Clinical Benefits of 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. A case replacing two maxillary lateral incisors with reduced buccal cortical bone by means of implant-supported crowns was illustrated. The socket shield technique was adopted to conserve the tissue volume, guided surgery was used to manage the optimal implant insertion, and anatomically shaped transmucosal implant components were selected to shape peri-implant soft tissues with the ideal emergence profiles and allow for direct digital impressions without scan bodies. The association of immediate implantation, guided surgery, 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. Int J Periodontics Restorative Dent 2022. doi: 10.11607/prd.5016

CLINICAL SIGNIFICANCE
This case report aimed to provide the clinicians with a solution for replacement of two maxillary lateral incisors with reduced buccal cortical bone. A new prosthetic system consisting of pre-formed healing abutments with anatomical emergence profiles mimicking the sub-gingival shape of different natural teeth is discussed and presented.

Introduction

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. Tooth extraction results in an inevitable alveolar ridge reduction, both vertically and horizontally, in particular in the anterior areas where the buccal bone is thinner. When primary stability is achieved, immediate tooth replacement has been suggested to support the soft tissues during osseointegration. The socket shield technique has been introduced with the aim of conserving the tissue volume by retaining the facial part of the root during the extraction at the immediate implant placement.

One of the biggest challenges in the aesthetic areas is to create an esthetically pleasing peri-implant soft tissue architecture which manages the transition between the circular diameter of the implant platform to the anatomical shape of the replaced natural tooth.

Several techniques, both at first and second stage surgery, have been proposed to achieve the above mentioned goal, like anatomically shaped healing abutments or the progressive modifications of the provisional restorations.

The purpose of this article is to describe the rehabilitation of two maxillary lateral incisors with reduced buccal cortical bone by means of implant-supported single crowns, associated with guided surgery immediate implant and tooth replacement, socket shield technique, and novel anatomically shaped transmucosal components.
Materials and Methods

Case Presentation

A 27-years-old man, undergoing orthodontic treatment, was referred to our office for treatment of external resorption of teeth 1.2 and 2.2. (Figs. 01 A-B).

Tooth 1.2 was diagnosed with a horizontal root fracture, at the level of the resorption, tooth 2.2 presented a crack line at the CEJ. Both lateral incisors were therefore considered non-restorable.

The treatment plan consisted of the extractions of the hopeless teeth and their replacement with implant supported crowns.

A full mouth digital impression was made with Trios 2 (3Shape). A cone-beam computed tomography (CBCT) was performed using a 5 × 5-cm field of view, with 90-µm scans (CS9300, Carestream) to evaluate the maxillary bone volume.

The CBCT revealed very thin vestibular bone walls covering both lateral incisors (Figs. 02 A-B).

In order to preserve such thin walls, the implants insertion was planned through guided surgery, socket shield technique, and immediate tooth replacement.

A guided-surgery software (Implant studio 3 shape) was used to select the optimal implant insertion axis. The software allowed the matching of the CBCT and STL files, creating a tridimensional virtual simulation of the implant supported restorations (Fig. 03).

A stereolithographic surgical stent and two PMMA provisional crowns with palatal retainers to facilitate intra-oral positioning were then fabricated (Figs. 04A-B).

Surgical Procedure

Teeth 12 and 22 were then sectioned vertically and cut mesio-distally, and their palatal portions extracted according to the shield technique protocol (Fig. 05).

Two implants (Naturactis, LYRA ETK), 4 x 12 mm for tooth 1.2, and 3.5 x 14 mm for tooth 22, were then inserted with the aid of the surgical template, reaching an insertion torque of 35 N/cm.
Two anatomically shaped healing abutments (Profile Designer Iphysio D, LYRA ETK), 4 mm high, were screwed on the implants (Figs. 06 A-B-C).

The IPhysio Profile Designer system allows the choice among 4 shapes with 3 different gingival heights, reproducing the morphology of incisors (A shape), cuspids and premolars (B shape), and molars (C shape). In this case a D shape 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 cement-less provisional components, removed, trimmed, finished, and then snapped back onto the healing abutments. The provisional crowns were then splinted to the existing orthodontic wire to increase stability (Fig. 08).

Post-operatively, the patient was prescribed oral antibiotic therapy, with amoxicillin plus clavulanate potassium (1g) every 12 hours for 6 days (Augmentin, GlaxoSmithKline), non-steroidal analgesic ibuprofen (600mg) 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 fully preserved (Figs. 09 A-B).

Restorative Phase

The provisional restorations were removed and a digital impression was recorded using Trios 2 intraoral scanner (3Shape) by scanning directly the Iphysio Profile Designer abutments, without the need of removing them to insert scan-body components. (Figs. 10 A).

In the laboratory, 3 Shape laboratory software (Dental Studio etc) was used to create the virtual cast, by matching the correct virtual Iphysio shapes, with its corresponding implant analogs, to the ones scanned intra-orally. (Fig. 10B)

Virtual abutments (Esthetibase, LYRA ETK) were then placed in the virtual cast, and the same software was used to design and produce machined screw-retained monolithic zirconia crowns (Figs. 10C).
To facilitate laboratory steps of feldspathic ceramic layering with the cut-back technique a resin model was also printed (Figs. 11 A-B).

At the clinical appointments the Iphysio profile designer abutments were removed (Fig. 12) and the crowns tried, adjusted, and screwed at 25Ncm on the implants. Periapical radiographies were performed to check perfect fitting. (Fig. 13 A-B). The access holes were then filled with PTFE tape and covered with composite resin (Enamel plus – Micerium) (Figs. 14 A-B).

DISCUSSION

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.13

The morphology of the soft tissue surrounding the implants depends upon several factors, like the thickness of the supporting bone 14, the thickness of mucosa15, the implant position16,17, and the trans-mucosal shape of the abutment and the prostheses. 9

Grunder et al suggested that in order to have a stable mucosal margin the underlying alveolar bone crest should be at least 2.0 mm thick.18

In our case, the CBCT scan showed a very thin bone wall, and therefore at risk for esthetic failure. In order to minimize buccal bone resorption after tooth extraction several approaches have been described in the literature: immediate implant placement after extraction19,20, palatal positioning of the implant (“palatal approach”) to preserve the buccal wall contact 21, flapless surgery to maintain vascularization22,23, soft and/or hard tissue grafting to maintain the dimension of the ridge24, socket shield technique (SST), which retains a buccal portion of the root after the extraction.7,8

A recent study evaluating 128 socket shield cases reported a success rate, in terms of implant survival and complications, comparable to conventional delayed and immediate implant placements.25
According to recent literature the advantages of the SST are: avoidance of soft- or hard-tissue grafting; reduced cost compared to grafting; reduced socket resorption; need for only a single surgical procedure; reduced comorbidity.

According to Baumer, the SST requires high technical skills, in particular to determine the precise position of the implant towards the palatal wall of the alveolar socket.

Therefore, to achieve a more predictable level of precision, in our case we opted for digital planning and guided surgery.

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, a recent RCT study demonstrated that insertion parameters, like entry point, apical and angular deviation, are more accurate when using computer aided implant placement.

In fact, recent studies showed that the bone is palatal and apical to the tooth root in 80% of the times, making proper planning a pre-condition for esthetic success.

Computer-assisted surgery procedure is also recommended for flapless procedures, for implant placements in situations with limited amount of bone, or in the proximity to critical anatomical structures thanks to improved control during the drilling phase.

The prosthetic system used in our case, consists of pre-formed healing abutments, called design profilers, with anatomical emergence profiles mimicking the sub-gingival shape of different natural teeth. A specific PEEK cement-less provisional component can be clipped on the profile designer in order 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 margins of the provisional crowns.

In our case the implant was placed towards the palatal wall of the socket to gain primary stability and allow for palatal screw access of the final crown. In order to maintain the peri-implant soft tissue profile to the labial aspect of the extraction socket, an eccentrically shaped healing abutment (Iphisio D
shape) was chosen. The peculiar shape of the abutment and its correct height allow for its 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 the progressive modifications of the provisional restorations, which requires extensive chair-time and high technical skills 9. Iphysio abutment can be also used for cement retained restorations.

The profile designer functions also as scan-abutment for digital impression, permitting a direct final impression which reproduces at the same time both the implant position and the shape of the peri-implant soft tissue. This avoids the removal of the healing abutment31 and the consequent collapse of the peri-implant soft tissue32, which must be compensated by customizing the impression coping11, therefore increasing chair-time.

The IPhysio system reduces the number of repeated connection-disconnection of the healing abutment, which may lead to marginal bone loss due to microleakage and disruption of the peri-implant connective fibers33,34.

The Dental System Software (3Shape) is then able to match the selected profile designer, recreating automatically the shape of the healed transmucosal tissues and the tridimensional position of the implant, allowing the creation of a reliable virtual model.

CONCLUSIONS

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

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REFERENCES


Figure Legends

Fig 1 A-B, Radiological investigation: pre-treatment intra-oral periapical radiographies.

Fig 2 A-B, Radiological investigation: cone beam computed tomography. Note thin buccal bone plate.
Fig 3 Prosthetically driven virtual implant planning. Please note that the external green profile identifies the safety zone and not a dehiscence of bone.

Fig 4 a) Simplified surgical guide design. b) pre-surgical provisional restorations design

Fig 5 A multi blade carbide bur was used to separate longitudinally the root in order to preserve the buccal portion in place.

Fig 6 A,B) Radiological investigation: post-treatment intra-oral periapical radiographies. Note anatomically shaped healing abutments in place. C) Implant treatment: anatomically shaped healing abutments in place with PEEK provisional components clipped on.

Fig 7 D-shape IPhysio Profile Designer.

Fig 8 Prosthetic treatment: provisional crowns in place splinted to the existing orthodontic wire.

Fig 9 A, B) Prosthetic treatment: intraoral view of healing abutments 16 weeks after surgery. Note soft tissues completely healed and volumes of the ridges fully preserved.

Fig 10 A) Prosthetic treatment: intraoral full-arch scan using TRIOS (3Shape). Healing abutments are scanned without the need of being removed. B) Prosthetic treatment: virtual healing abutments are matched to the scanned ones and placed in the virtual cast. C) Prosthetic treatment: definitive all ceramic screw-retained crowns are virtually designed using Dental Studio software (3Shape).

Fig 11 A-B) Prosthetic treatment: definitive zirconia crowns under processing on resin cast. Cut-back technique is selected to achieve better esthetic integration.

Fig 12 Postoperative view: please note the healing of soft tissue guided by the anatomical healing abutments.

Fig 13 A-B) Radiological investigation: post-treatment intra-oral periapical radiographies.

Fig 14 A-B) Postoperative view: all ceramic screw retained crowns in place.
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Figures 5016

Fig 1a

Fig 1b

Fig 2a

Fig 2b

Fig 3