

A Simplified Dental Protocol for the Construction of Implant/Mucosal Supported Removable Prosthesis.

The removable prosthesis with implant - mucosal support combines the aesthetic advantages of a removable prosthesis with the stability given by the implants. The protocol for of this type of prostheses may be intricate, both for the clinician and for the dental technician. This work illustrates a simplified dental protocol, which has, as its starting point, the recognition of a diagnostic prosthesis. This is used as a guide for the placement of implants and, once duplicated, for the impression for registration of the occlusal relationships and for obtaining an aesthetic prototype. Also the management of milled bar becomes simplified, thanks to the use of attachments with reduced dimensions, and the superstructure, made of PEEK. Following what is illustrated in the article it is possible to provide the patient with an aesthetic prosthesis, stable and easily maintainable from the hygienic point of view.



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Introduction:

Gradually more, edentulous patients present to the attention of the clinician with a precise request: to have a fixed prosthesis. However, mostly in the lower jaw, the implant-prosthetic treatment presents no particular technical difficulties; in the upper arch, instead there are a number of variables that is essential to keep in mind during the commencement of the treatment plan. If those elements are undervalued, a potential failure may easily occur. The shape of the jawbone and of the soft tissues can hold back the patient to the cleansing of the prosthesis that, too often, is fabricated trying to meet only the aesthetic needs, ignoring the importance of hygiene, basic requirement for the long-term success of the treatment^{1,2}. For these reasons, prosthesis with implants should be designed prior to their placement, whose insertion must be "guided" by the prosthesis itself³. Added to this, in the upper arch, more than in the inferior, the shape and the position of the lip strongly contribute to the aesthetics; indeed the perioral tissues must be correctly supported in order to restore facial harmony and the fonetics⁴.

On the basis of the above, the removable prosthesis with implant and mucosal support finds its application. This type of prosthesis is also called "hybrid", on one hand the implants perform a supporting function (like a Toronto Bridge) and not only as retention (as in the overdenture), on the other hand the prosthesis still remains removable from the patient. In particular, according to the classification of Misch, we speak of removable prosthesis "RP4" when the prosthesis is completely implant supported and of removable prosthesis "RP-5" when the prosthesis is implant and mucosal supported⁵. The latter type, subject of this work, is indicated when are present simultaneously 1) the patient's request for an implant-supported and 2) the need of a good support of the lips with a flange. In fact, a vestibular fixed flange will impede the patient's ability to maintain a proper hygiene, causing

the loss of the implants. Combining the use of implants and of a removable prosthesis, the clinician is able to offer the patient a stable, aesthetic, easily cleanable prosthesis, without the palate flange.

The purpose of this article is to provide a simplified technical protocol, compared to the classical one, with the intention to increase the accuracy of the restoration and to decrease the difficulty of implementation and the necessary time of processing.

Clinical Case:

The patient, male, 54 years old, non-smoker, with no major clinical diseases, came to the attention of the clinician with an upper edentulous arch. Teeth present from 34 to 45. The upper was incongruous, and caused some difficulties in chewing and phonation. The patient manifested a psychological discomfort due to its oral condition in relation to his age, which hindered the dialogue with his co-workers; He also expressed the wish to replace the removable upper dentures with implants, quoting his own words, "something that will stay fixed in the mouth and without palate."

The clinician started with a construction in the upper jaw of a new provisional but still complete removable prosthesis for diagnostic purposes, and with the periodontal treatment of the lower arch, with a provisional and removable partial denture. Once restored the aesthetics and a correct occlusal plane, it was clear that the upper lip must be supported by the buccal flange. Some diagnostic tests were then performed to study the placement of implants with a panoramic radiography, and a CBCT. In accordance with the patient, the clinician processes the following treatment plan: insertion of four implants, in 14, 12, 22 and 24, and the construction of an implant - mucosal supported prosthesis with a milled bar on the upper arch; a removable partial denture in the lower jaw.

Once the implants placed, whose position was established according to

the availability of the bone and to the prosthetic requirements, the patient waited for the osseointegration with the complete temporary prosthesis, suitably modified. In this period, the patient was subjected to the periodontal maintenance therapy. The same prosthesis was used as a base for the final restoration.

Treatment

Implementation of the transparent acrylic resin replica

Within the temporary prosthesis was positioned a precision silicone with a hardness of 70 Shore-A. The prosthesis and model silicone thus obtained were placed in a flask. It was then applied an insulator (insulating silicone spray, Transformer) and another silicone was placed between the replica and the cover of the flask, which was closed and held in place until the full curing of the silicone. The prosthesis was removed from the flask and two holes through the upper silicon (one of 0.5 cm diameter for the input channel, ad one of 0.3 cm for the output channel) to allow the injection of the transparent acrylic resin. The resin was mixed and injected inside the flask, which was maintained at 50°C for 25 min at a pressure of 2.5 bars. Once cured, the flask was opened and the replica was finished with rotary instruments mounted on a laboratory hand piece and delivered to the clinician.

Impression with the prosthesis replica

The transparent resin replica was used in a single chairside appointment, as customized tray, as a reference of the teeth set-up (control of the vertical dimension, the masticatory plane and the relationship with the antagonist), and as a first test of the aesthetics (smile line, midline, etc). The clinician proceeded with the insertion of the replica in the oral cavity, checking the occlusion and removing the wrong occlusal contacts. The precise occlusion was then recorded using an addition fast curing silicone. The replica has been perforated in correspondence with the emergence of the implants, and daubed with adhesive. For the impression an

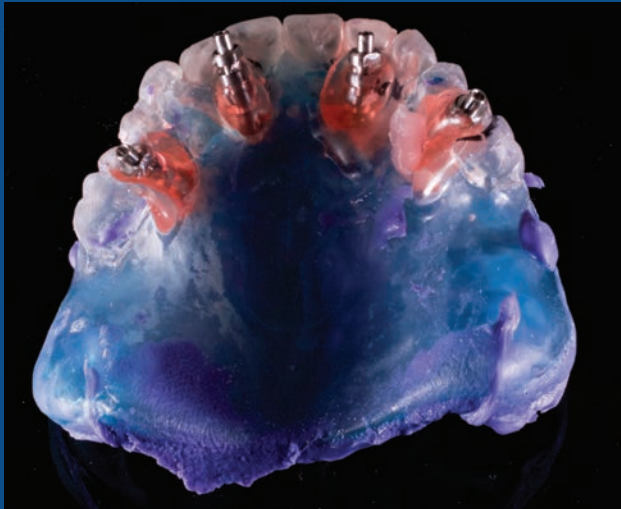


Fig. 1 — Impression obtained with the prosthesis replica

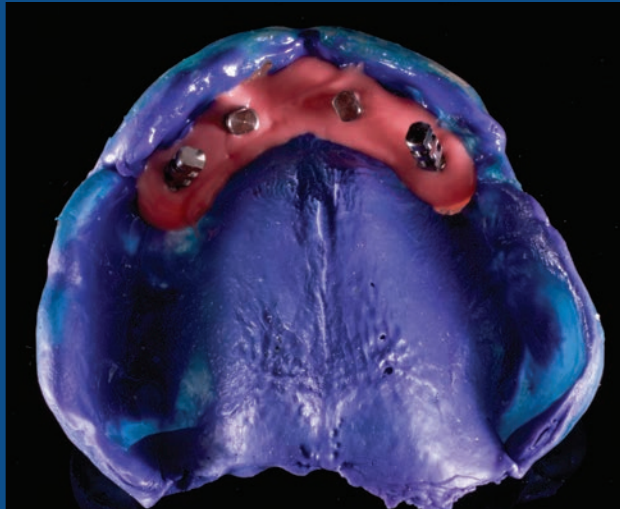


Fig. 2 — Placing of the laboratory analogs and the artificial gingiva

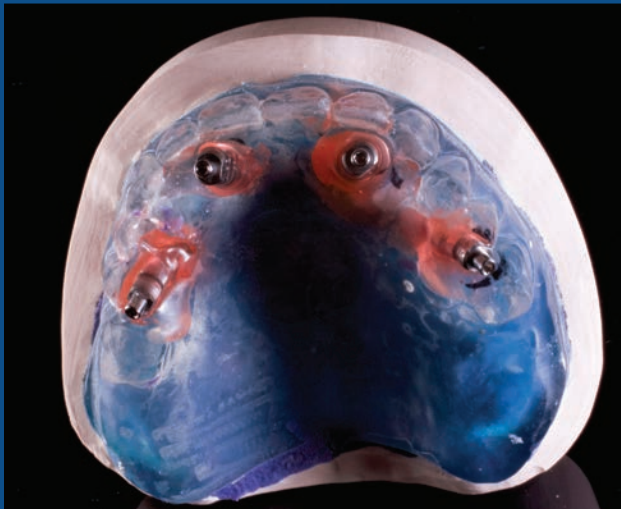


Fig. 3 — Master model



Fig. 4 — Master model with the artificial gingiva and analogs in position

In addition, silicone has been used and the replica was maintained in position by the patient with his own bite until the complete polymerization occurs; before its removal, a face bow was recorded. After removing the replica from the oral cavity, the silicone inside the holes was removed with a scalpel to allow the insertion of the pick-up transfers. The replica was placed back into the oral cavity and the transfers were screwed on the implants. Keeping the prosthesis in place, the transfers were blocked to the replica using the light-curing resin with low shrinkage. The fixing screws were removed from the transfers and the impression was delivered to the laboratory after the disinfection protocol (Fig.1).

Fabrication of the master model and of the aesthetic try-in

In the area around the transfers, was put a silicone reproducing the soft tissues, after that a proper insulation has been daubed (Fig. 2). The master model was poured by developing the impression obtained with the replica with a class IV plaster; according to the manufacturer's instructions (Fig. 3, 4). Once hardened, the transfers have been removed and the master model has been positioned on the articulator using the replica and the face bow. The antagonist model was placed on the articulator with the silicone bite. With a light curing resin the rims' produced the basis for aesthetic set-up. Since the treatment plan involved

the construction of a milled bar and a superstructure, in order to reduce the encumbrance of the prosthesis a set of preformed composite veneers were used. With the models positioned on the articulator, the veneers were placed on the resin basis, following the aesthetics indications of the transparent replica, using a hard wax (Fig. 5). In agreement with the patient, the following set of teeth were selected: the I47 set of for the anterior teeth and the L3 form for the posterior teeth. The purpose of this first assembly is to obtain an aesthetic prototype to be delivered to the clinician.

Aesthetic try-in

The patient was given the opportunity



Fig. 5 — Aesthetic prototype



Fig. 6 — Try-in of the aesthetic prototype



Fig. 7 — Reference mask on the articulator

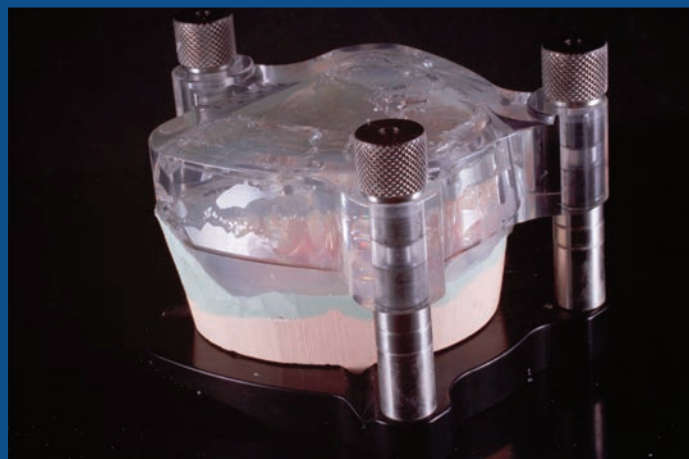


Fig. 8 — Transparent flask for future finalization

to evaluate the aesthetic result of the restoration prior to the finalization. The clinician with the set-up inside the patient's mouth evaluated the aesthetics, phonetics, overall dimensions of the buccal flanges and the resulting support of the upper lip and color of the dental elements. The occlusal relationships were also controlled, together with the protrusive and lateral movements (Fig. 6). The needed adjustments were made directly to the chair, being the aesthetic facets mounted on wax. With the patient's agreement, the prototype has been delivered to the laboratory after the disinfection protocol.

Realization of the bar

In order to preserve the changes made by the clinician, a silicone key was created (Universal, Transformer) using the articulator (Fig. 7). Subsequently,

the master model and the aesthetic prototype were positioned inside a flask, using the plexiglass cover, suitable for the light curing of the composite. Two wax pins for spruing were connected to the prototype to create the injection channels, the flask once closed was injected with a transparent silicone 22 Shore-A, (Fig. 8). Once cured, the prototype and the master model were removed from the flask and digitized through a laboratory scanner and then the files were loaded in a modeling software, Exocad (Fig. 9). The design of the primary bar has been relative accordingly to the teeth set-up in order to put the attachments perpendicular to the occlusal plane. The bar surface facing the gingiva has been drawn convex, to minimize the accumulation of plaque / food and to facilitate the maneuvers of hygiene. Using CAD / CAM technique, the bar

has been obtained by milling from a solid titanium alloy block (Fig. 10, 11). Four attachments, with the respective housings, were put on the bar. The attachment chosen (OT Equator) has a reduced vertical dimension compared to the spherical attachments, which allows saving space with an even stronger retention. Such attachments have been screwed directly into the thread inside the bar created directly by the milling center: This avoided the use of adhesive materials or to perform a weld (Fig. 12). Those threaded attachments, allow their quick and easy replacement, without removing the bar. The bar with the attachments screwed was delivered to the clinician.

Verification of the liabilities of the bar

The clinician proceeded to screw the bar on the abutments, verifying its passive seating (Fig. 13). The

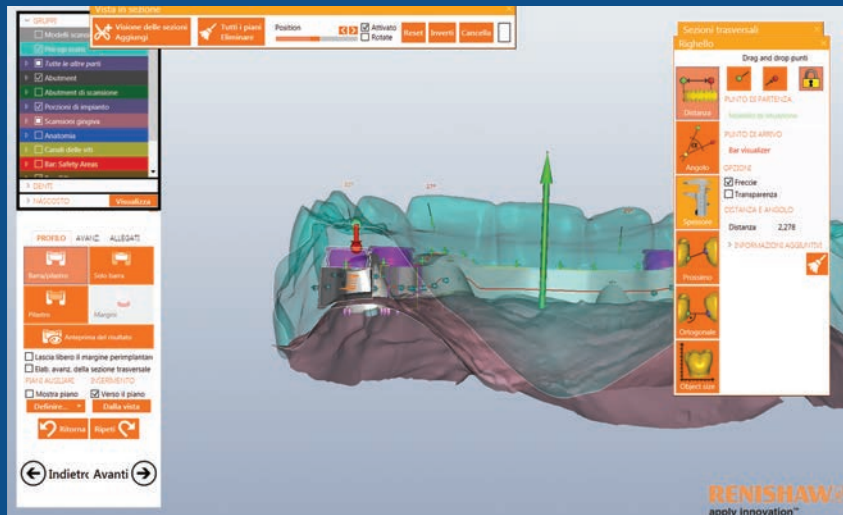


Fig. 9 — Design of the bar with the attachments



Fig. 10 — Master Model with bar and attachments



Fig. 11 — Bar seated and screwed without contacts with the soft tissues



Fig. 12 — Detail of the attachments used



Fig. 13 — Try-in of the bar in the patient's mouth

distance between the gingiva and the bar, playing a crucial role in the daily hygiene, was checked, and a test was performed to verify that the patient was able to use the floss and brushes. The compressive points on the gingiva were reduced. The bar was returned to the laboratory after the disinfection protocol.

Finalizing the restoration

The bar was placed on the model and the undercuts were eliminated with wax. The housings with the retentive caps were placed into position and the master model duplicated with silicone. The duplicate model was developed with class IV plaster; according to the manufacturer's instructions. A rigid thermoplastic mask with a thickness of 1 mm was adapted over the duplicated model as a basis for the modeling of the superstructure. The thermoplastic

mask was placed on the bar screwed into the master model; all this was repositioned on the articulator and the veneers were fixed in place within the mold silicone (Fig. 16). The anatomic supports for the veneers were modeled in wax (Fig. 14) and then inserted inside the casting cylinder, along with the investment. The cylinder was preheated to 630°C for 90 min, and then cooled down to 400°C and maintained at this temperature for 60 min. A predetermined amount of polymer based on PEEK was introduced inside the cylinder and left in position for 20 min. The cylinder was placed inside the unit for the vacuum injection system and the pressing was carried out at 4.5 bar. After cooling, the coating was removed and the superstructure obtained was subjected to sandblasting (aluminum oxide, 110 pm, 2.5 bar) (Fig. 15). In

the spaces for the metal housings, a primer was dabbed and cured for 90 s. The housings were then blocked with dual adhesive. Bar and superstructure were placed on the master model, inside the flask. The gap between the two structures was filled with silicon. The inner part of the veneers was subjected to sandblasting (aluminum oxide, 110 pm, 2.5 bar) and a primer was dabbed and then polymerized for 90 sec. The veneers were blocked on the transparent silicone inserted in the silicone inside the cover of the flask, verifying the absence of interference between them and the superstructure (Fig. 16). On the outer surface of the superstructure it was firstly applied a primer, as above, and then a pink opaque material (Fig. 17), over the flange areas (GUM color) and a dental shade in correspondence of the facets and then cured for 90 sec. The



Fig. 14 — Modeling of the superstructure



Fig. 15 — PEEK superstructure



Fig. 16 — Positioning of the facets inside the flask



Fig. 17 — Master Model, bar, superstructure and veneers before finalization



Fig. 18 — Denture completed, internal view

flanges have been characterized with composite resin with the technique of reverse stratification; on the inside of the veneers, a specific composite was used. Once the flask is closed, the resin was mixed and injected in the intake channel, and the system was kept at 50°C for 25 min at a pressure of 2.5 bar. The prosthesis obtained was finished with rotary instruments mounted on a laboratory hand piece and delivered to the clinician (Fig. 18-21).

Conclusions

The removable prosthesis with implant and mucosal support is a solution that combines the aesthetics and the support of the lip of a removable prosthesis with the stability of a fixed prosthesis over implants. Furthermore, a greater ease in cleaning and the absence of encumbrance of the palate flange comforts the patient.

The execution of the simplified

protocol here presented allows for a reduction of the processing times without any loss of quality and accuracy.

The use of low profile attachments screwed directly into the bar without gluing or welding, allows an easy installation and an eventual replacement, ensuring at the same time an excellent retention within small spaces. 

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Fig. 19 — Denture completed

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Fig. 20 — Denture completed, particular of the aesthetic vestibular flange



Fig. 21 — Denture completed, Inserted in the patient's mouth

About the author:

Dr. Maurizio Sedda graduated in Dentistry with Honors Degree at the University of Siena (Italy), after the achievement of the Certification of Dental Technician (Florence, Italy).

In the same University, he has obtained a Master of Science (MSc) in "Dental Materials" and he was a Tutor in the post-graduate Master degree in "Occlusion and Complete and Partial Removable Prosthodontics".

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He is Lecturer in scientific congresses and in post-graduate courses, and Clinical Trainer for some private companies. He has performed more than 50 international lectures in English language.

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Simone Fedi, Dental Technician graduated in Dental Technology with honors from the I.P.S.I.A. Gaslini in Genoa.

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Over the years he has attended many specialization courses on removable protheses, with a focus on complete dentures according to the method of Prof. A. Gerber and Prof. G. Passamonti and, at the same time, other courses on the implant-supported protheses and their construction techniques.

He dedicated to the study over the use of composite layering techniques and then applying them to the removable prothesis.

He collaborates with a number of companies as a consultant in the research and development sector.

In October 2015 he won the first prize at the "1st Contest Transformer Friends", organized by Transformer System, with an article on the implant prosthesis.

He led his own business in Pistoia.