce prosthetic misfit of implant-supported complete dentures using the combination of intra-oral luting and extra-oral laser welding,[49] others have introduced a time-effective intra-oral welding technique of titanium components for different dental and implant restorations to avoid long laboratory procedures.[50,51]

The Syncrystallization Technique

Gehrke describes the Syncrystallization technique as a clinical and laboratory procedure for a prosthetic concept for an accelerated rigid splinting of multiple implants for same-day immediate loading with metal-reinforced acrylic resin provisional restorations.

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 stability.

First, a facebow transfer and centric relation record are used to

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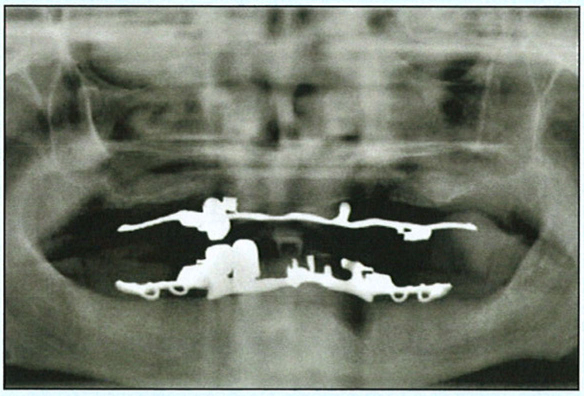

Figure 1: Pre-operative orthopantomograph X-ray.

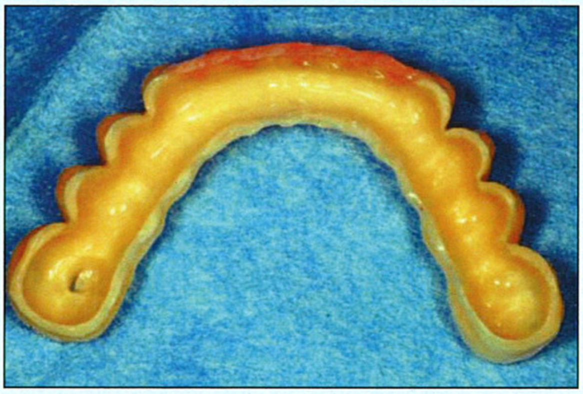

Figure 2: Hollow acrylic resin provisional restoration prior to relining.

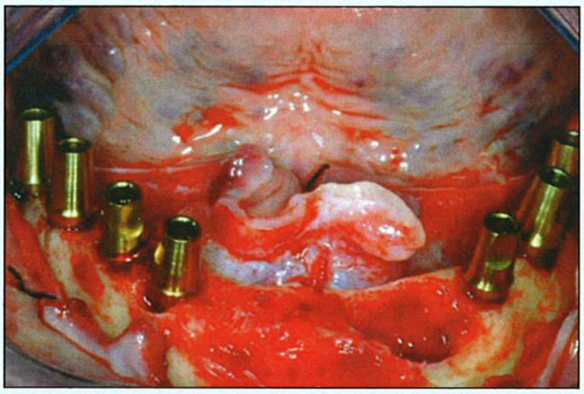

Figure 3: Clinical view after implant placement.

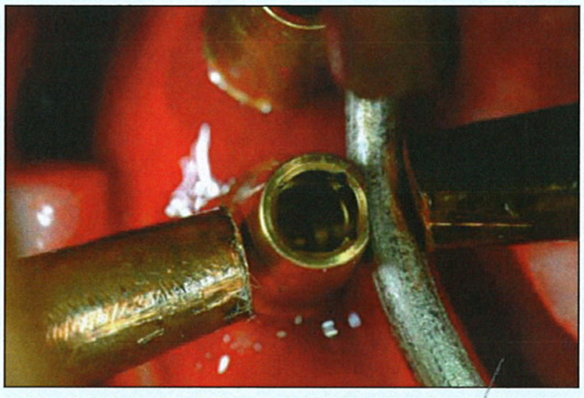

Figure 4: Occlusal view of intraoral welding process: Welding clamps holding implant abutment and titanium bar.

mount the diagnostic casts on a semi-adjustable 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 non-retrievability of the welded piece in case of pronounced disparallelism. The abutments consist of two parts (abutment and retaining screw) to ensure retrievability of the welded piece. A pre-existing or prepared flat surface area serves as the welding point. A titanium bar is shaped following the curvature of the implants positioned. At this point, temporary titanium implant abutments (TempBase, Dentsply Friadent, Germany) 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 into three stages: Pre-gas phase, welding phase, and post-gas phase. Whereas 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

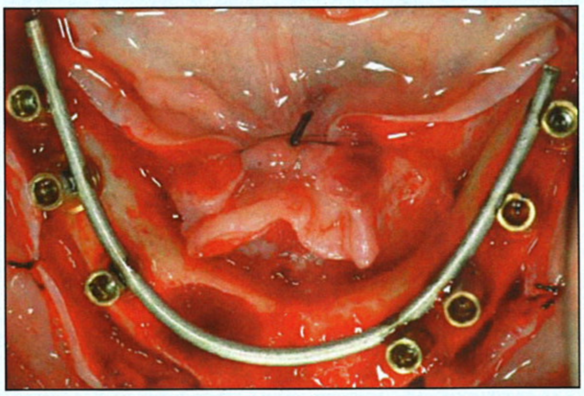

Figure 5: Intra-orally welded titanium bar.

Figure 6: Extra-oral view of welding spot.

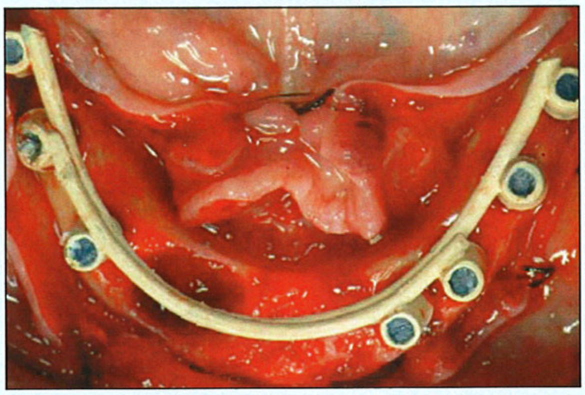

Figure 7: Try-in of welded abutment-bar construction after opaque application.

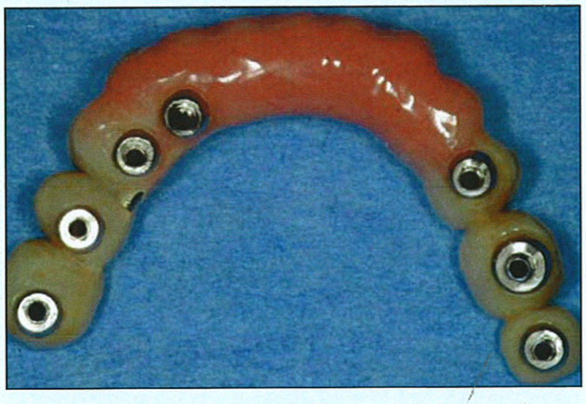

Figure 8: Provisional metal reinforced restoration after relining, trimming, and polishing; ready to be delivered two hours later.

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 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.

Figures 1-10 depict the Syncrystallization technique, from pre-operative to postoperative orthopantomograph X-ray. Figures 11 and 12 provide magnified views of the welding joint.

Conclusion

"Prosthodontic challenges in fixed immediate temporization of multiple implants," Gehrke says, "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 aesthetics 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.

Gehrke concludes, "Although using the Syncrystallization unit needs no specific training, an excellent collaboration between the experienced restorative surgeon and the laboratory team is desirable." The advantages of the new technique

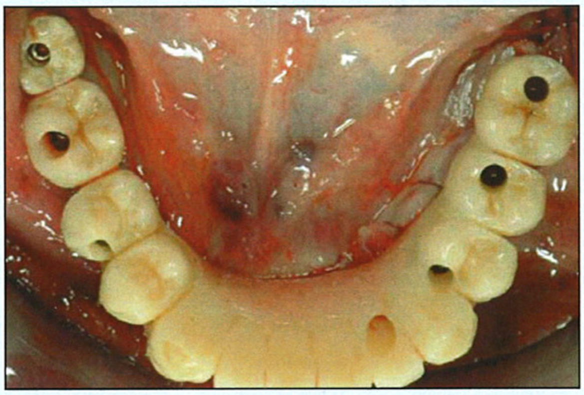

Figure 9: Occlusal view of screw-retained mandibular metal-reinforced provisional restoration in situ.

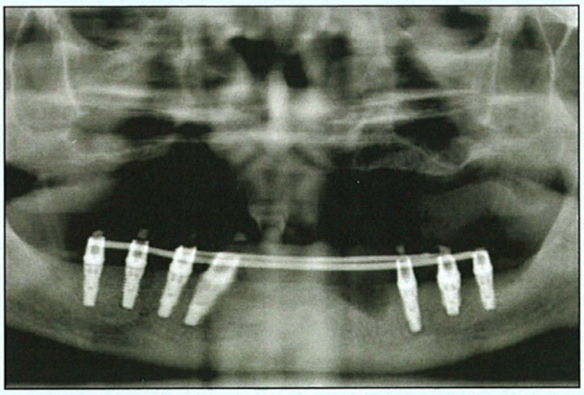

Figure 10: Immediate postoperative orthopantomograph X-ray.

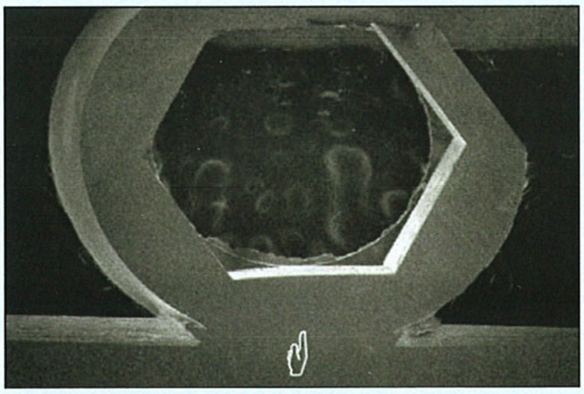

Figure 11: Cross-section of a welding joint at 20-fold magnification. Temporary abutment (round section above) and titanium bar (straight section below).

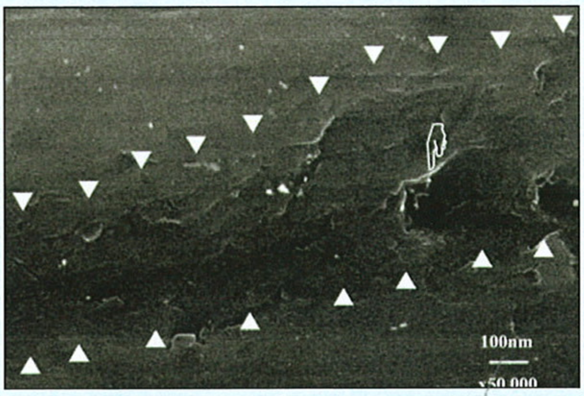

Figure 12: Welding joint at 50,000-fold magnification. Only minor porosity can be detected.

include reduction of treatment time for immediate temporization at stage one surgery, predictable fixation and immobility of implants in the early stages of bone healing, and less time spent for repairing provisional restorations as a result of no, or less frequent, fracture.

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Clinically Significant ABSTRACTS

Nagasao T, Miyamoto J, Jin H, et al. **The dynamics in implantation for patients with clefts.** *Cleft Palate Craniofac J* 2006; 43:84-91.

The objective of this study was to investigate the stresses and strains of an endosseous dental implant in patients with different types of cleft palate in a finite element model.

Seven three-dimensional (3D) maxillary models were designed on a personal computer according to computed tomography slice data obtained from seven dry skulls. Next, computer-aided modification was performed on each model to produce three other 3D models with different cleft patterns. Thus, four model types with different cleft patterns were designed and termed norm (without cleft), alveolar (only alveolar cleft), palatal (only palatal cleft), and complete (complete cleft). An implant was embedded into the molar region of each model, and 300-N vertical and 50-N horizontal loads were applied to simulate mastication. Under these conditions, the stresses occurring at the implant-bone interface were calculated by finite element analysis.

Different stress patterns were observed between the models with a palatal cleft (palatal and complete) and those without palatal cleft (norm and alveolar). Regarding vertical load application, greater stresses occurred in palatal and complete types than in norm and alveolar types. On application of a horizontal load, though the stresses did not show quantitative difference, their vector patterns differed.

In patients with palatal clefts, characteristic stress patterns occur on the bone-implant interface during mastication. This should be taken into consideration when performing an implant treatment in patients with clefts. ▼

Yamamoto H, Shibata Y, Tachikawa T, et al. **In vivo performance of two different hydroxyapatite coatings on titanium prepared by discharging in electrolytes.** *J Biomed Mater Res B Appl Biomater* 2005 Dec 16; [Epub ahead of print].

This study reports a discharging method for bone-like carbonated