Socket Shield Technique for Implant Placement in the Esthetic Zone: A Case Report

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Immediate implant placement is a widespread concept in implant dentistry to replace failing teeth, showing clinical success rates similar to dental implants placed into healed postextraction sites.¹ The success of osseointegration for the immediate approach is well documented,² the surgical exposure of the patient is minimized, and overall treatment time is thus significantly reduced. Yet, several authors remain critical of these techniques in terms of soft tissue alterations, which are especially important in the esthetic anterior zone.³ ⁴ Following tooth extraction, a variety of hard and soft tissue ridge alterations, particularly on the labial aspect, are known to occur.⁵ Clinically, approximately 29% to 63% of the labial bone plate is resorbed horizontally, and 11% to 22% vertically after 6 to 7 months. Studies have shown that this happens mainly within the first 3 months after tooth extraction.⁶ ⁷ In a canine model, Fickl et al⁸ showed a significant difference in the extent of bone resorption between flap and flapless extraction. However, the differences were negligible after 6 months.⁹ The tissue alterations often make predictable and adequate esthetic rehabilitation impossible without extensive ridge augmentation. To counter the loss of tissues, clinicians advocate immediate implant placement in an optimal three-dimensional position.¹⁰ In addition,
the use of soft tissue grafting, simultaneous with or prior to implant placement, has been recommended to compensate for the occurring tissue alteration. Placing bone substitute materials with or without barrier membranes to preserve the ridge has also been discussed. Yet none of these techniques is able to completely preserve the buccal bone plate, which is critical for esthetic success. However, retaining the buccal aspect of the root completely or even partially during implant placement has been shown to preserve the buccal bone plate, which is critical for esthetic success. However, retaining the buccal aspect of the root completely or even partially during implant placement has been shown to preserve the buccal bone plate and thus the facial gingival contour. In a histologic study in baboons, the unintentional placement of titanium implants close to retained root tips resulted in no signs of inflammation or other apparent negative histologic signs and did not negatively interfere with the clinical success of the osseointegrated implants. The present case report demonstrates and discusses the treatment of a single maxillary incisor using the socket shield technique in combination with immediate implant placement.

Clinical Presentation

A 47-year-old male patient with a noncontributory medical history presented with an oblique crown-root fracture of the maxillary right central incisor and insufficient composite restorations of the maxillary right lateral and left central incisors (Fig 1).

The patient requested a thorough reconstruction of his anterior teeth with replacement of the maxillary right central incisor and revision of the adhesive restorations. Cone beam computed tomography analysis prior to treatment revealed a sufficient buccal bone plate and no periapical infection of the tooth (Fig 2). The recorded periodontal parameters showed clinically healthy soft tissues as indicated by a low modified plaque index (mPI) and modified sulcus bleeding index (mSBI). Pocket probing depths (PPD) were evaluated at six points on each tooth. The maxillary right central incisor revealed 1 mm PPD on the labial, 1.5 mm interproximally, and 2 mm on the palatal side. Corresponding PPDs were found for the contralateral central and both lateral incisors. Alternative treatment options were discussed. The patient refused orthodontic appliances for forced eruption. After a decision in favor of immediate implant placement, the patient gave his consent to perform the root retention technique. After standard preoperative prophylactic antibiotic regimens (Amoxi 1000, 1A Pharma) and local anesthesia (Ultracain D-S Forte, Sanofi-Aventis), the implant osteotomy was performed according to manufacturer (SIC Invent) guidelines through the palatal aspect of the root (Fig 3). The pulp chamber was used as an initial guide to achieve maximum control and simplify the osteotomy. The authors also wanted to ensure that the apical part of the root and pulp were removed.

After full-depth implant site preparation, the remaining root was sectioned mesially and distally with a Lindemann Bur (Hu-Friedy) and carefully removed except for the buccal aspect. The retained buccal fragment was cut down and prepared for socket shield technique.

Fig 1 Pretreatment situation of a maxillary right central incisor with an oblique crown-root fracture. Note the thin soft tissue on the facial aspect. Additionally, the tooth was positioned slightly buccal compared to the contralateral central incisor, resulting in a more apically located (0.75 mm) gingival zenith.

Fig 2 Cone beam computed tomography analysis revealed an intact buccal bone, measuring approximately 0.7 mm. Vertically, the distance between the nasal cavity and the most coronal part of the buccal bone measured approximately 15 mm; the planned length of the implant was 13 mm.
by leveling it approximately 1 mm coronal to the buccal bone plate and 1 mm apical to the free gingival margin (Fig 4) using fine-grained rotational instruments (Intensiv). The implant (4.7 × 13 mm SICmax, SIC Invent) was inserted torque controlled (40 Ncm) using a surgical contra-angle and placed in contact with and slightly apical (1 mm) to the retained labial root fragment. The void between the remaining lateral and lingual bone walls and the implant body were filled with a xenograft bone material (Bio-Oss, Geistlich).

A prefabricated screw-retained PEEK-Optima provisional abutment (P2F, SIC Invent) was customized using a light-curing resin (Tetric EvoFlow, Ivoclar Vivadent) (Fig 5).

The subgingival contours were supportive of the soft-tissue profile; however, care was taken not to apply pressure on the remaining tooth fragment. After sufficient relining and leveling of the abutment 1 mm above gingival height with appropriate diamond laboratory burs and polishing, the customized healing abutment was disinfected and mounted to a laboratory analog/replica to immediately transfer the achieved subgingival profile to an impression coping using autopolymerizing resin (GC Pattern Resin LS, GC Europe).

Afterward, the healing abutment was cleaned and disinfected again and replaced on the implant using a torque ratchet (15 Ncm) (Fig 6). The patient was provided with a removable prosthesis for the period of healing and instructed in careful oral hygiene. A postoperative examination was performed after 1 week. Follow-up visits were scheduled for 1 and 3 months postoperatively and showed uneventful healing.

At 5 months after surgery, a periapical radiograph verified radiographic healing and showed little if any bone loss at the implant-abutment interface (Figs 7 and 8). At the first removal of the custom abutment after 5 months of healing, a healthy soft tissue interface was noted. Immediately thereafter, the prefabricated customized transfer coping was connected. The correct
seating was verified radiographically, and an open-tray impression (Identium Light, Heavy, Kettenbach Dental) was taken. The laboratory manufactured a soft tissue cast and constructed a screw-retained computer-aided design/computer-assisted manufacture (3shape) custom-milled zirconium oxide abutment (Simeda, Anthogyr) bonded to a titanium base (SIC Invent) for a cemented crown restoration (Fig 9). The margin was positioned 0.5 mm below the gingival margin to avoid negative esthetic influence by the white-opaque abutment substructure. An all-ceramic bilayered restoration was fabricated using the lost wax and cutback technique (IPS e.max Press and IPS e.max Ceram, Ivoclar Vivadent). After try-in, the abutment was screw retained with a ratchet (20 Ncm) and the access hole was sealed with Teflon tape. Rubber dam (Isodam, Sigma Dental Systems) was applied, and the final crown was adhesively cemented with RelyX Unicem 2 Automix (3M) under field isolation (Fig 10).

The clinical strategy and benefit of using a thin rubber dam for cementation of implant-based reconstructions is the control and easy removal of excess cement. This way the clinician can easily insert the restoration while respecting the gingival health and avoiding damage to the fragile peri-implant biology.

The direct composite restorations of the neighboring teeth were made from Enamel plus HFO (Micerium) using the primary laboratory wax-up as an index. After 24 months, there was no visible sign of contour change from an occlusal and facial view, even with no tissue grafting in conjunction with immediate implant placement. After 24 months and 12 months, respectively, mPI, mSBI, and PPD indicated no clinical change of soft tissue or plaque accumulation on the labial aspect of the restoration (Figs 11 to 14). Pocket probing showed depths between 1 and 1.5 mm buccally, which are consistent with presurgical measurements. Interproximal and palatal pocket probing, where no retaining root fragment was present, showed a slight increase (0.5 to 1 mm).

To quantify possible tissue alterations, impressions made immediately after implant placement and 6 months postoperatively, prior to the definitive restoration, were optically scanned (3Shape D900L, Rübeling + Klar). The digital casts were then aligned using the remaining teeth surfaces as reference and three-dimensionally evaluated.

The digital analysis (Geomagic Control 2014, Geomagic) of the buccal and midfacial area revealed little if any volumetric change during the course of treatment (Fig 15).
Fig 9  A computer-aided design/computer-assisted manufacture milled individual zirconia abutment connected to a titanium base served as an abutment for a bilayered all-ceramic crown.

Fig 10  Rubber dam–isolated luting improves the clinical management of excess cement.

Fig 11  The final result after 12 months. A good integration of the single implant crown and the direct resin restorations can be observed. Intraoral three-quarter occlusal view shows no changes in buccal soft tissue comparing to pretreatment situation and equivalent volume to that of the untreated contralateral incisor, even without augmentation.

Fig 12 (right)  Due to a previous restoration, three-dimensional data could be acquired. At 24 months, the peri-implant bone is stable at the implant-abutment interface.

Fig 13 (below) The cross-sectional reconstruction shows intimate contact between the retained portion of the root and the implant body. An inflammatory response is not visible radiographically. Note the image artifacts, especially in (c).

Fig 14  The 24-month follow-up shows healthy peri-implant tissues with little if any volumetric change of the buccal and midfacial contour. The surface of the resin restorations appears dull after 24 months and needs to be repolished.
Discussion

Due to atrophic ridge alterations that occur after tooth extraction, delayed or late implant placement often requires extensive tissue grafting prior to implant surgery. In contrast, immediate implant placement in a correct three-dimensional position\(^1\) shortens overall treatment time and can facilitate good esthetic results.\(^1\) However, to achieve optimal results, simultaneous augmentation procedures to compensate for horizontal and vertical remodeling are still necessary.\(^1\) In 1975, Guyer\(^2\) reported maintenance of the alveolar ridge for 27 months with the submergence of two vital roots in a patient. In two reports, coverage of a root and intrabony retention, and thereby conservation of the periodontal ligament, prevented resorption of the buccal bone plate and therefore preserved the natural contour of the alveolar process.\(^1\)\(^,\)\(^2\) In another study, dental implants inserted through impacted teeth with a follow-up of up to 8 years did not show any signs of inflammation or bone resorption.\(^3\) Furthermore, histologic examination showed intimate contact between the implant surface and the root without the interposition of fibers and formation of cementum on the surface of the implant without pathologic inflammatory signs.\(^1\)\(^,\)\(^4\)\(^,\)\(^2\) These findings are in accordance with other studies that could not find any negative biologic response.\(^1\)\(^,\)\(^6\)\(^,\)\(^2\) It can be concluded that the socket shield technique does not interfere, at least in the short term, with the function or biology of titanium oral implants.

To achieve clinical success, proper case selection (ie, the condition of the failing tooth) is of paramount importance. The remaining root and its periodontal ligament must be healthy, without mobility or radiologic or clinical pathology. Internal and external resorptions, endodontic perforations, or infections on the labial aspect are contraindications, in the present authors’ opinion. Tooth mobility or impaired periodontal apparatus may not only negatively affect the long-term stability of peri-implant tissues, it may also interfere with implant bed preparation and placement. Hence, a healthy periodontium is mandatory. Fractured or endodontically treated teeth are feasible if the remaining parts are healthy and cover the desired aspect of the socket. Bäumer et al\(^1\) reported that in cases with fracture lines on the buccal aspect that may lead to bacterial access and consequently to infection, the separation of the buccal shield in two pieces along the fracture line may be a viable option. While Hürzeler et al\(^1\) and Bäumer et al\(^1\) describe the use of a labial shield, Kan and Rungcharassaeng\(^2\) shield the proximal area to preserve the papilla. Hence, different modalities of the same technique seem feasible. The existing evidence for periapical pathology as a risk factor for the survival outcome of postextraction implants is contradictory.\(^2\) In conjunction with the socket shield technique, the present authors remain cautious regarding existing periapical infections.

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Fig 15 The digital overlap and sectioning (red = pretreatment, black = post-treatment) of the midfacial area showed no significant contour change during treatment.
The discussed case selection criteria reflect the authors’ professional opinion, as there is no evidence regarding the ideal clinical eligible situation for the socket shield technique. The present case seems ideal, though, as the failing tooth is compromised with an oblique crown-root fracture but vital and fully intact on the labial aspect. Further, periodontal examination did not reveal clinical signs of inflammation.

A screw-retained restoration requires an implant axis that is positioned lingual to the incisal edge. Otherwise, the access hole remains visible. In the present case, the implant body is intentionally placed in direct contact with the labial aspect of the root. The resulting different buccolingual long axis makes a screw-retained restoration impossible. The removal of excess cement in cases where implant crowns are cemented is clinically difficult and negatively affects peri-implant tissues. However, in the present authors’ experience in cases where this optimal implant position to screw retain is unfeasible, the use of rubber dam makes cement removal clinically easy to manage.

A thin gingival biotype is known to significantly influence the esthetic outcome in the anterior region, often resulting in loss of facial tissue or recession. Consequently, in such cases it is even more important to preserve as much tissue as possible over time and prevent the need to augment tissues. In the present case, a thin to medium-thick biotype was present and a gingival margin of approximately 0.75 mm was located apical to the contralateral incisor prior to treatment. However, the applied technique enabled the authors to maximize tissue stability and reduce surgical intervention to a minimum. As all alternative treatment options were discussed with the patient, the presented technique proved to be a reasonable choice considering risk versus gain. No human-derived histologic examinations are currently available; the results of this and other case reports using the described technique provide only clinical results. Before integrating this protocol on a daily basis, long-term studies and histology are required to show long-term success of the socket shield technique.

Conclusions

In this case report, a hopeless fractured maxillary central incisor was replaced by an immediately placed implant in combination with the socket shield technique and a cemented all-ceramic crown. Despite a thin biotype, the peri-implant tissues could be well preserved over time and a result could be achieved that was regarded a success by the patient. With some limitations and careful selection of the case, this treatment modality may be suitable for esthetically challenging anterior single implant restorations.

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