IMPLANT-RETAINED OVERDENTURE PERSONALIZED WITH GINGIVALLY COLORED COMPOSITE

PROSTHETIC REHABILITATION OF THE EDENTULOUS PATIENT:

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The prosthetic rehabilitation of the edentulous patient with implant overdentures has many advantages in comparison to conventional tissue-supported dentures in terms of retention, stability and chewing efficiency, resulting in high patient satisfaction. However, proper diagnosis and treatment planning are critical to obtain successful results. Factors such as the number and distribution of implants, abutment selection, superstructure design, type of occlusion and opposing dentition are key aspects in the treatment planning of implant-retained overdentures. This clinical report describes in a systematic sequence the diagnosis, treatment planning and surgical-prosthetic management in the rehabilitation of a completely edentulous patient using dental implants and a removable prosthesis personalized with pink composite.
INTRODUCTION

Prosthetic rehabilitation in edentulous patients with conventional tissue-supported dentures has been considered the standard treatment for over a century. However, the use of this type of prosthesis involves a number of problems in terms of lack of retention and stability, especially in the mandible. Moreover, the use of conventional prostheses is usually associated with continued reduction of residual ridges, which is particularly accelerated in the lower ridge, showing an increased susceptibility to the response to the functional loads transferred from the denture to the alveolar process.

Various studies have compared the use of conventional dentures with implant-retained overdentures, concluding that the degree of patient satisfaction improves with better prosthetic retention and stability, and therefore, the degree of satisfaction increases with the use of implant-retained overdentures compared to conventional dentures. The use of two-implant mandibular overdentures has shown a significant improvement in patient satisfaction and quality of life when compared to tissue-supported prostheses. Providing dental implants for an edentulous patient with complete dentures promotes masticatory efficiency, increases the maximum bite force and has a clearly positive effect on the level of satisfaction.

There are multiple considerations involved in the treatment planning of implant-retained overdentures, such as the number and distribution of implants, the design of the superstructure, if fitted, and the selection of retention attachments, the type of occlusion and opposing dentition, as these elements are critical to the biomechanical behavior of the prosthesis. Despite this, the current body of research on mandibular overdentures has shown that the number of implants and the selection of retention attachments only have biomechanical implications in terms of maintenance needs, but not in terms of implant survival, bone loss and level of patient satisfaction.

In a systematic review conducted in 2012, researchers found that bone loss, the degree of patient satisfaction and the number of complications are not significantly related to the number of mandibular implants supporting an overdenture. A randomized, prospective clinical evaluation conducted in 2011 assessed aspects such as prosthesis retention and stability, tissue response, patient satisfaction and preference, and complications in three different retention attachment systems for mandibular IODs (4-implant bar attachment fitted to all 4 implants, a 2-implant bar attachment, and 2 independent ball attachments), concluding that the 2-implant independent treatment with ball attachments showed equivalent or more favorable treatment outcomes in comparison to more complex and costly options.

Based on increasing scientific evidence, the McGill Consensus Statement published following a symposium held at McGill University in Montreal, Canada in 2002, and the York Consensus Statement developed during the Annual Conference of the British Society for the Study of Prosthetic Dentistry held in 2009 both propose that two-implant mandibular overdenture and maxillary tissue-supported prostheses should be offered as the first-choice standard of care to edentulous patients. The pattern of centripetal bone resorption commonly observed in the mandible after tooth loss is often followed by vertical atrophy and substantial horizontal atrophy in the residual ridge, which leads the clinician to opt for ridge augmentation procedures prior to placement of dental implants, increasing the time and cost of treatment, morbidity and the risk of postoperative complications. For this reason, the use of small-diameter implants as an alternative in overdenture treatment in cases of severe mandible resorption has proven to be a rather predictable treatment option.

The aim of this case report is to show the systematic sequence for the prosthetic rehabilitation of the edentulous patient using a small diameter implant-retained mandibular overdenture and a maxillary tissue-supported denture personalized with gingiva-colored composite in order to achieve optimal functional and esthetic results improving patient satisfaction.
A systemically healthy 74-year-old male patient presented to the Department of Prosthodontics and Implant Dentistry of the Universidad de La Salle Bajío with severe esthetic and functional problems. His chief complaint was the lack of stability and the poor esthetics of his prosthesis which he had been wearing unsatisfactorily for the last 5 years. **(Figures 1 and 2)**

Clinical and tomographic examination revealed a severely atrophied posterior mandible and the presence of periodontally compromised teeth with Miller’s class III mobility in the anterior mandibular region **(Figures 3 and 4).** A 3-unit porcelain fused to metal fixed prosthesis which involved teeth with poor periodontal prognosis were found in the maxillary arch **(Figure 5).** Presurgical evaluation and treatment planning were conducted using panoramic radiographs, study models and a cone beam computed tomography scan. Based on the available scientific evidence, vertical space assessment, patient requirements and financial aspects, a mandibular 2-implant overdenture with stud attachments (Locator, Zest Anchors, Escondido, CA) **(Figure 6)** and a maxillary tissue-supported denture highly characterized with gingiva-colored composite was chosen as a treatment option.

**[1] Baseline situation: maxillary and mandibular partial dentures.**

**[2] Baseline situation: maxillary partial denture.**

**[3] Baseline situation: cone beam computed tomography.**

**[4] Baseline situation: partially edentulous mandible with periodontally compromised anterior teeth.**

**[5] Baseline situation: Partially edentulous maxilla with a 3-unit porcelain fused to metal fixed prosthesis.**

**[6] Locator stud attachment system.**
Taking of maxillomandibular relationship records to mount the casts on the semi-adjustable articulator and fabrication of maxillary and mandibular transitional immediate complete dentures.

Fabrication of a surgical guide template based on the mandibular transitional immediate complete denture in order to place two mandibular implants.

Maxilla. Atraumatic tooth extraction of the maxillary left second premolar and second molar, followed by the regularization of the alveolar ridge.

Mandible. Atraumatic tooth extraction of the remaining anterior teeth with thorough debridement of the socket walls followed by the regularization of the alveolar ridge.

Taking of maxillary and mandibular definitive impressions after 4 weeks of transmucosal healing.

Fabrication of maxillary and mandibular baseplates, and wax rims to obtain definitive maxillomandibular relationship records in order to mount the casts on the semi-adjustable articulator.
THE FOLLOWING COMPREHENSIVE TREATMENT SEQUENCE WAS PROPOSED AND ACCEPTED BY THE PATIENT

Fabrication and try-in of the definitive waxed-up dentures.

Prosthetically guided immediate placement of two small-diameter implants in the mandible canine region with closure screws for submucosal healing (two-stage approach).

Placement of transitional immediate maxillary and mandibular dentures with temporary soft relineline material.

Laboratory processing of the maxillary denture and mandibular implant overdenture using the Biofunctional Prosthetic System protocol (SR Ivocap System, Ivoclar Vivadent, Schaan, Liechtenstein).

Placement and delivery of definitive prosthesis.

12 weeks later a second surgical procedure will be necessary to uncover the implants and to insert the healing abutments.
Atraumatic extractions of dental organs remnants were performed in the maxilla and mandible using flexible periotomes (Flexible Periotome Kit, Dowell Dental Products, Cucamonga, CA), followed by lifting of full thickness flap and regularization of mandibular process in order to create a bone platform to promote proper placement of dental implants using carbide rotary instruments (194-220 carbide cutter, HORICO DENTAL). Two Straumann Roxolid Bone Level 3.3 x 12 mm small-diameter implants were then placed in the canine region (Straumann, Basel, Switzerland) and the gap between the implant and the buccal alveolar wall of the mandibular right canine was filled with porcine xenograft particulate (ZCORE, Osteogenics Biomedical, Lubbock, Tx).

The implants were left with closure screws for a two-phase submucosal healing and the primary wound closure was performed with simple stitches using non-resorbable PTFE monofilament suture material (Cytoplast, Osteogenics Biomedical). The patient left with transitional immediate complete dentures with soft relining material (Ufi Gel SC, Voco, Cuxhaven, Germany) (Figures 7 to 16).

After a 12-week healing period, a second surgery was performed to uncover the implants and replace the closure screws, placing healing abutments and preserving the existing attached gingiva (Figure 17). The existing denture was hollowed out at the sites of the healing abutments and relined with the soft lining material.
Four weeks after placement of the healing abutments, the definitive physiological impression was made using light-body polyvinyl siloxane impression material after performing border molding with heavy-body polyvinyl siloxane (Virtual, Ivoclar Vivadent; Schann, Liechtenstein). The definitive impression of the lower arch was taken using the open tray technique at implant level (Figure 18), splinting each impression post to the impression tray with non-shrinking photopolymerizable gel (Triad Gel, Dentsply, York, PA). Once the definitive impression was obtained (Figure 19), implant analogs were connected to the impression posts applying artificial gum around them (Gingifast Rigid, Zhermack, Badia Polesine, Italy), and the working models were prepared with type IV gypsum (Elite Rock, Zhermack). The gingival height was measured in the lower gypsum model from the platform of the implant analog using a periodontal probe to adequately and accurately select the height of the stud attachments (Locator, Zest Anchors), and it was later evaluated intraorally with the patient (Figures 20 and 21).

The Locator inserts were selected by placing the parallel posts on the Locator attachments and measuring the angulation discrepancy using the Locator angle measurement guide as described in Figures 22 to 26. Subsequently, the baseplates and occlusion rims were prepared to obtain the definitive craniomandibular records to articulate the models in the semi-adjustable articulator (Stratos 300, Ivoclar Vivadent), and select the microfiller reinforced polyacrylic teeth with the appropriate shape and size (Physiodens, VITA Zahnfabrik; Bad Zäckingen, Germany). Once the assembly of the models in the semi-adjustable articulator was completed, the final denture wax-up was done.

The open-tray impression copings have been screwed into place.

The finished polyvinyl siloxane impression. Functional movements were performed while taking the impression.

The Locator abutments were screwed in and hand-tightened.

The periodontal probe indicates the appropriate cuff height of the Locator abutments.

To select the correct nylon Locator replacement male, special parallel posts were snapped into the Locator abutments.

Selection of the appropriate nylon Locator replacement male according to the angulation measured.

Locator angle measurement guide.

Dual-function Locator inserts (clear, pink, blue) were indicated.
LABORATORY FABRICATION

The predosed SR Ivocap High Impact denture base material (Ivoclar Vivadent) was selected as the definitive material due to its physical and mechanical properties\(^1\) (Figure 31). These properties are achieved by the injection technique used to process the dentures made from this material (SR Ivocap System, Biofunctional Prosthetic System, Ivoclar Vivadent).

The laboratory process began with the duplication of the master mandibular cast with the Locator abutments screwed into it using addition silicone (Elite Double 22, Zhermack). The main purpose for working on a lower duplicate model was to avoid possible damage to both the original model and the stud attachments. The duplication process of the lower model is shown in Figures 32a to 32f.

After obtaining the duplicated model in type IV gypsum (Elite Rock, Zhermack), the definitive mandibular wax up was mounted verifying the correct settlement of the baseplate in order to embed the wax model in the flask and dewax it according to manufacturer’s instructions (Figures 33 to 37).

The upper denture was processed on the original model, which was flasked and dewaxed in the conventional manner, as indicated by the manufacturer’s technique (BPS, Ivoclar Vivadent) (Figures 38 and 39). After ensuring no waxy residues were left, the separator was applied on the gypsum surface in both models, the predosed resin was prepared for both dentures (SR Ivocap High Impact) and they were subjected to a pressure injection of 6 bar (85 psi) for 5 minutes (Figure 40). After completing the injection process, the molds were polymerized in hot water at 100 °C for 35 minutes and then they were cooled in cold water for 30 minutes, the last 10 of which were without pressure.
[32a] Master cast with Locator abutments screwed into place with black processing males inserted into each Locator abutment.

[32b] Master cast placed into the plastic duplicating flask.

[32c] Subsequently, a thin stream of duplicating silicone was poured and allowed to harden for at least 30 minutes.

[32d] After pouring a thin stream of duplicating silicone, it was allowed to harden for at least 30 minutes.

[32e] After hardening, the master model was removed with compressed air and pulled out of the silicone mould without tilting. Type 4 dental stone material was mixed and filled into the silicone mould.

[32f] Duplicate model.


[37] Boil-out procedure: duplicate model with the Locator steel female housings in situ.

[38] Lower flask half. Full-flasking and wax elimination of the maxillary complete denture.

[39] Upper flask half with the injection funnel and the funnel in its place.

[40] Flask and the injection funnel.
When the cooling process concluded, the conventional upper denture and the mandibular overdenture were recovered with the housing of each integrated attachment Locator. Excess acrylic was trimmed away and cleaned from the prostheses. Next, they were sandblasted with 100-μm aluminum oxide and afterwards a pink veneering composite (Crea.lign, Bredent, Senden, Germany) consisting of about 50% of opalescent ceramic particles was applied to faithfully and naturally reproduce gingival anatomy of the prosthesis according to the manufacturer’s instructions, as shown in Table 1 and 2 (Figures 41 to 45).

**Table 1** Polymethyl methacrylate surface conditioning protocol according to the manufacturer prior to the application of pink veneering composite.

<table>
<thead>
<tr>
<th>Step</th>
<th>The PMMA surface must be sandblasted at a pressure of 2-3 bars using 110 microns aluminium oxide</th>
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<tbody>
<tr>
<td>1st</td>
<td>Use compressed air in order to remove remaining particles. Do not use the steamer.</td>
</tr>
<tr>
<td>2nd</td>
<td>Priming the PMMA surface with a thin layer of light-curing bonding agent.</td>
</tr>
<tr>
<td>3rd</td>
<td>Polymerized subsequently in the light polymerization unit (wavelength range of 370-400 nm) for 90 seconds.</td>
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**Table 2** Application of gingiva-colored composite. Step by step layering recommendations.

<table>
<thead>
<tr>
<th>COLOR</th>
<th>STEP BY STEP LAYERING</th>
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<tbody>
<tr>
<td>1</td>
<td>Beige</td>
</tr>
<tr>
<td>2</td>
<td>Lila</td>
</tr>
<tr>
<td>3</td>
<td>Rosa</td>
</tr>
<tr>
<td>4</td>
<td>Pink</td>
</tr>
<tr>
<td>5</td>
<td>Light</td>
</tr>
<tr>
<td>6</td>
<td>Opal &amp; Blue</td>
</tr>
</tbody>
</table>
[41–43] Pink composite veneering system kit for individualization of the gingiva.

[44a] Schematic drawing presenting the gingiva color map according to the proposed characterization.

[44b] Schematic drawing presenting the gingiva color map according to the proposed characterization.

[45] Artistic illustration of final gingiva characterization following the proposed guidelines previously described.
Figures 46 to 56 show the mandibular overdenture and maxillary complete denture after the application of pink composite and the patient’s condition a few weeks after the treatment was completed.

The complete treatment sequence, including the clinical and laboratory procedure is shown in Table 3 below.

| TABLE 3 | Overview of the treatment sequence with clinical and laboratory procedure involved in a Locator-retained mandibular overdenture. |
| TIME | CLINIC | LABORATORY |
| 0 week | History, examination, radiograph, planning and anatomic impression | Fabrication of the diagnostic casts, baseplates and wax rims to obtain the maxillomandibular relationship records; mounting of diagnostic casts on the articulator; wax up/set up of the transitional dentures |
| 1 week | Altraumatic tooth extractions and implant placement; removal of the sutures | Processing of the mandibular transitional immediate denture; fabrication of a surgical guide template derived from the mandibular transitional denture |
| 2 weeks | Second stage surgery; uncovering the implants placed and insertion of the healing abutments | |
| 14 weeks | Definitive impression of the implants with custom tray and border molding | Fabrication of a custom impression tray (open tray technique) |
| 19 weeks | Maxillomandibular relationship record, selection of polyacrylic teeth and shades | Mounting the master cast on the articulator; anterior teeth set up |
| 20 weeks | Try in of the anterior set up | Laboratory processing of the mandibular implant overdenture with the locator female parts embedded; adjustment of occlusion and finishing in the articulator |
| 21 weeks | Full try in | |
| 22 weeks | Try in of the definitive prosthesis; checking the adequate setting of the steel female housings on the locator abutments | Conditioning of the prosthesis surface and application of pink veneering composite in order to customize the overdenture |

Locator abutments definitively driven in and incorporation of the prosthesis.
Frontal, right lateral and left lateral views of the maxillary complete denture and mandibular implant overdenture personalized with pink composite.

Base view of the mandibular implant overdenture with the black processing inserts.

Locator abutments with the dual function exchangeable nylon retention inserts (white, pink and blue).
Prosthetic rehabilitation of the completely edentulous patient poses a true challenge for both the clinician and his team. However, a clear understanding of the etiology, proper diagnosis, meticulous design of a comprehensive treatment plan suited to the needs of each patient and the integration of laboratory techniques along with an artistic philosophy can lead to positive results.

This case report shows that the fabrication of a complete maxillary denture and a two-implant mandibular overdenture is an excellent, less invasive and expensive treatment alternative for the edentulous patient.

**CONCLUSION**

The patient’s smile.

Portrait photograph after 4 months. The completed treatment reflects the high level of knowledge and interdisciplinary communication in reconstructing the esthetic and functional parameters while restoring the patient’s quality of life.

Panoramic radiograph after 1 month.

Panoramic radiograph after 4 months.
was formally trained in Prosthodontics and Implant Dentistry at Universidad de La Salle Bajío from 2013 to 2016. He has attended several courses with Dr. Milko Villarroel, Dr. Roberto Yoshida and Dr. Jaime Lozada and also a training by Zirkonzahn Military School.

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