Preserving the Ridge Naturally: A Review on the Socket Shield Technique in Contemporary Implantology

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***Abstract*—The rapid progress in implant dentistry has improved esthetic outcomes, especially in the anterior maxilla. However, maintaining peri-implant soft tissue and ridge contour remains challenging. The Socket Shield Technique (SST) addresses these issues by preserving the buccal root portion during implant placement, minimizing ridge resorption and maintaining natural soft tissue architecture. This minimally invasive, esthetically focused approach shows promising results, though further long-term and randomized studies are needed to standardize protocols and confirm its broader clinical applicability.**

***Index Terms*—Socket Shield Technique, Ridge Preservation, Emergence Profile, Immediate Implant Placement**

I. INTRODUCTION

Dental implants are a predictable solution for tooth replacement, offering functional and esthetic benefits[1]. However, in the anterior maxilla, post-extraction bone and soft-tissue loss can compromise outcomes[2]. Studies by Araujo and Lindhe revealed up to 56% horizontal bone loss within four months after extraction, with the buccal plate most affected due to its thin structure and loss of periodontal ligament (PDL) vascularization[2]. Conventional ridge preservation methods, such as guided bone regeneration (GBR), socket grafting, and soft-tissue grafts, reduce but cannot fully prevent resorption since they do not maintain the PDL-bone complex[3].

Introduced by Hürzeler et al. in 2010, the Socket Shield Technique (SST) preserves the buccal root fragment during immediate implant placement to maintain the PDL, cementum, and bundle bone, thereby preventing ridge collapse and preserving soft-tissue contours[4]. Subsequent modifications—such as Partial Extraction Therapy (PET) and design refinements by Gluckman, Han, and Glocker—have enhanced its applicability and esthetic outcomes[5].

Despite its promise, SST is technique-sensitive, requiring precise execution and case selection[5]. Complications like shield exposure or infection often result from improper handling[4]. The absence of standardized protocols and limited long-term data remain challenge[5].

Overall, evidence suggests that SST effectively minimizes ridge resorption, preserves peri-implant soft tissue, and achieves high esthetic scores, with implant survival rates comparable to conventional methods[4][5].

II. HISTORY

Alveolar ridge resorption following tooth extraction is well documented, resulting from disruption of the periodontal ligament (PDL) blood supply. This vascular loss triggers remodelling, with greater resorption on the buccal aspect, leading to reduced ridge volume and compromised aesthetics in anterior implant sites.Conventional preservation methods—such as immediate implant placement, grafting with alloplastic or xenograft materials, and guided bone regeneration—can limit but not prevent buccal plate resorption, as they do not restore PDL function.[6]The concept of root retention emerged decades ago.

O'Neal et al. (1978) showed that submerged root fragments maintained alveolar bone and promoted cementum and connective tissue formation between dentin and new bone. The root submergence technique similarly preserved the PDL at pontic sites, maintaining ridge contour and soft-tissue aesthetics. Further studies confirmed the biocompatibility of implants placed adjacent to ankylosed roots.[7]

Building on these principles, Hürzeler et al. (2010) introduced the Socket Shield Technique (SST). In a beagle dog model, a 1.5 mm buccal root fragment was retained 1 mm coronal to the buccal plate, and implants were placed lingual to it. After four months, all implants showed osseointegration, preservation of the buccal PDL, and new cementum formation—providing histologic proof that partial root retention prevents ridge resorption.Subsequent clinical studies and refinements have validated SST as a biologically driven, minimally invasive approach for maintaining hard and soft tissue stability in implant therapy.[8]

Principle:

The Socket Shield Technique (SST) preserves the coronal third of the buccal portion of the tooth root to create a stable buccal shield. The tooth is sectioned, the palatal portion removed, and an implant is immediately placed in the palatal socket. By retaining the buccal root fragment, the periodontal ligament (PDL), bundle bone, and vascular supply are maintained, preventing buccal bone resorption and preserving ridge contour and soft-tissue aesthetics.[8]

Biologic:

Rationale SST's success is based on maintaining the PDL and its vascular network, preserving the physiologic connection between bone and root. This prevents ischemia and resorption of the buccal bone, maintaining the natural contour and gingival architecture. The retained fragment acts as a biologic barrier, supporting soft-tissue stability and promoting a natural emergence profile and esthetic integration of the implant restoration.[9]

III. INDICATIONS

- Esthetic zones, especially the anterior maxilla with thin buccal bone.
- Compromised or non-restorable anterior teeth requiring ridge preservation.
- Sites where interdental papilla preservation is essential.
- Immediate implant placement requiring buccal plate stability.
- Buccofacially fractured teeth without periapical pathology.
- Cases requiring minimal surgical intervention and tissue preservation.
- Patients with high esthetic demands or thin gingival biotypes.

IV. CONTRAINDICATIONS

1. Systemic conditions:
   - Uncontrolled diabetes mellitus
   - Radiotherapy or chemotherapy
   - Immunocompromised states
2. Local factors:
   - Root caries or severe decay on the buccal surface
   - Root resorption (internal/external)
   - Horizontal root fracture below bone level
   - Tooth mobility or widened PDL space
   - Buccal bone loss from vertical fracture or periodontitis

Clinical Procedure / Surgical Technique:

1. Preoperative Planning
   - Clinical and CBCT evaluation of root anatomy and buccal bone thickness.
   - Digital planning and CAD/CAM guides improve accuracy and safety.
2. Tooth Preparation
   - Decoronate tooth to gingival level.
   - Section root vertically, separating buccal from palatal fragment.
3. Removal of Palatal/Lingual Fragment
   - Carefully extract the palatal root without disturbing the buccal shield or bone plate.
4. Shield Preparation
   - Reduce buccal fragment to 1–2 mm thickness, slightly coronal to bone crest.
   - Smooth edges for stability and soft-tissue adaptation.
5. Immediate Implant Placement
   - Place implant palatal/lingual to the shield, maintaining or avoiding contact.
   - Fill any jumping gap with bone graft if required.
6. Healing and Restoration

- Place healing abutment or provisional restoration as indicated.
- Monitor for shield stability, proper soft-tissue healing, and absence of infection.

V. DISCUSSION

The Socket Shield Technique (SST) represents a biologically driven innovation aimed at preserving alveolar ridge integrity and optimizing esthetic outcomes in implant therapy. Alveolar bone resorption following tooth extraction remains a well-established challenge in implant dentistry, particularly in the anterior maxilla where even minimal dimensional changes can affect esthetic harmony. Studies by Araujo and Lindhe demonstrated that within four months post-extraction, up to 56% horizontal bone loss may occur, with the buccal plate showing the most significant resorption due to its thin cortical structure and loss of the periodontal ligament (PDL) vascular supply. [10]This physiologic remodeling compromises implant positioning, emergence profile, and soft-tissue aesthetics. Conventional ridge preservation and augmentation techniques, including socket grafting, guided bone regeneration (GBR), flapless surgeries, and immediate implant placement, have been employed to mitigate these resorptive changes. Although partially effective, such methods cannot fully prevent buccal plate resorption because they do not maintain the PDL or the bundle bone complex.[11] As a result, the overlying soft tissue often collapses, particularly in thin gingival biotypes or high smile lines, leading to compromised esthetic outcomes.The introduction of the Socket Shield Technique by Hürzeler et al. (2010) marked a significant paradigm shift in implantology. By deliberately retaining the buccal portion of the tooth root during immediate implant placement, SST preserves the PDL, cementum, and bundle bone complex. This biologically sound approach maintains the vascular supply to the buccal bone and provides a natural scaffold for soft-tissue support. Histologic findings from Hürzeler's original study demonstrated successful osseointegration and the presence of new cementum formation along the implant–shield interface, confirming the biological plausibility of maintaining a root fragment to prevent buccal bone resorption.Subsequent clinical and histologic studies have reinforced these findings, reporting favorable Pink Esthetic Scores, stable ridge dimensions, and preserved papillary height.[12] Modifications such as Partial Extraction Therapy (PET), the Pontic Shield Technique, and interproximal shield preservation have further expanded the applicability of SST, particularly in multiple adjacent implant placements. The integration of digital workflows, including CBCT imaging and CAD/CAM-guided surgery, has improved surgical precision, minimized trauma, and enhanced implant positioning relative to the retained root fragment.Despite these advantages, the SST remains a technique-sensitive procedure requiring advanced surgical skill, precise planning, and appropriate case selection. Complications such as shield exposure, infection, or mobility may occur if the fragment is inadequately prepared or subjected to excessive implant pressure.[13] Contraindications include systemic conditions such as uncontrolled diabetes or immunocompromise, and local factors like root fractures, extensive caries, or buccal plate loss. Additionally, the absence of standardized protocols and limited long-term clinical data continue to restrict widespread clinical adoption.From a biological standpoint, the SST aligns with the modern principles of minimally invasive and tissue-preserving implantology. By maintaining the PDL and bundle bone, it supports both hard- and soft-tissue stability, reduces the need for grafting, and enhances esthetic predictability. This not only benefits patient comfort and satisfaction but also streamlines clinical workflow by reducing the number of surgical interventions.[14]Looking ahead, further long-term and randomized controlled clinical trials are needed to validate the durability and safety of SST, particularly in posterior regions, where functional demands differ from esthetic zones. Future advancements may involve the integration of digital planning, novel biomaterials, and microsurgical techniques to enhance predictability and broaden its clinical indications.[15] In summary, the Socket Shield Technique offers a biologically and clinically rational approach to alveolar ridge preservation and esthetic implant therapy. By combining surgical innovation with periodontal and bone biology, SST effectively prevents post-extraction ridge collapse, preserves peri-implant soft tissue, and achieves superior esthetic outcomes. However, its success is contingent upon meticulous execution, case selection, and continued research to establish standardized guidelines and confirm long-term clinical success.

VI. CONCLUSION

The Socket Shield Technique (SST) is a minimally invasive, biologically driven method for preserving alveolar bone and peri-implant soft tissue.It involves retaining the buccal root fragment to maintain the periodontal ligament, bundle bone, and vascular supply.This preservation prevents buccal plate resorption and maintains the natural ridge contour and soft-tissue architecture.SST enhances esthetic outcomes and emergence profiles, especially in the anterior maxilla.Clinical and histologic studies show reduced bone loss, preserved papillae, and high Pink Esthetic Scores. Modifications such as Partial Extraction Therapy (PET) and digital planning have improved precision and predictability.

The technique is sensitive and requires skilled execution, with limited long-term and posterior evidence.SST aligns with minimally invasive, esthetically oriented implant principles, offering a promising alternative to grafting procedures.

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