Clinical Benefits of the Socket Shield Technique Associated with Anatomical Transmucosal Implant Components: A Case Report

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One of the key factors in determining the esthetic success of implant-supported prostheses in the esthetic zone is the preservation of the natural architecture of the peri-implant tissues. The present case replaces two maxillary lateral incisors with reduced buccal cortical bone by means of implant-supported crowns. The socket shield technique was adopted to conserve the tissue volume, guided surgery was used to manage optimal implant insertion, and anatomically shaped transmucosal implant components were selected to shape peri-implant soft tissues with ideal emergence profiles and allow direct digital impressions without scan bodies. The combination of immediate implants, guided surgery, the socket shield technique, anatomically shaped transmucosal implant components, and digital impressions without scan bodies was used to achieve a successful rehabilitation with healthy, stable, and anatomically shaped peri-implant tissues.
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The long-term success of implant-supported prostheses in the esthetic zone depends on the position of the implant and on the volume, health, and stability of the supporting tissues.[1,2] Tooth extraction results in an inevitable alveolar ridge reduction, both vertically and horizontally, particularly in the anterior areas where the buccal bone is thinner.[3,4] When primary stability is achieved, immediate tooth replacement is suggested to support the soft tissues during osseointegration.[5,6] The socket shield technique aims to conserve the tissue volume by retaining the facial part of the root during the extraction and placing an immediate implant.[7,8]

One of the biggest challenges in the esthetic areas is to create an esthetically pleasing peri-implant soft tissue architecture that manages the transition between the circular diameter of the implant platform to the anatomical shape of the replaced natural tooth.[9,10] Several techniques (at both the first- and second-stage surgery) have been proposed to achieve this goal, including anatomically shaped healing abutments and progressive modifications of provisional restorations.[9,11,12]

The present article describes the rehabilitation of two maxillary lateral incisors with reduced buccal cortical bone by means of

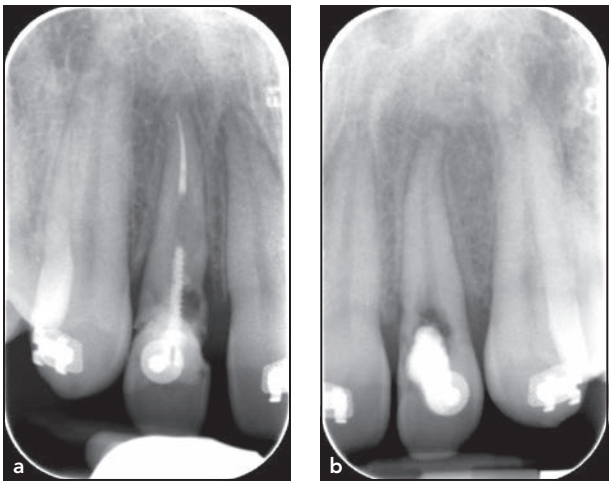

Fig 1 *Pretreatment intraoral periapical radiographs of* (a) *tooth 12 and* (b) *tooth 22.*

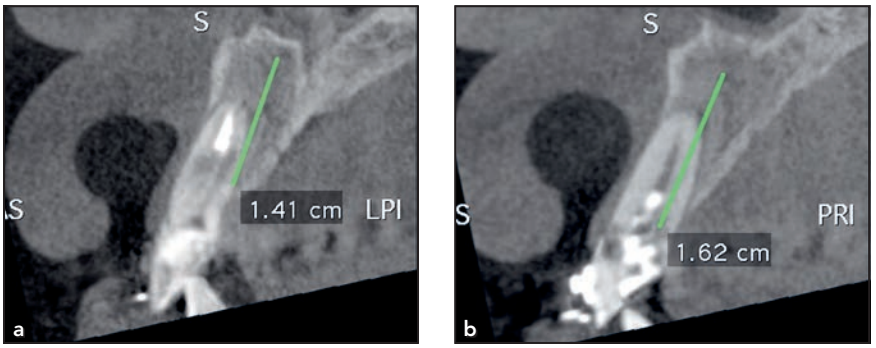

Fig 2 *CBCT scans showed the thin buccal bone plate of* (a) *tooth 12 and* (b) *tooth 22.*

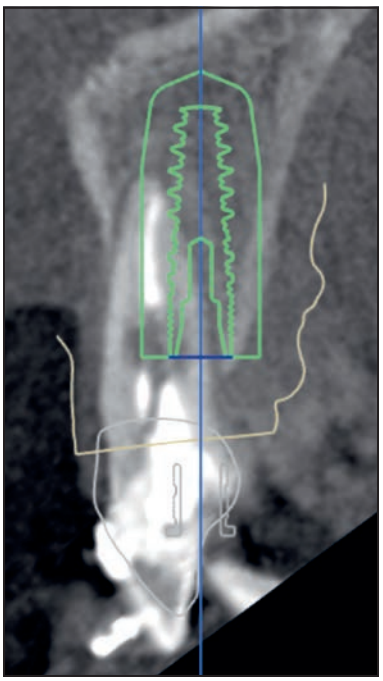

Fig 3 *Prosthetically driven virtual implant planning. The external green profile identifies the safety zone and not a bone dehiscence.*

implant-supported single crowns, associated with guided surgery, immediate implant placement, the socket shield technique, and novel anatomically shaped transmucosal components.

Materials and Methods

Case Presentation

A 27-year-old man undergoing orthodontic treatment was referred to the present authors' office for treatment of external resorption of teeth 12 and 22 (FDI tooth-numbering system) (Fig 1). Tooth 12 was diagnosed with a horizontal root fracture at the level of the resorption, and tooth 22 presented a crack line at the cementoenamel junction. Both lateral incisors were therefore considered nonrestorable.

The treatment plan consisted of extracting the hopeless teeth and replacing them with implant-supported crowns. A full-mouth digital impression was made with Trios 2 (3Shape). A CBCT scan was performed using a 5 × 5-cm field of view, with 90-µm scans (CS 9300, Carestream) to evaluate the maxillary bone volume. The CBCT revealed very thin vestibular bone walls covering both lateral incisors (Fig 2). To preserve such thin walls, implant placement was planned through guided surgery, the socket shield technique, and immediate tooth replacement.

A guided-surgery software (Implant Studio, 3Shape) was used to select the optimal implant insertion axis. The software allowed the CBCT and stereolithographic (STL) files to

be matched, creating a 3D virtual simulation of the implant-supported restorations (Fig 3). A stereolithographic surgical stent and two PMMA (polymethyl methacrylate) provisional crowns with palatal retainers were then fabricated to facilitate intraoral positioning (Fig 4).

Surgical Procedure

Teeth 12 and 22 were then sectioned vertically and cut mesiodistally, and their palatal portions were extracted according to the shield technique protocol (Fig 5).

Two implants (4 × 12 mm [tooth 12] and 3.5 × 14 mm [tooth 22]; Naturactis, Lyra ETK) were then inserted with the aid of the surgical template, reaching an insertion torque of 35 Ncm. Two anatomically shaped healing abutments (4 mm tall; iphysio Profile Designer, Lyra ETK) were screwed on the implants (Fig 6).

The iphysio Profile Designer system allows the user to choose from four shapes with three different gingival heights, reproducing the morphology of incisors (shape A), canines and premolars (shape B), and molars (shape C). In this case, shape D (for incisors and premolars) with eccentric screw access was selected to support the buccal soft tissue contour and avoid contact with the palatal bone (Fig 7).

The previously fabricated provisional crowns were relined on their PEEK (polyether ether ketone) cement-free provisional components, removed, trimmed, finished, and then snapped back onto the healing abutments. The provisional crowns

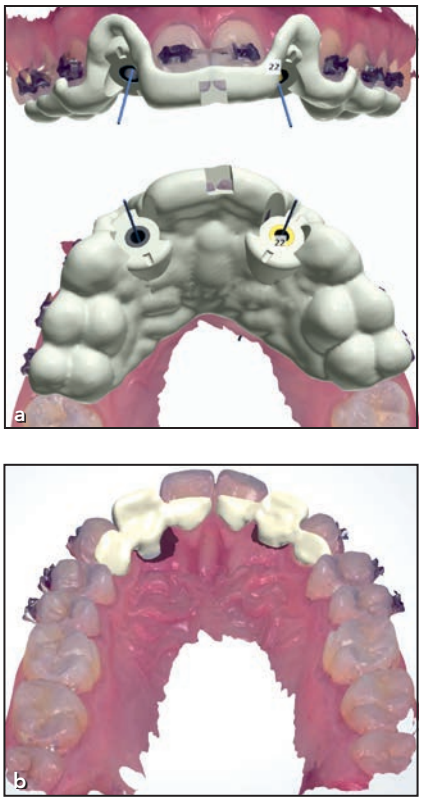

Fig 4 (a) *Simplified surgical guide design.* (b) *Presurgical design of provisional restorations.*

Fig 5 *A multiblade carbide bur was used to longitudinally separate the root, preserving the buccal portion in place.*

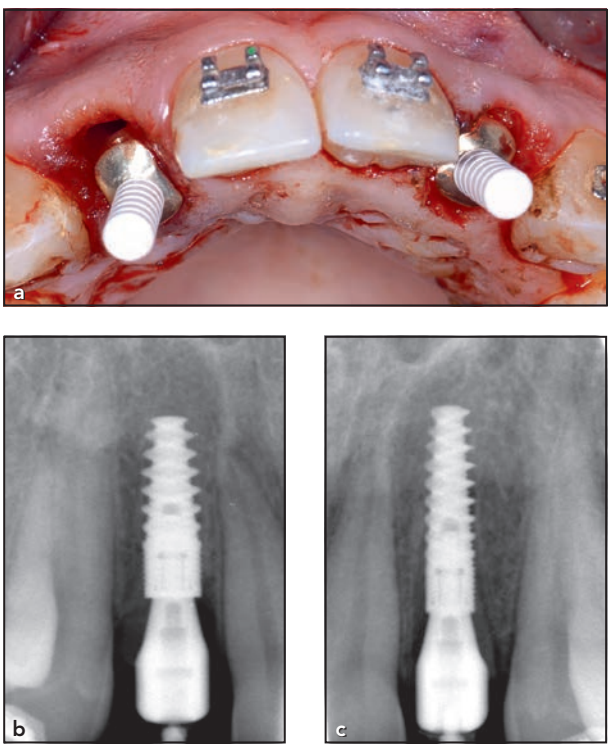

Fig 6 (a) *Anatomically shaped healing abutments were placed, and PEEK provisional components were clipped on.* (b and c) *Posttreatment intraoral periapical radiographs of teeth 12 and 22, respectively. Note the anatomically shaped healing abutments in place.*

Fig 7 *For both sites, shape D of the iphysio Profile Designer was selected.*

Fig 8 *Prosthetic treatment: Provisional crowns were placed and splinted to the existing orthodontic wire.*

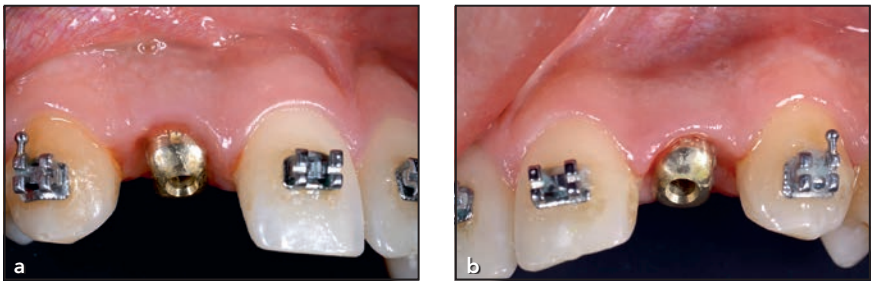

Fig 9 *Intraoral views at* (a) *tooth 12 and* (b) *tooth 22 of the healing abutments 16 weeks after surgery. Soft tissues were completely healed and ridge volumes were fully preserved.*

Fig 10 *Prosthetic treatment.* (a) *An intraoral full-arch scan was performed using Trios. Healing abutments were scanned without needing to be removed.* (b) *Virtual healing abutments were matched to the scanned ones and placed in the virtual cast.* (c) *Definitive all-ceramic screw-retained crowns were virtually designed using Trios Dental Studio software.*

were then splinted to the existing orthodontic wire to increase stability (Fig 8).

Postoperatively, the patient was prescribed oral antibiotic therapy, with amoxicillin plus clavulanate potassium (1 g) every 12 hours for 6 days (Augmentin, GlaxoSmithKline); nonsteroidal analgesic ibuprofen (600 mg) as needed (Brufen, Abbott); and a chlorhexidine gluconate 0.2% rinse three times a day (Curasept ADS 0.2%, Curaden).

Sixteen weeks after surgery, the soft tissues appeared completely healed and the ridge volume was fully preserved (Fig 9).

Restorative Phase

The provisional restorations were removed, and an intraoral scanner (Trios 2) was used to record a digital impression by directly scanning the iphysio Profile Designer abutments, without needing to remove them to insert scan-body components (Fig 10a).

In the laboratory, software (Trios Design Studio, 3Shape) was used to create the virtual cast by matching the correct virtual iphysio Profile Designer shapes (with the corresponding implant analogs) to the ones scanned intraorally (Fig 10b). Virtual abutments (Esthetibase, Lyra ETK) were then placed in the virtual cast, and the same

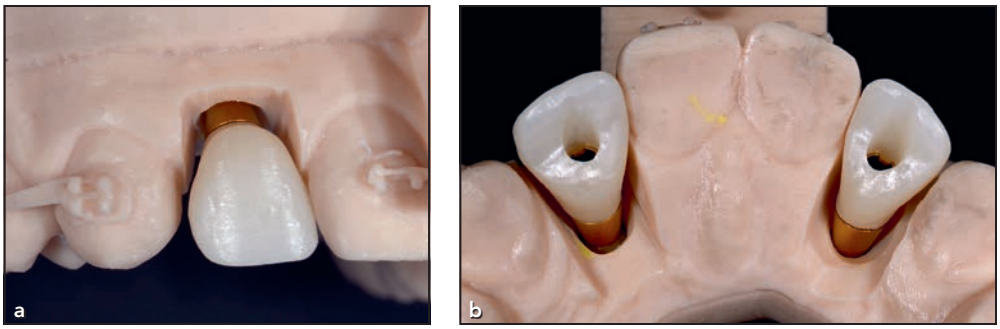

Fig 11 *Definitive zirconia crowns underwent processing on a resin cast. The cut-back technique was selected to achieve better esthetic integration.*

Fig 12 *Postoperative view at delivery of the definitive ceramic restorations. Note the soft tissue healing guided by the anatomical healing abutments.*

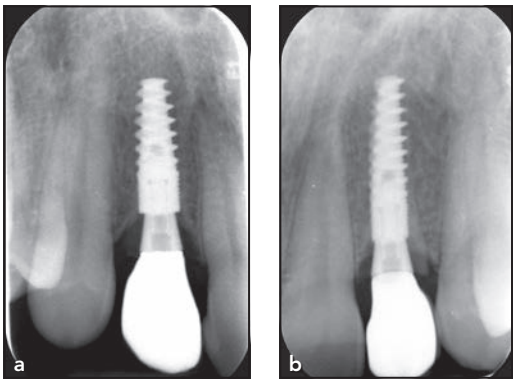

Fig 13 *Posttreatment intraoral periapical radiographs of* (a) *tooth 12 and* (b) *tooth 22 at delivery of the definitive ceramic restorations.*

software was used to design and produce machined screw-retained monolithic zirconia crowns (Fig 10c). A resin model was also printed to facilitate laboratory steps of feldspathic ceramic layering with the cut-back technique (Fig 11).

At the clinical appointments, the iphysio Profile Designer abutments were removed (Fig 12), and the crowns were tried, adjusted, and screwed at 25 Ncm on the implants. Periapical radiographs were performed to check for perfect fit (Fig 13). The access holes were then filled with PTFE (polytetrafluoroethylene) tape and covered with composite resin (Enamel Plus, Micerium) (Fig 14).

Discussion

One of the key factors that determines the esthetic success of implant-supported prostheses in the esthetic zone is the preservation of the natural architecture of the peri-implant tissues.[13]

The morphology of the soft tissue surrounding the implants depends upon several factors, such as the thickness of the supporting bone,[14] mucosa thickness,[15] implant position,[16,17] and transmucosal shape of the abutment and the prostheses.[9]

Grunder et al suggested that the underlying alveolar bone crest should be at least 2.0 mm thick to achieve a stable mucosal margin.[18] In the present case, the CBCT scan showed a very thin bone wall, which was therefore at risk for esthetic failure. Several approaches have been described in the literature to minimize buccal bone resorption after tooth extraction, including immediate implant placement after extraction,[19,20] palatal implant positioning (palatal approach) to preserve the buccal wall contact,[21] flapless surgery to maintain vascularization,[22,23] soft and/or hard tissue grafting to maintain ridge dimensions,[24] and the socket shield technique, which retains a buccal portion of the root after the extraction.[7,8]

A recent study evaluating 128 socket shield cases reported a

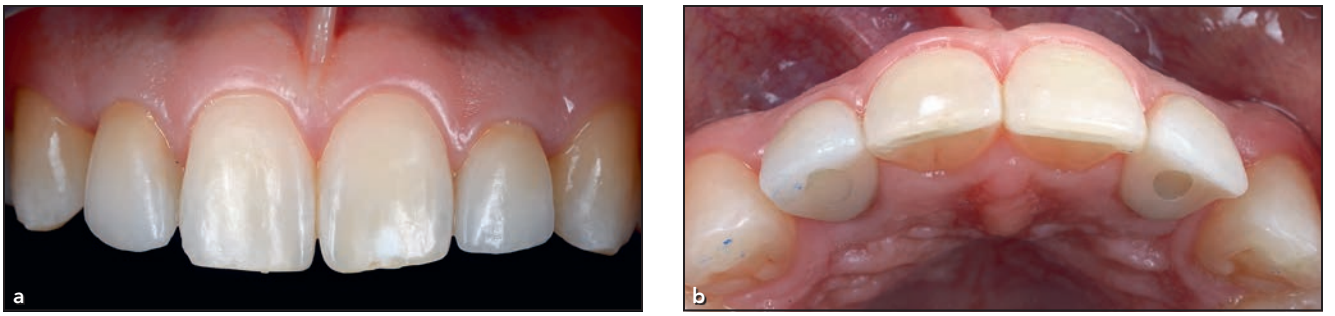

Fig 14 (a) *Facial and* (b) *occlusal postoperative views with the all-ceramic screw-retained crowns in place at the final delivery.*

success rate comparable to conventional delayed and immediate implant placements in terms of implant survival and complications.[25] According to recent literature,[8,25] the advantages of the socket shield technique are avoidance of soft or hard tissue grafting; reduced costs (compared to grafting), socket resorption, and comorbidity; and the need for only one surgical procedure.

According to Bäumer et al,[26] the socket shield technique requires high technical skills, particularly for determining the precise implant position towards the palatal alveolar socket wall. Therefore, to achieve a more predictable level of precision in the present case, digital planning and guided surgery were selected.

Recent studies[22,25] showed that the bone is palatal and apical to the tooth root in 80% of cases, making proper planning a precondition for esthetic success. Although no decisive evidence yet exists suggesting that computer-assisted surgery is superior to conventional procedures in terms of safety, treatment outcomes, morbidity, or efficiency,[27] a recent study[28] demonstrated that insertion parameters (entry point and apical and angular deviation) are more accurate when using computer-aided implant placement. Because of the improved control during the drilling phase, computer-assisted surgery is also recommended for flapless procedures, for implant placement in situations with limited bone, or for situations in close proximity to critical anatomical structures.[28,29]

The prosthetic system used in the present case (iphysio Profile Designer, Lyra ETK) comprises preformed healing abutments with anatomical emergence profiles mimicking the subgingival shape of different natural teeth. A specific cement-free PEEK provisional component can be clipped on the profile designer to retain a provisional crown without venting for the screw insertion. The risk of bacteria colonization due to the absence of the cement is minimized by the coronal position of the provisional crown margins.

In the present case, the implant was placed towards the palatal socket wall to gain primary stability and allow for palatal screw access of the final crown. To maintain the peri-implant soft tissue profile relative to the labial aspect of the extraction socket, an eccentrically shaped healing abutment (shape D) was chosen. The peculiar abutment shape and its correct height allowed for proper seating, preventing contact with the palatal bone.[30]

This prosthetic system has several advantages. The gingiva heals directly around the profile designer, shaping peri-implant soft tissues with an ideal emergence profile. This avoids progressive modifications of the provisional restorations, which require extensive chair time and high technical skills.[9] The iphysio abutment can be also used for cement-retained restorations.

The profile designer also functions as a scan-abutment for digital impressions, permitting a direct final impression that reproduces both the implant position and the peri-implant soft tissue shape. This avoids having to remove the healing abutment[31] and the consequent collapse of the peri-implant soft tissue,[32] which must be compensated by customizing the impression coping,[11] therefore increasing chair time. The iphysio system also reduces the number of repeated connection-disconnections of the healing abutment, which may lead to marginal bone loss due to microleakage

and disruption of the peri-implant connective fibers.[33,34]

Then, Trios Design Studio software was able to match the selected profile designer, automatically recreating the shape of the healed transmucosal tissues and the 3D implant position, allowing the creation of a reliable virtual model.

Conclusions

This case report described the replacement of two maxillary lateral incisors with reduced buccal cortical bone by means of implant-supported crowns. The association of immediate tooth replacement, guided surgery, socket shield technique, anatomically shaped transmucosal implant component, and a digital impression without scan bodies resulted in a successful rehabilitation with healthy, stable, and anatomically shaped peri-implant tissues. Reducing the costs, number of appointments, and chair time were additional advantages of these techniques.

Acknowledgments

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