Clinical Benefits of the Immediate Implant Socket Shield Technique

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ABSTRACT

Objective: Extraction-socket resorption is considered a major problem that can limit implantological rehabilitation options and compromise the esthetic outcome. Surgical techniques to reduce remodeling are of restricted predictability and commonly require several surgical interventions and grafting. This increases the treatment cost and places a physical and psychological strain on the patient. This clinical case report presents a replacement of an upper canine using the socket-shield technique (SST) with a CAD/CAM surgical guide, resulting in a predictable, high esthetic, and functional result.
Clinical considerations: The SST is an alternative approach to curbing remodeling and resorption by retaining the facial part of the root during tooth extraction. An immediately placed implant supports the facial root fragment, preventing the collapse of the buccal wall. The SST with digital precision planning in combination with a CAD/CAM surgical guide benefits patients by preserving their tissue architecture and causing only insignificant trauma. Furthermore, the SST reduces the number of surgical and prosthetic interventions required to one each for pre-operative planning, surgical procedures, and prosthetic rehabilitation.
Conclusions: The socket shield technique is a minimally invasive implantological approach offers patients and clinicians multiple benefits.

CLINICAL SIGNIFICANCE

The socket-shield technique (SST) represents an alternative approach to intervene remodeling and resorption processes by the maintenance of the facial part of the root during tooth extraction. The immediate placement of an implant supports the facial root fragment and thereby prevents a collapse of the buccal wall. The SST associated with a CAD/CAM fabricated surgical guide, can reduce the amount of appointments, due to the immediate fabrication of the definitive restoration with the existing model. Therefore, no further necessary appointments are required apart from first pre-operative planning, second for surgical treatment, and third for prosthetic rehabilitation.

INTRODUCTION

Socket healing after tooth loss results in altered dimensions of the alveolar ridge[1,2] due to remodeling[3] and tooth-dependent alveolar process.[1] The degree of alterations varies and it can result in the loss of ridge volume and changes in ridge shape, with up to 3.8 mm horizontal and 1.24 mm vertical reduction.[4] Moreover, the greatest losses occur on the buccal aspect, which is related to a thinner bone wall[2] composed of large

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amounts of bundle bone[2] primarily vascularized by the periodontal tooth membrane[3] and particularly susceptible to surgical trauma and resorption.[5–7] Other important reasons to maintain the bone wall while teeth are present include maintenance of the periodontal ligament and the provision of nutritional and functional stimuli.[8]

Most dimensional changes that compromise socket healing occur during the first to third months.[8] A reorganization of the alveolar ridge can be observed for up to 1 year, but with a less pronounced influence on the hard and soft tissues.[9] In most situations, these changes adversely affect with the esthetic outcome, treatment planning, implant positioning, material selection, and osseointegration.[1] This is even more critical in the anterior regions[10] where these changes directly influence red and white esthetics.[11,12] Soft-tissue augmentations immediate or posterior to implant placement are successful to control the tissue alterations. However, it means more surgical interventions.[13]

Several approaches have been described for contouring the socket alterations caused by tooth extraction[10–12]: implant placement directly after extraction[4]; positioning of the implant on the palatal/lingual wall ("palatal approach"), preserving the buccal wall contact[1]; performing the surgery using the flapless technique to maintain vascularization[1]; and using soft-tissue or bone grafts to maintain the dimension of the ridge by socket augmentation.[10] Recent studies concentrated either on immediate implants or on the use of grafts, but they also stated that remodeling cannot be avoided with these techniques but can continue even after 3 to 6 months of healing.[1,14] Moreover, any surgical intervention can result in an anxiety response on the part of the patient. Anxiety is a state of discomfort and stress as well as tension, both before and after surgery, according to a definition by the American Psychiatric Association.[15]

The socket-shield technique (SST) may reduce the extent of treatment and decrease patient stress and pain.[10] Additionally, the SST might reduce socket resorption and help avoid soft-tissue or hard-tissue grafting. The technique retains the buccal root after extraction, preserving periodontal vascularization, cementum bundle bone[16] and the buccal bone wall.[17] Furthermore, the technique has additional advantages: there is no added cost for materials, comorbidity is reduced, and it can be applied in the presence of endodontic apical pathology, and reduced surgical intervention.[16]

There are suggestions in the literature that a root can be retained to preserve alveolar ridge volume underneath removable complete prostheses without complications such as infection.[2,18–20] This additionally allows vertical bone growth coronal to the decoronated root.[19,20] No further resorption and no interference with implant osseointegration was observed.[3,10,11,17] Enamel matrix derivate (Emdogain; Straumann, Basel, Switzerland) can be co-administered with the technique (applied on the internal aspect of the fragment) to prevent epithelial proliferation, in addition to its antimicrobial effect.[10,11]

Meticulous presurgical planning is mandatory, including the fabrication of a surgical guide to allow optimal implant placement and to ensure esthetic and functional restorative success. The use of computer-aided design/computer-aided manufacturing (CAD/CAM) stereolithographic (SLA) surgical guides associated with cone-beam computed tomography (CBCT) facilitates optimal positioning of the implant with more precision than with conventional templates. A digital image of the situation makes it possible to fabricate an individual healing abutment prior to tooth extraction.

The aim of this article was to describe the use of the innovative SST in the upper canine region, combined with a surgical CAD/CAM guide that allows the insertion of the final restoration at the second appointment, maintaining the tissue architecture. In addition, the SST reduces postoperative patient morbidity in terms of swelling and pain.

CLINICAL CASE PRESENTATION

A 38-year patient presented to the Department of Prosthodontics at the Dental School in Munich in

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2014 in connection with pain at the upper left canine. Intraoral examination showed no sensitivity, probably as a result of a previously trauma during the practice of martial arts (Figure 1). Clinically, the canine showed external resorption; periapical radiographic examinations showed a related radiolucent area (Figure 2). A CBCT scan was therefore indicated to evaluate the depth of the resorption and the possibility to restore the compromised tooth (Figure 3). The patient was referred to an endodontic specialist for a root canal treatment (Figure 4). However, at the 6-month follow-up, a renewed radiographic examination showed progressive resorption, compromising the chance of tooth preservation.

FIGURE 1. Preoperative frontal view of the upper jaw.

This unexpected outcome caused the dental team, in consultation with the patient, to embark on planning

FIGURE 2. Preoperative intraoral/palatal photograph and periapical radiograph of the internal resorption.

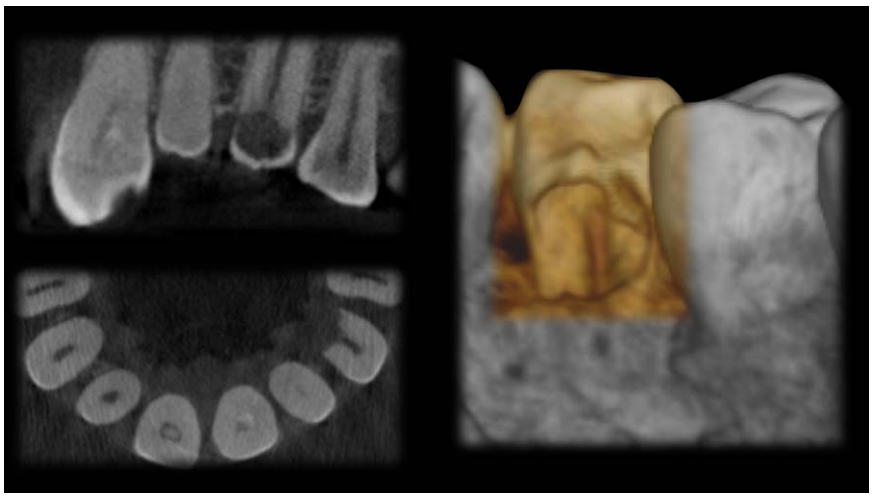

FIGURE 3. The 3D scan (CBCT) of the internal palatal resorption at the canine site.

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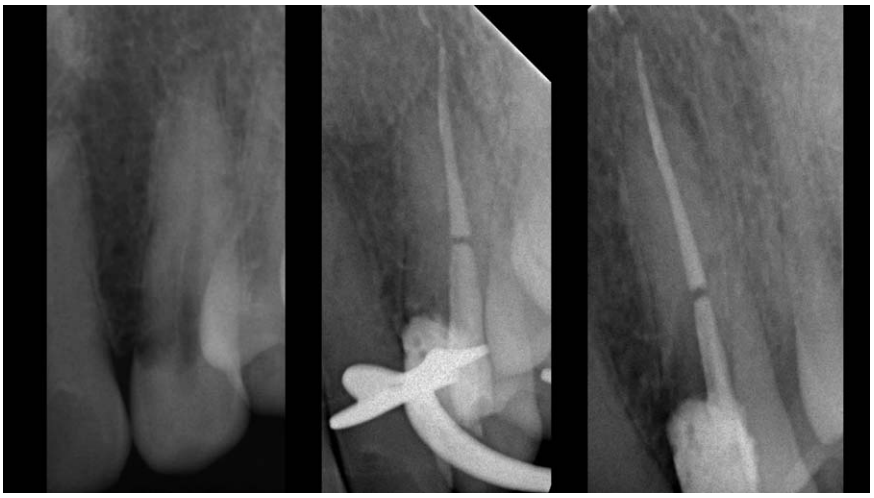

FIGURE 4. Periapical radiographs, pre- and postendodontic.

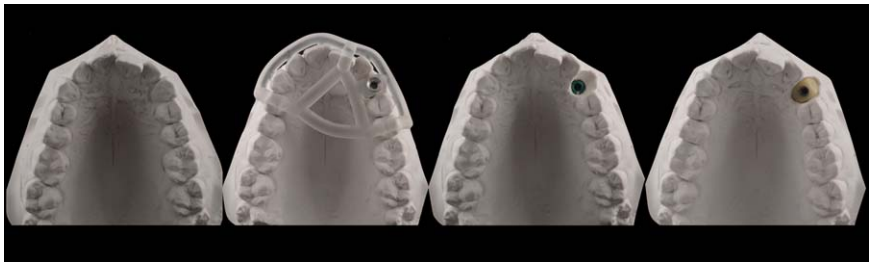

FIGURE 5. Study cast of the first situation, surgical guide fabricated over the cast, installation of the implant on the model, and fabrication of a custom healing abutment.

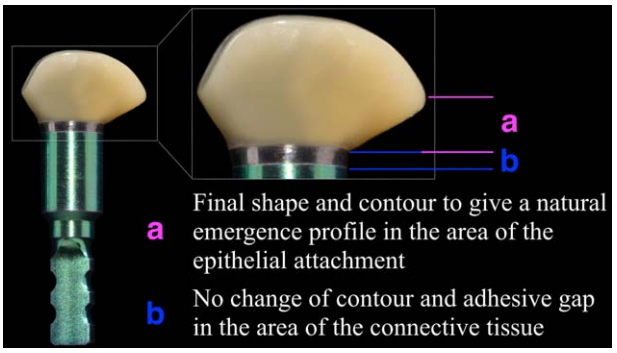

FIGURE 6. Custom healing abutment with a special contour.

FIGURE 7. Preoperative lateral photograph of the upper left canine.

for the extraction of the afflicted tooth and its replacement with an implant. The prominent canine contour combined with a high smile-line suggested the use of the SST, which is minimally invasive and has a positive effect onto the buccal bone contour.[10]

On a study cast based on a maxillary polyether impression (Impregum Penta; 3M, Seefeld, Germany), a CAD/CAM surgical guide (Smop Powered; Swissmeda AG, Zürich, Switzerland) was manufactured by matching the CBCT data, with the additional aim to provide a screw-retained implant-supported restoration. A diagnostic "implantation" was performed on the study cast (Figure 5), and a custom healing

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FIGURE 8. View of the teeth after decoronation.

FIGURE 9. Implant placement using a surgical guide.

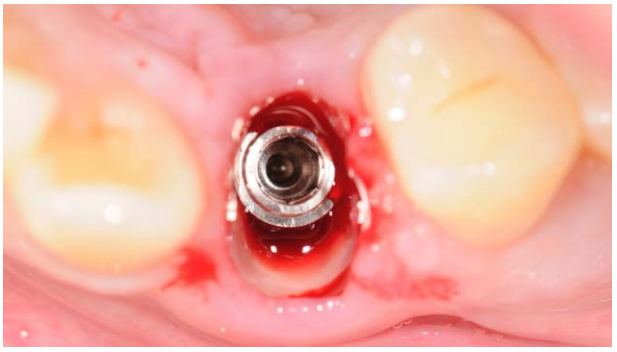

FIGURE 10. Postimplantation occlusal view with the remaining buccal fragment of the canine.

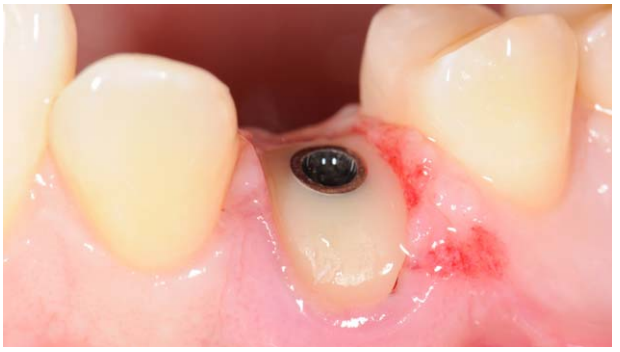

FIGURE 11. Custom healing abutment installed.

FIGURE 12. Interim prosthesis inserted.

FIGURE 13. CAD/CAM surgical guide with implant position.

abutment and interim prosthesis were produced; the latter served as a provisional esthetic solution while splinting the adjacent teeth to avoid any tooth movement.

The use of a CAD/CAM surgical guide facilitated the correct and precise positioning of the implant with the residual buccal root, allowing the additional fabrication of the individual healing abutment (Figure 6). Figure 7 shows a preoperative lateral view of the upper left canine. The complex surgical implant placement procedure was initiated by extraoral disinfection of the surgical site with a chlorhexidine solution for one minute, application of local anesthesia, and decoronation of the tooth with a diamond bur, leaving the tooth margins 1 mm above the gingival level (Figure 8). The implant bed was prepared accord to the manufacturer's guidelines, with the remaining root in the alveolar socket (Figure 9). At this point, the

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FIGURE 14. Frontal view after three months of clinical implant service.

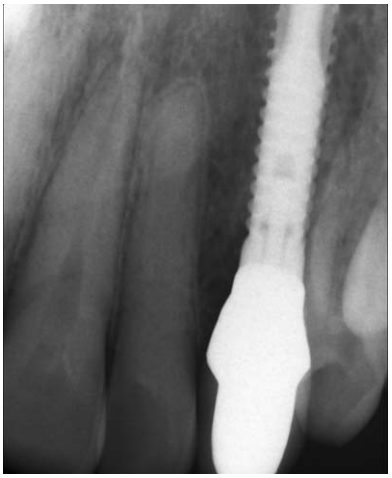

FIGURE 16. Postprosthetic radiographic evaluation.

FIGURE 18. Lateral view after definite insertion of the ceramic restoration.

lingual, distal, and mesial fragments were carefully removed with minimal trauma, retaining the buccal part with approximately 4 to 5 mm on the socket, approximately 1 mm coronal to the buccal bone plate. An enamel matrix protein was applied and the implantation performed using the specified implant

FIGURE 15. Ceramic restoration ready to be installed.

FIGURE 17. Frontal view after definite insertion of the ceramic restoration.

system (Swiss Precision Implant; Thommen Medical, Grenchen, Switzerland) and surgical guide. The implant (14 mm/4 mm, Thommen SPI Element; Swiss Precision Implant) was placed according to the manufacturer's recommendation, situated closer to the palatal wall and at the height of the buccal root segment (Figure 10).

For this implant system—again according to the manufacturer's guidelines—the final torque should exceed 25 Ncm to for maximum primary stability. Although the torque in the present case was lower than 25 Ncm, adequate primary stability was achieved and a custom healing abutment (Figure 11) and an interim prosthesis (Figure 12) could be inserted. The interim prosthesis was connected to the adjacent teeth, not placed directly on the implant, to shield it from masticatory forces. During implant placement, a specific point at the implant adapter ensures the correct buccal position. This point also exists for the laboratory analog. If there is no perfect agreement, small intraoral modifications can still be made to the healing abutment.

Thanks to this technique, no augmentation or reconstructive surgical treatment was necessary.

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FIGURE 19. Postoperative smile.

FIGURE 20. Postoperative profile view.

Postoperative instructions were given to the patient, and medication including an antibiotic and an analgesic was prescribed, as well as the use of a chlorhexidine mouthrinse.

The implantation was following by a bite registration using the existing surgical guide (Figure 13). The impression coping was connected with the surgical guide with light-curing resin (FRP-Resin; Bredent, Senden, Germany) to allow accurate insertion of the definitive implant analog into the former master cast ahead of fabricating the final restoration.

Three months after implant placement, stable tissues around the custom healing abutment were observed (Figure 14), allowing the installation of the previously fabricated definitive crown (Figure 15) with a torque of 20 Ncm, resulting in an esthetic and functional outcome with tissue stability preserved (Figures 16, 17, and 18). The implant screw channel was closed using gutta percha (VDW, Munich, Germany) and Tetric Evo Flow (Ivoclar Vivadent, Schaan, Liechtenstein).

Figures 19 and 20 shows the patient's smile and profile with the final restoration.

DISCUSSION

Recent studies have affirmed that the SST has the potential to reduce bone resorption after tooth extraction and immediate implantation, mainly through the retention of the buccal/facial root section.[10,11,16,17] This is consistent with the present case report that demonstrated soft- and hard-tissue stability around the implant, which is advantageous for lasting esthetic and functional outcomes.

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The SST requires registration of a surgical index during implantation ahead of fabricating the definite restoration. Without this technique, it would be difficult to predict the shape and behavior of the remodeled soft tissue after completed healing. Especially the tooth extraction trauma, with its associated loss of periodontal ligament and vascularization,[16,17] results in unpredictable socket remodeling. Socket alterations have also been demonstrated with immediate implant procedures and even with already osseointegrated implants, due to trauma to the bone wall.[16]

Immediate as well as delayed implant placement are often associated with soft- or hard-tissue augmentation. This requires additional surgical interventions with a risk for resorption and infections, compromising the treatment result.[17] The SST was developed to preserve the buccal/facial root sections and to avoid trauma to the buccal wall during extraction and implant preparation.

The concept of retaining a root to stabilize the alveolar ridge has been repeatedly described since 1950,[2,18] normally associated with pontic regions of fixed dental prostheses (FDP) and complete dentures where no inflammation was reported.[2,18–20] Combined with the SST, an enamel matrix derivative can also be indicated, as in the present case.

In conclusion, the most important advantages of SST can be summarized as follows: no added cost for materials; only a single surgical procedure; reduced comorbidity; possibility of implant treatment in patients with previous endodontic pathology.

Disadvantages such as the need for tissue augmentation in several surgical steps (requiring additional time and putting added stress on the patient) or increasing cost, or the difficult preservation of the tissue architecture[16,17] making the SST a favorable option for dental practice. Also important is the fact that the number of appointments is reduced, which is desirable for patients and dentists alike.

The SST offers a solution for tissue preservation directly after extraction and for implant osseointegration with a low risk of inflammation. Based on histological and clinical results, It also reduces resorption.

It should be emphasized, however, that this is a sensitive technique that needs extensive planning. Its success greatly depends on the operator's skills and ability to create a satisfying and long-lasting rehabilitation.

The present case report demonstrates the SST's potential for highly esthetic outcomes, with reduced time and expense and less psychological stress for the patient and the restorative team alike.

DISCLOSURE

The authors do not have any financial interest in the companies whose materials are included in this article.

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