

Implant-prosthetic rehabilitation of the severely atrophic maxilla

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Introduction

Modern instrumentation and improvements in regenerative techniques have facilitated both the surgical treatment and the subsequent prosthetic restoration. Nevertheless, dentists and patients frequently are conflicted when deciding between fixed or removable full-arch restorations. Many patients, especially those requiring extensive rehabilitation, clearly prefer fixed, implant-retained restorations. Under certain circumstances, the patient's aesthetic demands, however, can be difficult to satisfy with this type of restoration. Aesthetic outcomes are most frequently hindered by bone

loss resulting from advanced periodontal disease or by bone resorption following tooth loss. Although several methods can be used to augment hard and soft tissue to meet aesthetic demands, the patient can reject these options or the dentist might not be entirely familiar with the procedure selected. Both scenarios may produce unsatisfactory results that become apparent only when treatment is complete.

Removable restorations that use telescopic crowns as attachments are an alternative to full-arch rehabilitation with fixed bridges. Removable restorations can be used especially in cases with extensive jawbone atrophy (e.g. resorption), re-

Fig. 1_First examination. Palatal view.

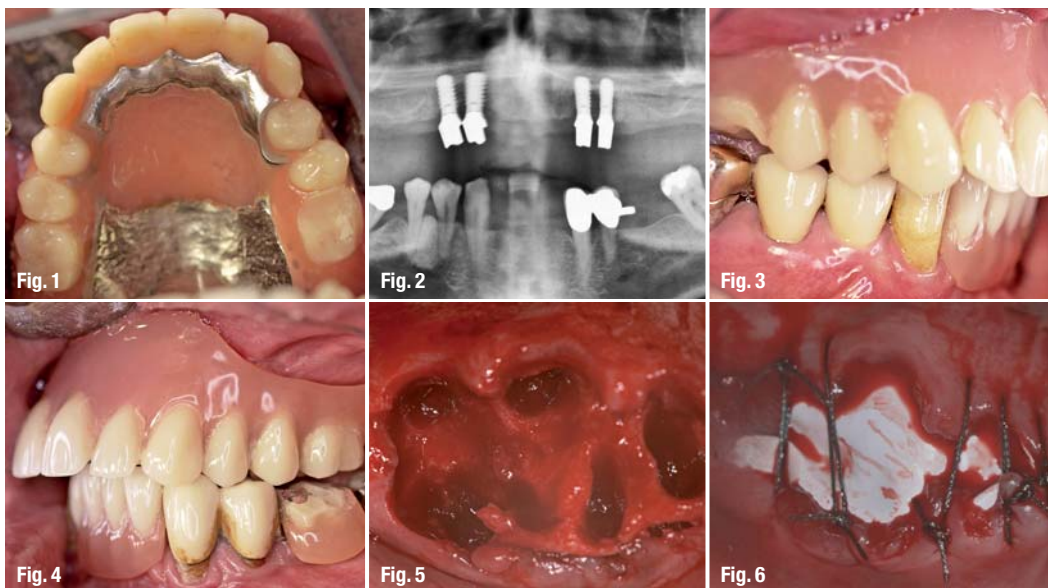
Fig. 2_First examination. Orthopantomograph. Periimplant defects in the maxilla, deep vertical defect #47, generalised horizontal bone loss.

Fig. 3_First examination. Clinical view, Right.

Fig. 4_First examination. Clinical view, Left.

Fig. 5_Socket preservation: cleaning of the extraction sockets.

Fig. 6_Socket preservation: sockets coverage.





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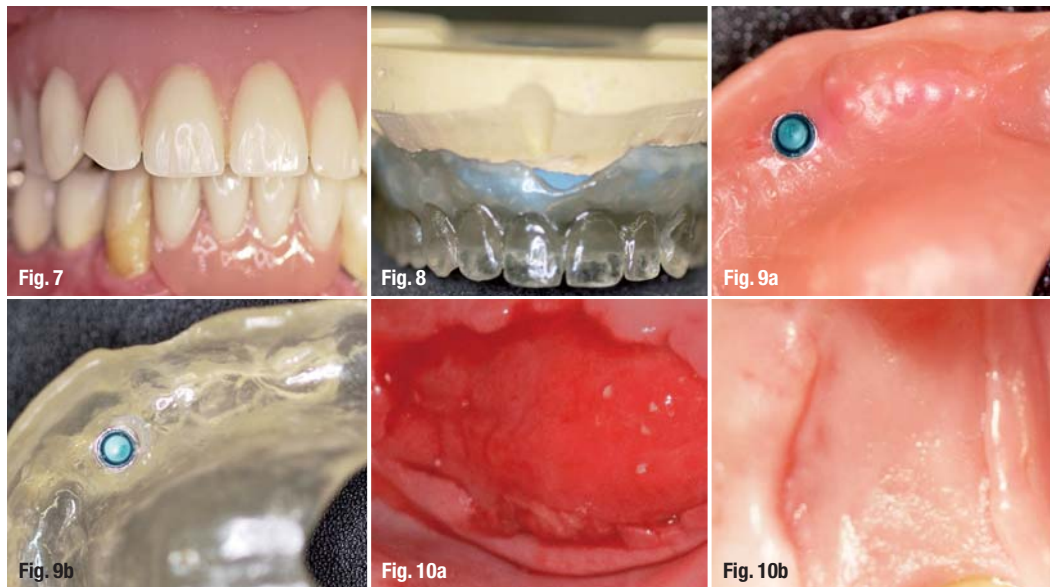
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Fig. 7 New interim denture in the maxilla and improved partial denture in the mandible.

Fig. 8 Duplicate of the maxillary denture (DentDu).

Fig. 9a–b Locator-matrice(s) embedded in the basis of the denture (a) and of the duplicate (b).

Fig. 10a–b Socket preservation: a: after removal of the membranes, b: soft tissue healing.



sulting in a large vertical dimension.¹⁻⁴ This article presents the treatment of such a case.

Case

The 55-year-old patient (male, nonsmoker, in good general health) presented for consultation and treatment in our clinic in August 2010. The patient had a three-year-old removable denture (with mid-palatal strap) in the maxilla, supported by four implants using telescopic crowns as attachments (Table 1; Figs. 1 & 2). It was shown that the premolars/molars of the maxillary denture were not in occlusion with the mandibular teeth (Figs. 3 & 4). Furthermore, the denture was fabri-

cated with a sagittal malposition in the anterior area (Figs. 3 & 4). Around the implants, pockets of 6–10 mm with spontaneous bleeding, swelling of the soft periimplant tissue and pain by palpation were recorded (Fig. 2).

A 15-year-old removable partial denture and fixed partial dentures (FPDs) were found in the mandible. The removable partial denture used the following attachments: a) direct retainers (clasps, areas #37 and #43), b) customised gold attachment (area #34–33), c) a gold double crown (area #47) (Figs. 3 & 4). The periodontal tissue showed an inflamed gingiva, pockets of a depth of 5–6 mm and a deep vertical bone defect at the mesial site of the tooth #47 (Fig. 2).

Table 1 Implant Characteristics

Implant area, Restoration (new/old)	Implant Line Diameter x Length (mm)	Time (Months) until uncovering	Customized Abutments
13 (old)	RN #, 4,1x10	4	Gold †
14 (old + new)	RN #, 4,1x10	4	Gold †
23 (old)	RN #, 4,1x10	4	Gold †
24 (old)	RN #, 4,1x10	4	Gold †
16 (new)	SB *, 4,5 x 11,5	4	CrCo ‡
15 (new)	SB *, 3,75 x 10	4	CrCo ‡
12 (new)	SB *, 3,75 x 10	4	CrCo ‡
23 (new)	SB *, 3,75 x 10	4	CrCo ‡
25 (new)	SB *, 3,3 x 10	4	CrCo ‡
26 (new)	SB *, 4,5 x 10	4	CrCo ‡

Treatment

Implants #13, 23, and 24 were explanted, the bone defects were cleaned and augmented by using non-resorbable dPTFE membranes (Cytoplast, Regentex GBR-200; Osteogenics Biomedical, Lubbock, TX, USA) without additional use of any grafting materials, as previously described (Fig. 5, Fig. 6).^{5,6} Flaps were repositioned with interrupted sutures. Membranes were left partially exposed (Fig. 6). The implant #14 (incl. abutment) was saved and used for supporting the maxillary denture. In the same clinical session, sinuses were augmented using a demineralised bovine xenograft (DBX; CompactBone B, Dentegris, Duisburg, Germany).

In the mandible, the natural teeth were treated by scaling and root planing and the crown margins were shorted and finished for allowing a better healing of the soft tissue. Tooth #37 was extracted and the socket was preserved/augmented as above described.

RN # = Regulat Neck, Institut Straumann, Basel, Switzerland
SB * = Soft Bone, Dentegris, Duisburg, Germany

† = Portadur P4, Au 68.50%, Wieland, Pforzheim, Germany
‡ = Ankatit, Anka Guss, Waldaschaff, Germany

Impression was taken in the maxilla for the fabrication of a new denture. An impression was taken from the mandible using an alginate material with the partial removable denture in situ, so that the dental laboratory could put new denture teeth in occlusion with the maxillary denture (Fig. 7). A duplicate of the new maxillary denture (DentDu) was fabricated using clear methyl-methacrylate (Paladur; Heraeus, Hanau, Germany) and kept for later use (Fig. 8). The customised gold abutment from implant # 14 was replaced through a locator and locator matrices were embedded in the basis of both the denture and the DentDu (Fig. 9).

Four weeks after socket augmentation and preservation, membranes were removed (Figs. 10a & b). Four implants were placed in the mandible (#36, 35, 32, 42; Table 1) and the periodontal pocket #47 was regenerated using DBX and a resorbable collagen membrane (BoneProtect, Dentegris, Duisburg, Germany). Additionally, FPDs #34, 33, 44-47 were removed and the natural teeth abutments were prepared. Impression of the mandibular teeth abutments was taken using a polyether material (Impregum Penta Soft, 3M ESPE) and a master cast was made. After that, chairside temporary FPDs for the natural teeth abutments in the mandible were fabricated, using a self-curing composite material (Structur 2, VOCO, Cuxhaven, Germany). The dental technician fabricated: a) metal-reinforced long term provisional FPDs and b) final metal-ceramic FPDs (which were kept for later).

On the next day, the metal-reinforced temporary FPDs were fixed using a provisional cement (TempBond, Kerr, Bioggio, Switzerland) and both maxillary denture and DentDu were fitted and the occlusion was controlled (Fig. 11).

The analysis of the articulated casts showed large vertical distances between the occlusal plane and the maxillary alveolar crest: 1.7 cm in the left premolar/molar area, 1.4 cm in the right premolar/molar area, 1.5 cm in the anterior area (Fig. 12). Therefore, a removable restoration was suggested.

Six months after augmentation in the maxilla, the DentDu were used as planning templates for assigning the implant positions (Fig. 13). Six implants were placed and implant # 14 was also kept (Table 1, Fig. 14).

Four months after implant placement, the implants were recovered and system-specific healing caps were mounted. An open-tray impression was taken using a polyether material (Impregum Penta Soft, 3M ESPE) and the working cast was fabricated.

DentDu supported by the locator was used for recording the maxillo-mandibular relationship. A bite registration was taken with a resin (pattern resin®, GC, Alpir, IL, USA) and DentDu was placed on the cast and mounted in the articulator (Fig. 15).

Implant abutments were fabricated using system specific customisable abutments (PTIR, Dentegris, Duisburg, Germany) casted with a CoCrMo alloy (Ankatit Laser, Ankatit-Anka Guss, Waldaschaff, Germany) and served as primary telescopes. Electroformed gold copings (0.25 mm thick; AGC Galvanogold, Au>99.9%, Wieland Dental, Pforzheim, Germany) were also fabricated over the customised implant abutments. The DentDu, the customized abutments and the gold copings were used for scanning, creating and milling of a titan framework (Zenotec Ti, Wieland Dental, Pforzheim, Germany). For veneering of the framework, a micro-ceramic composite was used (Ceramage, SHOFU Dental, Ratingen, Germany).

After veneering, the abutments were mounted with 35 Ncm (Fig. 16). The electroformed copings were placed on the abutments (Fig. 17) and fixed in the super-construction using a self-curing cement (AGC Cem, Wieland Dental, Pforzheim, Germany).

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Fig. 11_Mandibular temporaries in situ and fitting of the denture duplicate.

Fig. 12_Planing casts mounted in the articulator.

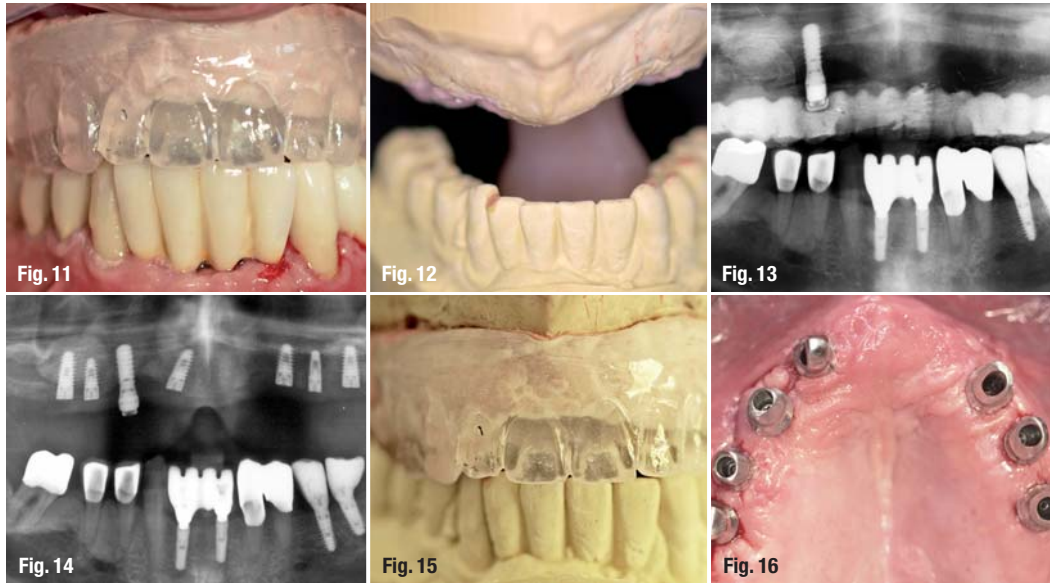
Fig. 13_Orthopantomograph.

Maxilla: after augmentation (sinus, periimplant defect), implant planing. Mandible: after regeneration surgery, temporary restoration.

Fig. 14_Maxilla: implant placement.

Fig. 15_Mounting of the casts using the denture duplicate.

Fig. 16_Customised abutments in situ.



At the same session, the final mandibular FPDs were fixed using an acrylic/urethane based temporary cement (Implant Provisional, Alvelogro Inc., Snoqualmie, WA, USA; Figs. 18–22).

Discussion

This case report details the treatment of a patient with insufficient maxillary alveolar ridge height caused by generalised advanced periodontal disease, as well as by subsequent implant treatment, insufficient implant-prosthetic restoration, failure of maintenance, and development of periimplantitis. A considerable distance between the occlusal plane of the mandible and alveolar ridge of the maxilla was caused by extensive bone resorption.

Telescopic crowns have been used successfully to connect dentures to natural teeth for several decades. Recent clinical data have indicated that the use of telescopic crowns with implant-supported overdentures can lead to predictable long-term treatment outcomes.^{7–11} The patient's ability to remove the secondary structure also facilitates abutment hygiene, providing an additional peri-

odontal advantage for the telescopic crown system.^{2,11} Furthermore, the high retention achieved through friction force leads to good mastication and phonetics. Further advantages of treatment with telescopic crowns include (a) maximisation of masticatory-force transmission that are always axial to the abutments; (b) facilitation of effective oral hygiene; (c) ability to position teeth favourably; (d) avoidance of several soft- and hard-tissue augmentative surgeries; (e) achievement of favourable aesthetics, even with severe atrophy of the jawbone, which can be covered by the lip shield; (f) the ability to renew veneering at any time; and (g) stability of the restoration, even when an abutment implant is lost. The main disadvantages of this type of construction are cost and technical requirements, as well as possible psychological burdens experienced by the patient provided with a removable appliance.^{5,11}

The initially delivered denture allowed for the correction of the interocclusal relationship, tooth shape, colour, and angulation throughout the treatment period. In this way, the patient could become acclimated to the function and aesthetics of the denture. By using a duplicate of this denture to take the bite records and as a mounting guide, the maxillo-mandibular relationship was recorded and transferred accurately and the aesthetic outcome previously accepted by the patient was achieved. Thus, it was not necessary to repeat the usual clinical recordings (e.g., centric relation, occlusal vertical dimension, tooth position and aesthetics, wax try-in) at the time of final restoration fabrication.¹²

Additionally, the combined use of the DentDu and the silicon key allowed for the selection of im-

Fig. 17_AGCs fitting.





Fig. 18



Fig. 19



Fig. 20

plant abutments of optimal angulation and shape, and also facilitated the fabrication of an aesthetically pleasing implant-supported restoration.

In the case presented here, the customised abutments were not removed after mounting and torquing until the final restoration was fitted and placed. Thus, the position of the abutments remained unchanged, eliminating or minimising errors that might occur during repeated attachment of the abutments (for various test fittings of the restoration) to the implants and master cast. The fixation of the electroformed gold copings after and not before veneering eliminates additional errors which may occur due to the influence of the veneering composite during polymerization. In the present report, the patient wished for a fixed restoration of the maxilla. Based on the planning model, he accepted a telescopic construction. In the case of a fixed implant-based denture, the crown-to-root ratio would have been unfavourable had natural teeth been used to support the restoration.

To date, no long-term studies have documented the influence of the crown-to-root ratio on the success rate of implants fully. Researchers have postulated that an increase in crown-to-tooth and crown-to-implant ratios will cause an increase in the magnitude of non-axial forces transmitted to the tooth or implant. This, in turn, could cause increased vulnerability of either teeth or implant abutments and lead to the loss of

supporting bone around the implants (Gomez-Polo et al. 2010). The existing data does not allow any definitive conclusions to be drawn.

In the present case, the patient's hard and soft tissues could have been augmented surgically to provide an aesthetically and functionally acceptable rehabilitation using fixed restorations. Cases such as this raise the question of whether it is preferable to exhaust all surgical possibilities or to pursue the path of least resistance by combining classic prosthetic experience with modern techniques and materials. In many circumstances, the latter is a better and safer treatment alternative. For this reason, oral surgeons and periodontists should consider the prosthodontic treatment plan extremely carefully before selecting any course of action.

Editorial note: A complete list of references is available from the publisher.

Fig. 18_Final restoration. Frontal view.
Fig. 19_Final restoration. Right view.
Fig. 20_Final restoration. Left view.

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implants

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Fig. 21



Fig. 22

Fig. 21_Final restoration. Palatal view.
Fig. 22_Final restoration. Orthopantomogram.