A comprehensive approach to a deficient implant site in the aesthetic zone

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The rehabilitation of compromised aesthetic cases in implantology requires a comprehensive, multidisciplinary approach to address both functional and aesthetic challenges. This case report describes the treatment of a 52-year-old female patient with a missing maxillary right central incisor due to a fracture at age 17. The case involved implant placement and management of adjacent malpositioned teeth and gingival recession. The patient declined orthodontic treatment owing to financial constraints, accepting aesthetic compromises regarding papillary height and symmetry. Digital implant planning guided the placement of a bone-level implant and simultaneous horizontal bone augmentation, and connective tissue grafts enhanced the soft-tissue support. A two-stage surgical approach was used, involving a four-month healing period before implant exposure. The definitive restoration was delivered after 7.5 months, showing a successful aesthetic result. The patient's soft tissue and bone stability were maintained at 12 months, and there were no biological or prosthetic complications. This treatment highlights the importance of interdisciplinary planning, mucogingival expertise and proper implant system selection for optimal, stable long-term outcomes in complex aesthetic cases.

Introduction

Implant rehabilitation in the aesthetic zone is one of the most challenging procedures in implantology. In the anterior maxilla, the vestibular bone thickness is typically less than 1 mm, leading to greater volumetric contraction compared with other areas.[1–3] It is essential to consider that the situation will evolve over time, tissue tending to resorb owing to the loss of biological function after the disappearance of the periodontal ligament.

In cases of a single missing tooth, the presence of adjacent teeth helps limit tissue contraction at the proximal level and maintain papillary height, provided the subsequent implant procedure is properly executed.[4, 5] When immediate implant placement is feasible, it offers the advantage of preserving the anatomy of both hard and soft tissue, provided the site is suitable. Commonly, bone grafting techniques, along with autologous or xenogeneic connective tissue grafts, are combined with various flap types during implant placement.[6–9] This approach offers the patient a significant reduction in treatment duration and, when appropriate, allows for the placement of an immediate provisional restoration, minimising discomfort and reducing the costs associated with alternative provisional solutions, such as removable or fixed Maryland prostheses.



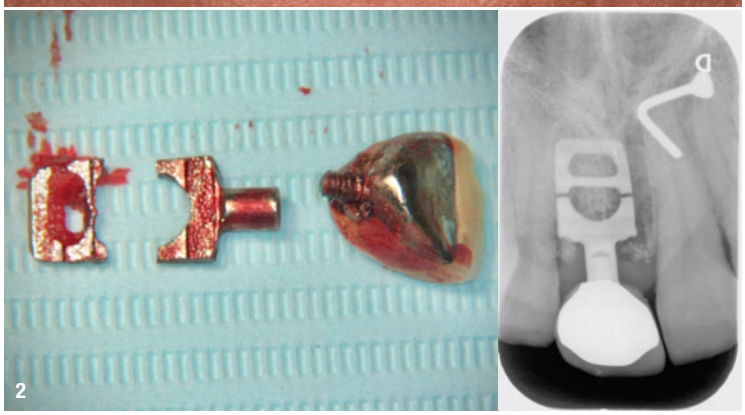


Fig. 1: Pre-op smile view. – **Fig. 2:** Removal of the fractured blade implant in 2003.

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Fig. 3: Intra-oral close-up of the baseline situation. – **Fig. 4:** Pre-op occlusal view: horizontal deficiency. – **Fig. 5:** Pre-op frontal view: vertical deficiency. – **Fig. 6:** 3D implant planning.

In cases of healed single edentulous sites in the aesthetic zone, there is almost always a volumetric deficiency; therefore, implant rehabilitation cannot be performed without predictable tissue volumetric enhancement procedures, which are essential for ensuring a favourable prognosis. The advantage of working in a site that has healed for 12 months or longer is the stability of the deficient area, which is generally not subject to further contraction.

To achieve a successful implant outcome, several key factors must be considered. In the aesthetic zone, precise 3D implant positioning is crucial to prevent both biological and aesthetic failures.[10, 11] Therefore, comprehensive digital planning and guided implant placement are highly recommended.[12] Another critical aspect is the prosthetic connection: the more stable it is, the less it will negatively affect the peri-implant tissue.[13] In this context, opting for a self-locking conical connection (< 12°) is undoubtedly the most suitable choice.[14]

When selecting the implant system for an aesthetic site, consideration should also be given to platform switching. The option of using smaller prosthetic components in the subcritical zone allows more space for soft tissue, ensuring better vascularisation and providing protection for the coronal peri-implant tissue.[15, 16]

Regarding the planning of a single restoration in a healed site, it is crucial to assess the periodontal condition of the adjacent teeth. The presence of significant vestibular tissue recession or the loss of papillary height often represents an insurmountable obstacle to achieving an optimal aesthetic result.[17] If such issues cannot be addressed, the patient should be informed that compromises may be necessary. The combined volumetric enhancement of the implant site and correction of adjacent tooth recession requires the use of mucogingival techniques, so it is important for the clinician performing the rehabilitation to have substantial experience in this type of surgery. The treatment described in this case report outlines a restorative approach to the functional and aesthetic rehabilitation of three incisors using a combination of guided bone regeneration (GBR), connective tissue grafting, coronally advanced flaps and conservative direct composite restorations.

Case presentation

A 52-year-old female patient (Fig. 1), ASA Class I, presented to the clinic requesting treatment for the previous loss of her maxillary right central incisor, which had been extracted owing to a fracture at the age of 17. At that time, the single edentulous site was treated with the placement of a blade implant by her previous

dentist. The rehabilitation had lasted for approximately 14 years before mechanical failure, and the implant was removed in this dental practice (Fig. 2). An immediate provisional restoration was placed, anchored with titanium wire to the adjacent teeth.

The patient did not have the financial means to undergo a new implant treatment and waited about 20 years before proceeding with the rehabilitation. The new baseline presented several critical issues concerning the adjacent teeth and the implant site. The right lateral incisor was tilted vestibularly and had a 4 mm gingival recession and a reduction in the distal papillary height of 1 mm and in the mesial papillary height of over 2 mm. The left central incisor showed a 3 mm recession and a reduction in the mesial papillary height of 2 mm (Fig. 3). In the edentulous site of the right central incisor, there was considerable volumetric contraction both horizontally and vertically (Figs. 4+5).

An orthodontic treatment was proposed to correct the tooth angulation and align the teeth, including orthodontic extrusion of the right lateral incisor to position the interdental papillae coronally. Although this pretreatment was presented as absolutely necessary to minimise aesthetic compromises in the definitive rehabilitation, the patient declined it, mainly for financial reasons. Considering the low smile line as a favourable factor, the patient confirmed her willingness to accept aesthetic compromises, primarily related to the asymmetry and incongruity in papillary height.

A CBCT scan and an intra-oral scan were performed, and once matched, they enabled comprehensive digital planning for guided implant placement (RealGUIDE®, 3DIEMME). The cross-sectional view of the edentulous site revealed a fairly compact bone structure (Class D2) and both vertical and horizontal volumetric deficiencies. The site was, however, deemed suitable for the placement of a bone-level implant of 4 mm in diameter and 10 mm in length, along with a simultaneous horizontal bone regeneration procedure, and a two-stage approach. According to the planning, the implant-to-crown length ratio was 0.8 (Fig. 6).

After sculpting and elevation of a trapezoidal flap (Fig. 7), the osteotomy was performed using a surgical guide (INTEGRAL, Anthogyr; Fig. 8). The implant (Axiom X3®, Anthogyr; Fig. 9) was positioned 1.5 mm sub-crestally relative to the palatal bone wall, and an insertion torque of 48 Ncm was recorded (Fig. 10).

Autologous bone chips were collected using a scraper on the vestibular bone surface, and these were placed over the vestibular implant dehiscence. Subsequently, a particulate xenograft bone graft (XenoGraft, Straumann®) and a resorbable collagen membrane (XenoFlex,

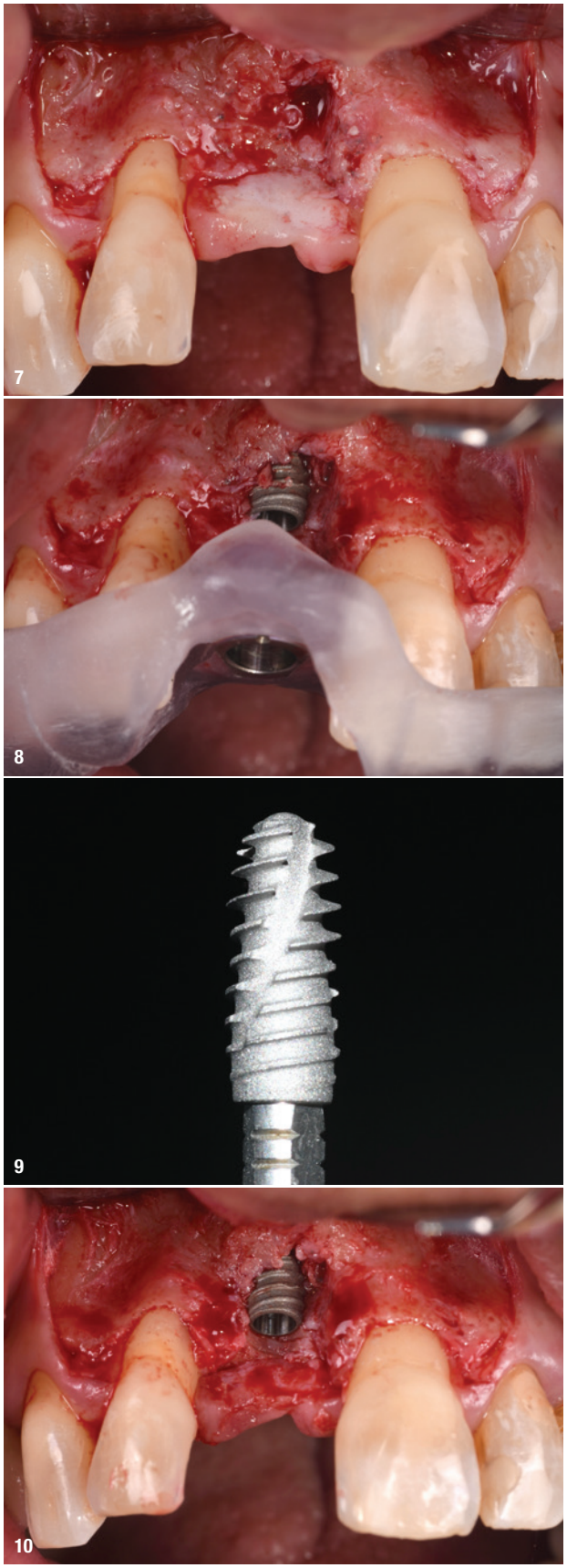


Fig. 7: Implant site with the skeletal structure fully exposed. – **Fig. 8:** Implant placed through the surgical guide. – **Fig. 9:** Axiom X3® implant, 4 × 10 mm. – **Fig. 10:** Final position of the implant.





Fig. 11: Xenograft layered over the autologous graft. Resorbable membrane securely fixed palatally with a pin. – **Fig. 12:** Resorbable membrane secured over the graft with three pins.



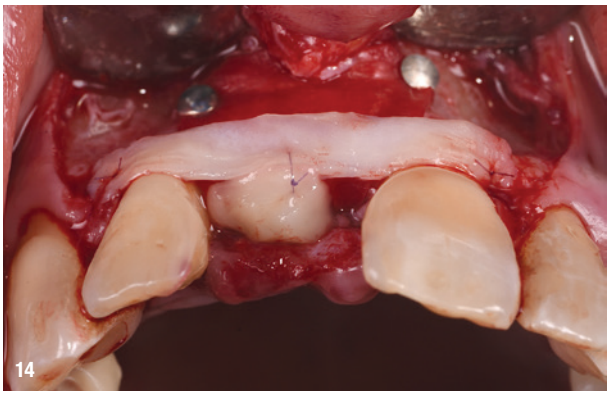
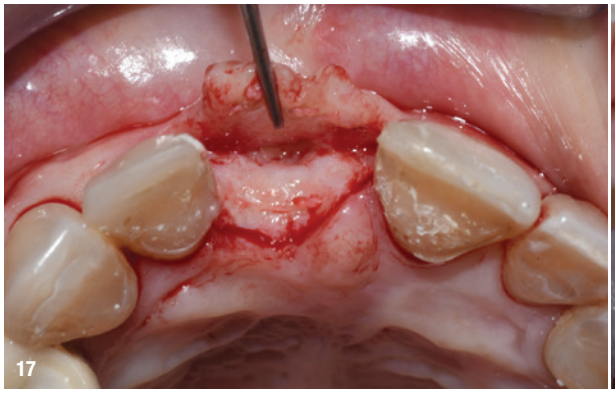


Fig. 13: EDTA-based conditioning gel applied to the root surfaces to be covered. – **Fig. 14:** Double connective tissue graft secured with #7/0 resorbable sutures.





Fig. 15: Coronally advanced flap secured with #6/0 and 7/0 resorbable sutures. – **Fig. 16:** Post-op view at four months.



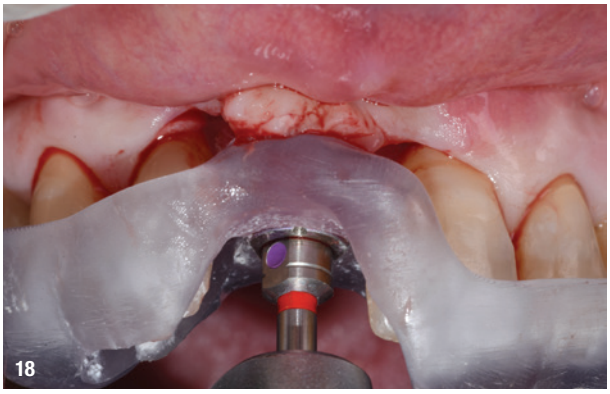


Fig. 17: Split-thickness flap for implant exposure. – **Fig. 18:** Implant exposure with the surgical guide and a 4 mm mucotome.

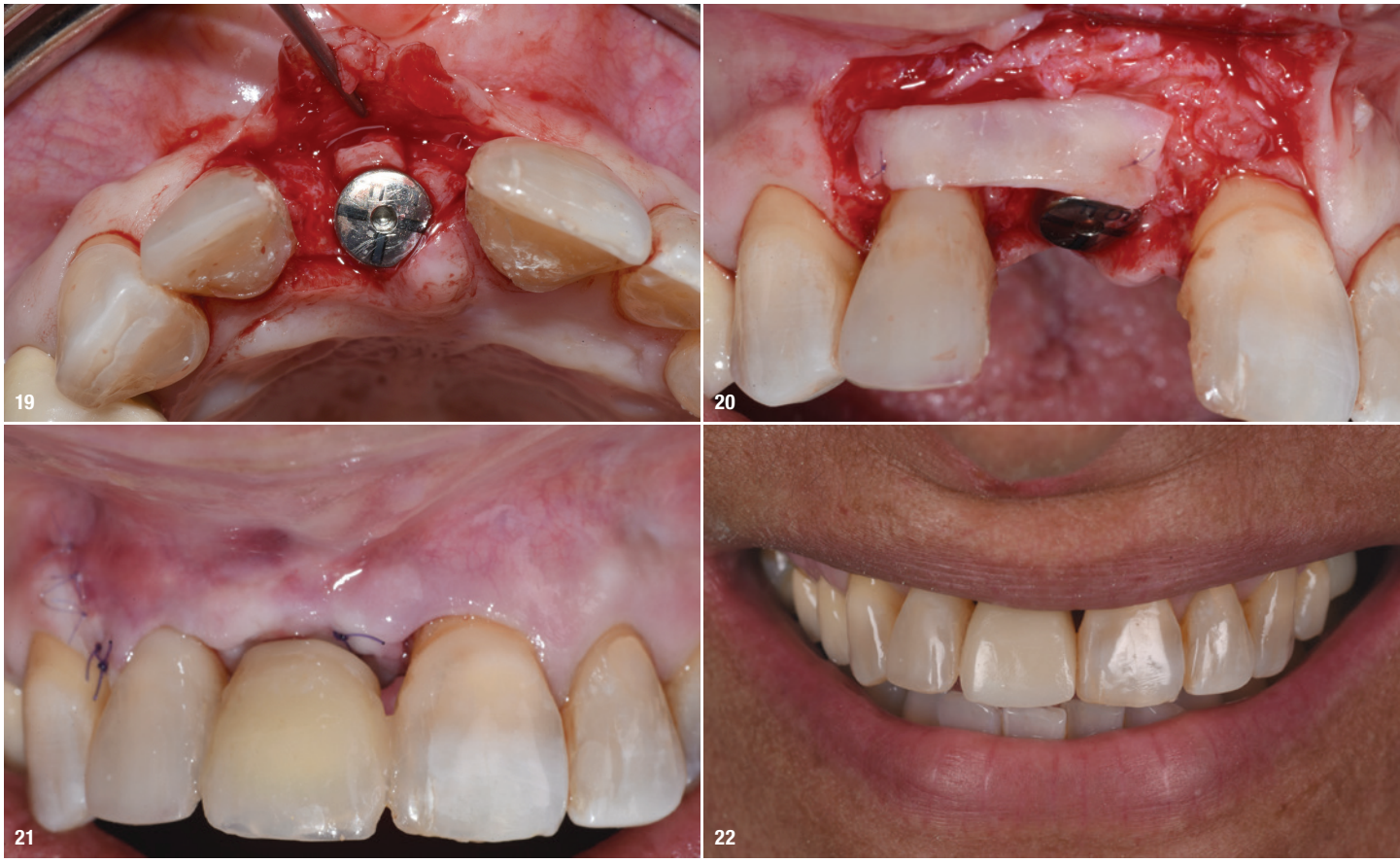


Fig. 19: Cover screw secured to the implant, and the tissue through which the mucotome had passed mobilised vestibularly. – **Fig. 20:** Second connective tissue graft secured with #7/0 resorbable sutures. – **Fig. 21:** Coronally advanced flap secured with #6/0 and 7/0 resorbable sutures. – **Fig. 22:** Screw-retained provisional restoration provided 14 days after implant exposure.

Straumann®) were applied (Fig. 11). The membrane was secured with three pins: one palatal and two vestibular, at the sides of the nasal spine (Fig. 12).

The root surfaces of the right lateral incisor and left central incisor were scaled using Gracey curettes. A conditioning gel based on EDTA (PrefGel, Straumann®) was then applied to the scaled surfaces for two minutes. This was followed by thorough irrigation with saline solution and the application of a gel-formulated enamel matrix derivative (Emdogain, Straumann®; Fig. 13).

A 21 mm long and 4 mm high epithelial–connective tissue graft was then harvested from the palate. After de-epithelialisation, the graft was secured to the base of the anatomically de-epithelialised distal papillae of the two incisors adjacent to the implant with a #7/0 resorbable suture (ARYAN®, Kalos di NIKE). The connective tissue component of the palatal mucosa was found to be of insufficient thickness; therefore, a second graft was harvested at the tuberosity level. This second donor site also had limited connective tissue volume. The second graft was positioned coronal to the first and secured to it with a #7/0 resorbable suture (Fig. 14).

The trapezoidal flap was disconnected from the muscular component using a blade to allow coronal advancement and was then sutured with #6/0 and 7/0 resorbable sutures (Fig. 15). A new Maryland bridge was subsequently applied, cemented with composite resin on to the palatal surfaces of teeth #12 and 21. During the healing period, direct restorative interventions and at-home bleaching were performed.

After a four-month waiting period, implant uncovering was to be performed. The soft-tissue condition was still deficient (Fig. 16), both at the implant site and at the site of the lateral incisor recession. A split-thickness flap approach was then planned. A flap was raised at the implant site (Fig. 17), and using the surgical guide and a 4 mm diameter mucotome (Fig. 18), the implant's prosthetic connection was uncovered. The connective tissue through which the mucotome had passed was kept pedicled at the vestibular site and then mobilised vestibular to the implant (Fig. 19).

The flap elevation was then completed by creating a new surgical papilla distal to the right lateral incisor and a single vertical incision at this site. A new epithelial–connec-

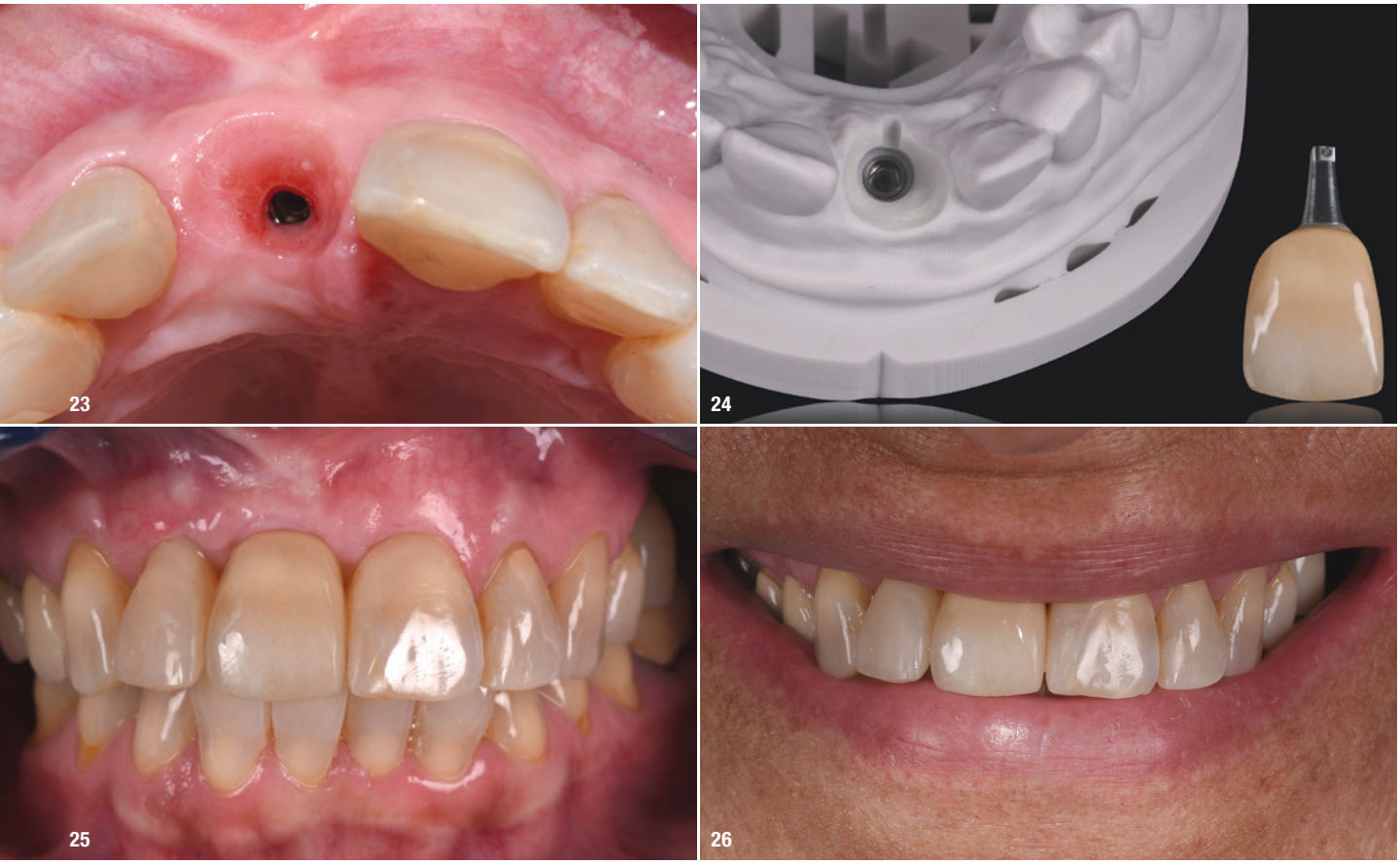


Fig. 23: Occlusal view after three months of tissue conditioning with the provisional restoration. – **Fig. 24:** 3D model and definitive screw-retained zirconia restoration. – **Fig. 25:** Final outcome of the treatment, 7.5 months after initiation. – **Fig. 26:** Final smile view, 7.5 months after initiation.

tive tissue graft was then harvested, de-epithelialised and sutured to the base of the anatomically de-epithelialised distal papilla of tooth #12 and to the vestibular periosteum of the implant site (Fig. 20). The flap was mobilised by disconnecting the muscular component and then advanced coronally and sutured with #6/0 and 7/0 resorbable sutures (Fig. 21).

The scan body was connected, and a 3D scan of the implant position was taken. Fourteen days later, the provisional restoration was screwed on to the implant (Fig. 22). The soft tissue was left to mature for a period of three months (Fig. 23), after which a definitive zirconia crown was fabricated (Fig. 24) and delivered to the patient (Figs. 25+26).

Results

The treatment lasted 7.5 months, during which time no biological or prosthetic complications occurred. Partial root coverage was achieved on the adjacent teeth, a result influenced by the initially reduced height of the surrounding papillae. The remaining area of recession, deemed non-coverable during the diagnostic phase, was managed with direct composite restorations prior to surgery. Satisfactory augmentation of the initial volumetric deficit was achieved (Figs. 27+28).

After 12 months, a slight improvement in the papillary height was observed (Fig. 29). However, a deficit of approximately 1.5 mm remained in the papillary height between teeth #22 and 23, which served as the reference point. Grafted soft tissue shows a tendency to proliferate, and in the following years, a progressive improvement of the papillae adjacent to the implant may occur. The aesthetic outcome was satisfactory, and the appearance of the prosthetic crown demonstrated good integration with the natural teeth (Fig. 30). The radiographic control at 12 months after completion of treatment revealed good stabilisation of the bone tissue in the area of the prosthetic connection (Fig. 31).

Discussion

In determining the treatment plan, several compromises were made. Firstly, the relatively low smile line allowed for the acceptance, from the initial phase, of a disparity in the height of the mesial and distal papillae around the

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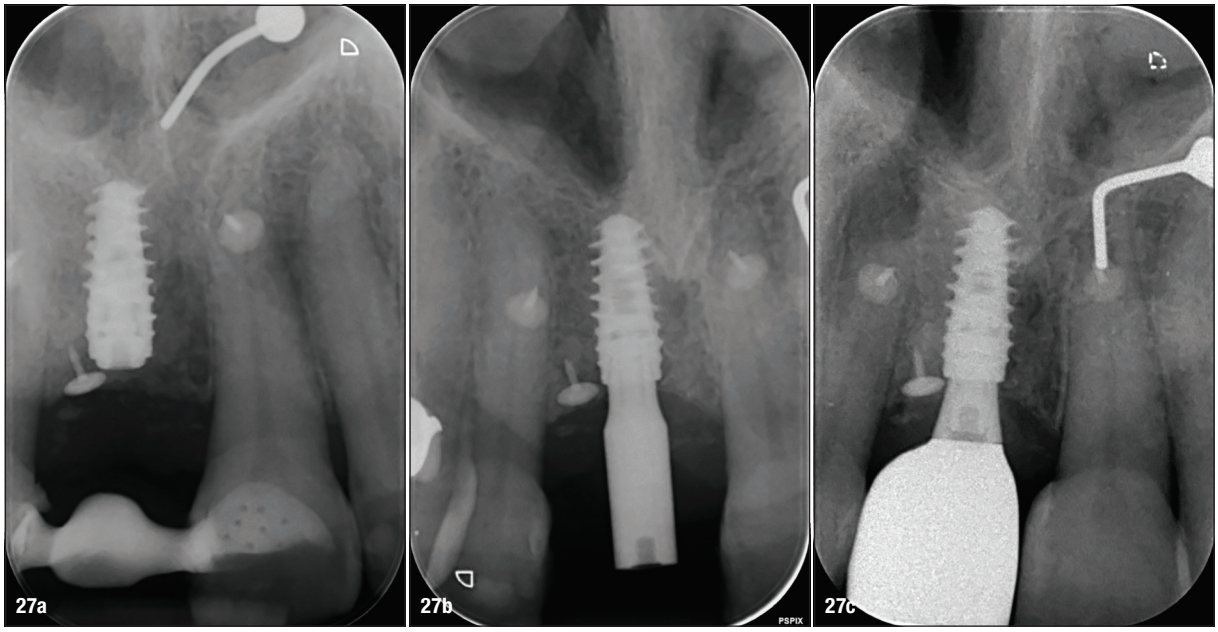
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Figs. 27a–c: Intra-oral radiograph at baseline **(a)**. Intra-oral radiograph four months post-op **(b)**. Intra-oral radiograph 7.5 months post-op **(c)**.

implant. Secondly, the decision not to perform vertical regeneration and thus to accept an unfavourable implant-to-crown ratio arose from a prognostic assessment of the treatment: the height of the alveolar crest of the adjacent natural teeth was reduced, and an attempt to modify this with vertical augmentation would not have guaranteed predictability in the medium and long term. However, the implant system used employs a Grade V titanium alloy, which has a significantly higher fracture toughness than Grade IV titanium alloys do.[18–20] This will help reduce the risk of mechanical failure of the implant. The maintenance of the coronal peri-implant tissue was undoubtedly supported by other features of the implant system, particularly the self-locking conical connection with a 6° taper and the use of platform switching.

The decision to perform horizontal GBR in conjunction with implant placement in a deficient site with vestibular implant dehiscence must always be carefully considered. Indeed, the exposed implant surface does not provide biological elements (osteoblasts) useful for the colonisation of the particulate graft placed on it, and it effectively represents an obstacle to the osseointegration of the graft itself. These biological elements can only partially infiltrate the graft, coming from the proximal regions of the dehiscence. In this case, the surface area of the implant in direct contact with the patient's native bone was deemed adequate to ensure proper osseointegration for functional loading. In other situations, it is generally advisable to operate in two stages, positioning the implant after the GBR-treated tissue has adequately matured. Such maturation usually requires six to nine months. Only in the case of a block autograft is it possible to advance implant placement to three months.



Figs. 28a+b: Comparison of the lateral views. Pre-op **(a)**. Post-op **(b)**. – **Fig. 29:** 12-month follow-up, intra-oral close-up.



Fig. 30: Integration of the definitive screw-retained restoration. – **Fig. 31:** 12-month radiographic follow-up.

The bone graft in the case described in this article will therefore be partially integrated into the bone structure, while the non-integrated portion will serve only as a volumetric stabiliser, similar to a filler. This portion represents the potentially weak point of the rehabilitation. However, the presence of a double connective tissue graft over it acts as a protective element by promoting adequate vascularisation of the area and facilitating a robust local immune response to safeguard the underlying tissue.

For the exposure of the implant, a waiting period of four months was observed to allow the connective tissue grafts to adequately mature. A second phase, performed with a split-thickness flap, ensured that the maturation of the GBR-treated tissue was not disturbed. In a similar case, if no soft-tissue augmentation had been necessary in the first or second phase, it would have been possible to expose the implant with the surgical guide and mucotome, performing a flapless exposure, ten to 12 weeks after implant placement. This would have allowed for the implant to osseointegrate and for the regenerated horizontal bone to mature undisturbed.

Conclusion

The comprehensive treatment of compromised aesthetic cases requires a multidisciplinary evaluation of the issues to be addressed and the possible solutions. Orthodontics can, in some cases, be an essential aid in helping to resolve complex problems in a predictable and non-invasive manner and should therefore always be considered and proposed to the patient. Mastery of mucogingival techniques allows for better management of these cases and leads to better and more stable long-term outcomes. Finally, the choice of an appropriate implant system is crucial to a good long-term prognosis in complex cases involving the aesthetic zone.

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Literature

about the author



Dr Gian Battista Greco graduated in dentistry and dental prosthetics from the University of Trieste in Italy in 2000 and completed a master's degree in prosthetics and implant prosthetics at the University of Milan in Italy in 2008. He is in private practice in Milan, focusing on implant-supported prosthetic therapy and cosmetic dentistry. He has been a member of the Italian Academy of Prosthetic Dentistry since 2002. Dr Greco can be contacted at gianbattista.greco@dentalnarco.com.

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