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Complexity's Solution

*By Rafael Del Castillo, DDS, and
Juan Carlos Delgado (Spain)*

**Protocol for the Rehabilitation of the Atrophic Maxilla
with Full-Arch, Implant-Supported, Screw-Retained,
Metal-Ceramic Restorations.**

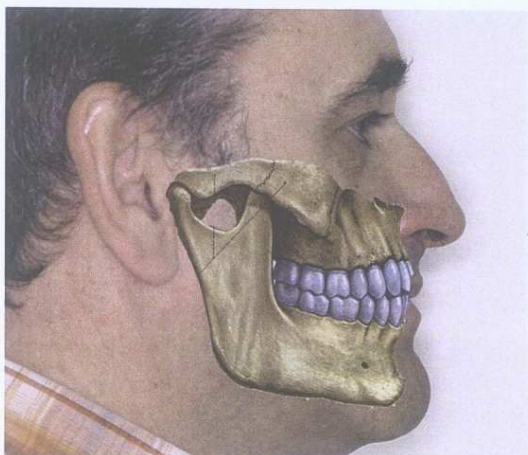
Rehabilitation of the moderate to severe atrophic maxilla, the wasting away of the upper jaw, with an implant-supported restoration is a challenge for the restorative team due to anatomic limitations and loss of natural dentition.

An accurate diagnosis, evaluating extra-oral factors such as facial support, lip support, smile line and esthetic plane and intraoral factors such as alveolar crest morphology, quantity and quality of the mucosa, crown to bone relationship, phonetics and maxilomandibular relationship, as well as the patient's attitude and expectations, allows the elaboration of a successful treatment plan.¹ From the surgical, prosthetic and technical perspectives, the restoration of the fully edentulous patient utilizing a fixed, metal-ceramic, implant-supported prosthesis is conceivably one of contemporary dentistry's most complicated tasks.

It is especially in these cases that the concept of the team approach (prosthodontist, surgeon and dental technician) to treat these complex cases acquires all its relevance. A treatment protocol should be developed by team members on the basis of a multidisciplinary approach.²

Many patients prefer a fixed restoration to be utilized to restore both esthetics and function.³ At the same time, from the technical and restorative point of view, these reconstructions must meet certain requirements such as, simplicity during fabrication and insertion, ease of retrievability, hygiene and function.

Full-arch screw-retained implant-supported restorations represent one of the available options for restoring completely edentulous patients. The main reason for using screw-retained implant-supported restorations is the possibility of prosthesis retrieval for hygiene or technical reasons.⁴ However, achieving passive fit is difficult when fabricating screw-retained restorations, especially in fully edentulous patients, where the amount of hard and soft tissue loss is considerable, and disparallelism of the implants is present.



Figures 1 and 2

Composition representing the significance of transferring maxillary arch position to a semi-adjustable articulator.

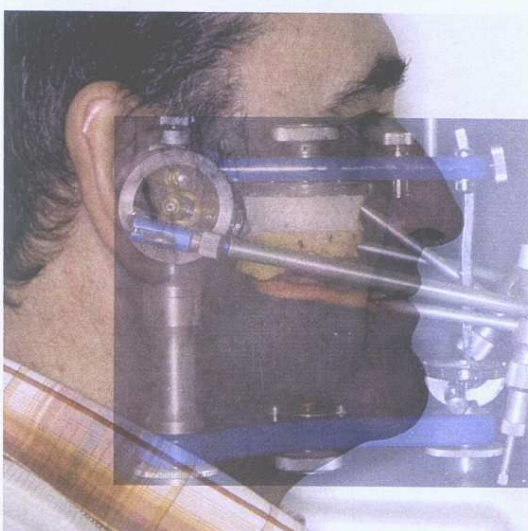


Figure 3

(Below.) Pre-treatment photograph of patient, with a medium smile, used to determine the amount of tooth exposure and position of incisal edge in relation to vermilion of lower lip.



Take a World View

The international technical issue returns next month featuring articles from Brazil, England, Greece, Russia and the United States. *Complexity's Solution* was written by a dentist and technician team from Spain and gives you a taste of the interesting perspectives you'll be reading in the February issue of the *Journal of Dental Technology*.

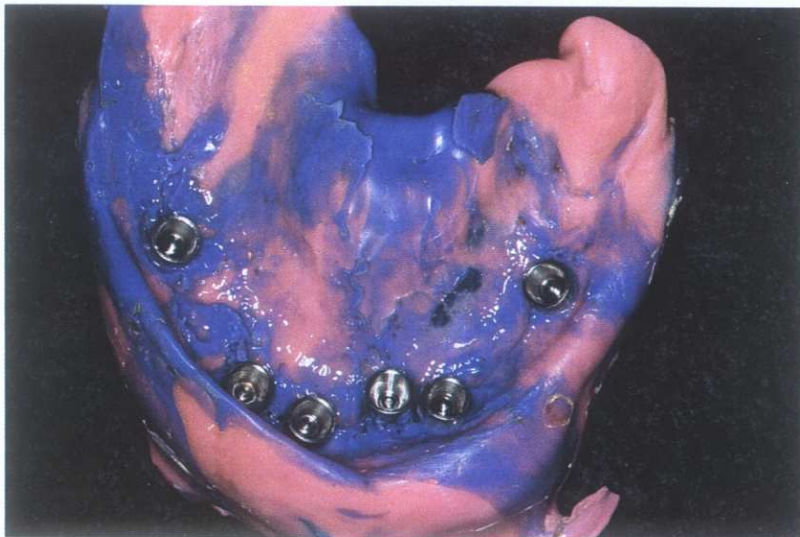
Figure 4

Intraoral pre-treatment view of the patient in maximum intercuspation.



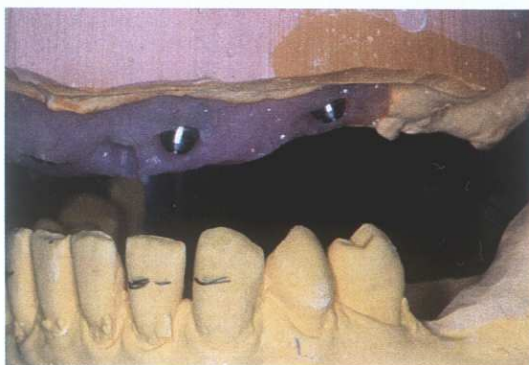
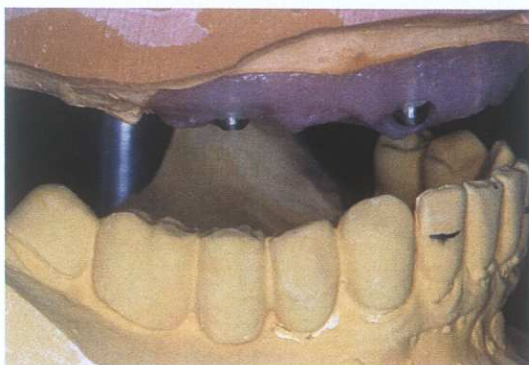
Figure 5

(Below.) Completed abutment-level impression. Polyether impression material and custom resin tray were used for this procedure.



Figures 6 and 7

Right and left view of master casts mounted in the articulator ready for the immediate provisional restoration fabrication. Observe the reverse curve of the occlusal plane present in the mandibular right quadrant.



Recently, new methods for framework fabrication have been introduced for achieving passive fit, such as the Cresco System™ (Astra Tech AB, Sweden). This new system represents a simplified and cost-effective technique that minimizes misfit between a cast framework and the supporting dental implants while correcting the angulation of misaligned implants.^{5,6} The possibility of repositioning the screw-access openings to a more favorable location, along with the method employed for achieving passive fit with this system, has simplified the fabrication of full-arch implant-supported screw-retained restorations.

An accurate diagnosis is one of the key factors for achieving excellence in any complex case where esthetics plays a basic role. This must include:

1. An accurate mounting of the diagnostic casts on a semi-adjustable articulator.
2. Pre-treatment photos of the patient's smile with different lip positions (during rest, speech and broad smile).

Diagnostic mounting on a semi-adjustable articulator must be done in the first place by recording the position of the maxillary arch, in relation to a reference plane (Figures 1 and 2). Because esthetics and the occlusal scheme can be affected by an erroneous orientation of the maxillary cast on the articulator, accurate orientation the maxillary cast to a reference plane, plays a basic role during treatment planning and execution. Gonzalez and Kingery⁷ suggested that although the most logical plane of reference to use in making facebow records is the axis-orbital, because it is the least variable and the most easily established, placing this plane horizontal on the articulator is erroneous because it is not horizontal in the patient. Its posterior condylar point is an average of 7mm below the Frankfort horizontal plane.⁸ At the same time, the discrepancy between the sagittal orientation of the axis-orbital plane in the patient and the horizontal plane established between the orbital indicators and the condylar axis found in semi-adjustable articulators, will increase the sagittal inclination of the maxillary cast posteriorly on the articulator.

Gonzalez and Kingery⁷ suggested that compensation for the error in the location of the points of reference could be accomplished by placing the orbital pointer of the facebow 7mm below instead of on the orbitale of the patient during the transfer of the facebow record. When the facebow record is then transferred to the articulator, the patient's

relationship of this plane of reference will be maintained because the condylar axis and the orbital indicator of the articulator are also on a horizontal plane. This approach is valuable due to the possibility that it gives the clinician and the laboratory technician to communicate in an effective and error-free manner.⁹ As a matter of fact, when the technician observes the casts mounted on the articulator from such a corrected facebow, he or she can evaluate the features of that dentition (length of teeth, cant of the occlusal plane, inclination of the midline, etc.), being certain of the relationship that they have with the horizon. The technician will be able to look at the casts on the articulator in the same way the clinician observes the patient (Figures 1 and 2).

Pre-treatment clinical photographs will provide the treatment team the necessary information to determine the amount of corrections needed in the anterior teeth in the provisional restoration before any definitive procedure is undertaken (Figures 3 and 4). If performed accurately, the clinician and the dental technician will be able to use and transfer the information for the fabrication of the definitive restoration, thus using the provisional prosthesis as true prototype.

In cases where the treatment plan includes an immediate loading implant protocol, as it was planned for this patient, this approach is even more critical. Following implant insertion, an abutment-level pick-up impression with an open tray was made and master cast was fabricated (Figure 5). Facebow transfer and an accurate record of the patient's VDO and centric occlusion were then performed to complete the mounting of the master casts on the articulator (Figures 6 and 7). Autopolymerizing acrylic resin and acrylic denture teeth were used for the fabrication of the screw-retained immediate provisional fixed restoration. In order to provide reinforcement for the provisional restoration, a 0.040-inch stainless steel orthodontic wire was bent and adjusted in the palatal aspect of the implant temporary abutments. Insertion of the provisional prosthesis was done within the initial 24 hours after the insertion of the implant fixtures (Figures 8 and 9).

New clinical photos were taken five months after the insertion of the provisional restoration to carefully evaluate esthetics and lip support, and to determine if any correction was needed before the fabrication of the definitive prosthesis (Figure 10).



Figure 8

Occlusal view of the immediate provisional fixed prosthesis fabricated within 24 hours after implant insertion. Five implants were used to support this restoration, while one implant was unloaded to simplify provisional restoration fabrication.



Figure 9

Anterior view of the immediately provisional fixed restoration in centric occlusion after initial soft tissue healing.



Figure 10 Esthetic result of the immediate provisional screw-retained restoration with the lips in repose. Note the inclination of the incisal plane towards the right side.



Figure 11 Esthetic wax try-in with the patient showing a medium smile. Inclination of the incisal plane and position of the anterior teeth observed in the immediate provisional restoration was corrected.



Figure 12

Metal framework substructure screwed on the master cast after casting, laser welding (for passive fit purposes, as indicated by the Cresco™ Precision Method) and initial polishing. Observe the metal bar soldered between lingual aspects of the last molars, used to counteract metal framework deformation during porcelain firing.

Figure 13

Pink porcelain buttons made by mixing modifiers and dentin masses.

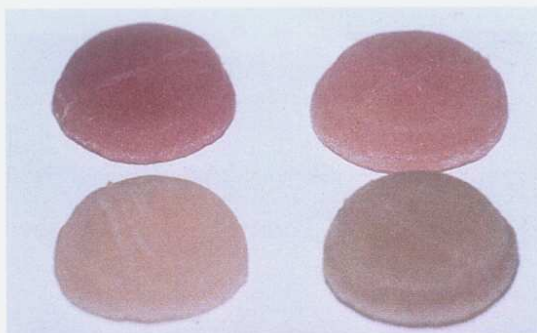
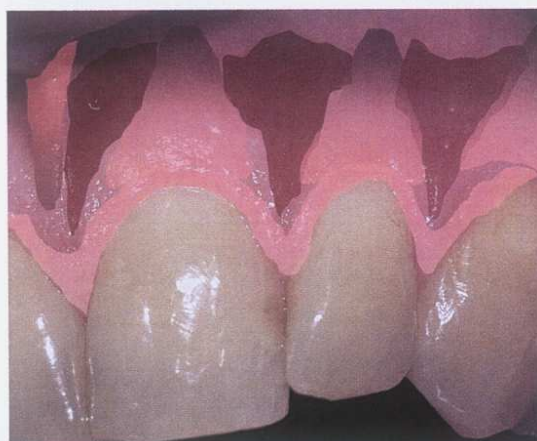


Figure 14

Schematic representation of simple gingival porcelain stratification based on gingival tissue hues and chromas.



Figures 15 A, B and C

Lateral and anterior views of definitive metal-ceramic restoration. Note porcelain stratification and translucency both in tooth anatomy and gingival porcelain.



Figure 16

Occlusal view of the definitive restoration before insertion. Pontic areas of the final restoration must be perfectly polished. A convex design in these areas is necessary to avoid food entrapment and reduce plaque accumulation.



It was observed that the incisal plane was inclined towards the right side. A new wax try-in was therefore done using a screw-retained light-polymerized resin base supported by two implants. Acrylic denture teeth were remounted in order to establish proper incisal plane orientation and anterior teeth position (Figure 11). It is of utmost importance for the success of the final restoration that these changes are transmitted accurately to the dental technician, with all the esthetic parameters already examined and approved by the clinician and the patient.

The amount of bone reabsorption and soft tissue loss was evaluated using silicone matrices fabricated from the buccal and occlusal aspects of the diagnostic wax-up. These indexes allowed to establish the crown to bone ratio, the length of the denture teeth and the amount of wax needed to set the denture teeth on the custom resin tray. These parameters will provide the necessary esthetic and functional information to assist the ceramist in the fabrication of the definitive metal substructure and to determine the amount of labial support needed to be restored with gingival porcelain in the definitive metal-ceramic restoration.

A metal framework for a full-arch implant-supported screw-retained fixed restoration was fabricated using the technical and laboratory procedures proposed by the CrescoTM Precision Method (Astra Tech AB, Sweden).^{5,6} A noble alloy (Cerapall 6, Metalor Technologies SA., Switzerland.) was used for this procedure (Figure 12). After metal framework passive fit verification in the laboratory and clinically, the metal substructure was returned to the ceramist for veneering porcelain application and fabrication of the final metal-ceramic, implant-supported, screw-retained restoration. It is advisable that during initial porcelain application and firing, first define dental anatomy and, later on, gingival anatomy with pink porcelain masses. This protocol will avoid mixing porcelain masses of different colors.

The gingival porcelain used in this case was Creation Porcelain (Creation Willi Geller International AG and KLEMA, Austria.) This kit is conformed by only two colors: Hell pink (clear) and Dunkel pink (more saturated). Mixing both masses together or in combination with conventional dentin masses allows obtaining a range of pink colors, large enough to obtain the different hues and chromas clinically observed in the gingi-

val tissues (Figure 13).¹⁰ Areas corresponding to the alveolar mucosa are the areas with higher vascularity, thus darker gingival ceramic masses were used (Dunkel pink 100 percent), whereas areas corresponding to the attached gingiva, where blood supply is reduced and the colour is more whitish-beige, less saturated and lighter ceramic masses were used (Hell pink + D2 Dentine). At the same time, Hell pink (100 percent) was used on top of the areas corresponding to the attached gingiva since this is the gingival porcelain that will provide these areas with a more natural appearance. More translucent porcelain (Hell pink + A1 Dentine) was used in areas of the gingival sulcus, since these are the areas with less vascular supply. The labial fraenum also shows a more luminous whitish-beige colour, in contrast with the alveolar mucosa areas (Figure 14).

After glazing and polishing (Figures 15 A, 15B and 15C), final metal-ceramic prosthesis was inserted using titanium prosthetic screws tightened manually. Screw access openings were then sealed with a cotton pellet and composite resin. It is important that the tissue aspect of the gingival porcelain to be in contact with the gingival tissues does not show a ridge lap design. On the other hand, pontic areas should be as convex as possible to avoid food entrapment. At the time of prosthesis insertion, pontic areas must exert light pressure on the gingival tissues. This design will facilitate an adequate hygiene, thus reducing plaque accumulation (Figure 16).

Occlusal design in the right side was established applying the removable prosthodontics concept of lingualized occlusion¹¹ due to the reverse curve occlusal plane outlined by the FPD supported by teeth 27 and 31 (Figures 17A and 17B). This design allowed two features. First, the maxillary lingual cusps were used as centric holding cusps, articulating with the occlusal surfaces of opposing FPD, and second, the esthetic plane was maintained by the maxillary buccal cusps. This occlusal design gave the illusory perception of a highly esthetic restoration without jeopardizing occlusal function (Figures 18, 19 and 20).

By incorporating techniques from fixed and removable prosthodontics, the treatment team had full control of the prosthesis and, consequently, the fabrication of the full-arch, implant-supported, metal-ceramic reconstruction became a more straightforward procedure. The clinical protocol



Figures 17 A and B

Lateral views of the occlusal design in the right and left side. In the right side, the buccal cusps of the maxillary second premolar and first molar do not contact mandibular teeth for esthetic purposes.

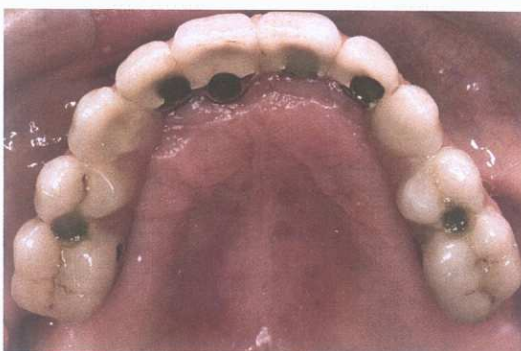


Figure 18

Occlusal view of definitive prosthesis after insertion. The laboratory protocol allowed positioning the screw-access holes in areas where esthetics was not compromised while easy accessibility was maintained.



Figure 19

Anterior view of the final metal ceramic restoration in occlusion after insertion. Metal collars present on teeth 12 and 22 were not an esthetic problem due to the low smile line of the patient.

Figure 20

Esthetic results with the patient with a medium smile after treatment completion.



Chicago's Sizzle

Co-author Rafael Del Castillo, DDS is the reserve speaker for this year's American Prosthodontic Society meeting Feb. 21-22 in Chicago. To find out more about the seminars and continuing education courses available during the Midwinter Meetings see the course guide in this issue of the *Journal of Dental Technology*. Find out more about the APS meeting at www.prostho.org or by calling (877) 499-3500.

using the diagnostic mounting of both the study casts and the master casts by means of a facebow and a centric occlusion record on a semi-adjustable articulator, together with pre-treatment and treatment clinical photographs of the patient's anterior aesthetics, allowed the clinician and the laboratory technician to communicate in an effective and error-free manner. The treatment team was able to complete the fabrication of the definitive metal-ceramic reconstruction without the need of a bisque try-in appointment, because all the esthetic and functional parameters had already been tested and approved by the clinician and the patient during the provisional phase of treatment. These circumstances allowed expediting the fabrication of the definitive restoration, thus reducing clinical appointments and consequently chair time with the patient. **JDT**

About the Authors

Del Castillo graduated from the University of Granada, Spain, in 1995. He earned a Specialist in Prosthodontics certificate from the University of Rochester, Rochester, NY, in 1999. He is the author of several clinical and scientific articles published in international peer reviewed journals. Del Castillo's private practice in Alicante, Spain, is limited to restorative dentistry and prosthodontic.

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