The socket-shield technique to support the buccofacial tissues at immediate implant placement

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Abstract

Aim: Tooth loss and subsequent ridge collapse continue to burden restorative implant treament. Careful management of the post-extraction tissues is needed to preserve the alveolar ridge. In-lieu of surgical augmentation to correct a ridge defect, the socket-shield technique offers a promising solution. As the root submergence technique retains the periodontal attachment and maintains the alveolar ridge for pontic site development, this case report demonstrates the hypothesis that retention of a prepared tooth root section as a socket-shield prevents the recession of tissues buccofacial to an immediately placed implant. **Materials and Methods:** An adult male patient had a ferrule-less central maxillary incisor sectioned to prepare a socket-shield at implant placement. The implant was provisionalized and immediately loaded until definitive restoration at 4 months of healing. **Results:** The implant osseointegrated successfully and without complication. Immediate postoperative as well as the 1 year follow up demonstrated a functional and aesthetic outcome of the treatment. The socket-shield technique in conjunction with immediate placement and provisionalization positively supported the ridge facial to the implant. **Conclusions:** The socket-shield technique is a highly promising addition to clinical implant dentistry and this case report is among the first to demonstrate the procedure in clinical practice with a 1-year follow up.

Keywords: Socket-shield technique, dental implant, ridge preservation, immediate placement

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Introduction

Immediate implant placement is a well-recognized and successful treatment option following tooth removal.[1] Although the success rates for both immediate and delayed implant techniques are comparable, the literature reports that one can expect there to be recession of the buccal / facial gingiva of at least 1 mm following immediate implant placement, with the recession to possibly worsen in thin gingival biotypes.[2] Low aesthetic value areas may be of less concern, however this recession and ridge collapse can pose an aesthetic disaster in areas such as the anterior maxilla. Compromised aesthetics may be masked to some degree by a low lip-line, thick gingival biotype, when treating single tooth cases, and so forth, but when implant therapy is carried out in patients with high lip-lines, patients with high aesthetic demands, with a very thin gingival biotype or multiple missing teeth where there is more extensive tissue deficit, then the risk for an aesthetic failure is far greater.[3]

The socket-shield (SS) technique provides a promising treatment adjunct to better manage these risks and preserve the post-extraction tissues in aesthetically challenging cases.[4] The principle is to prepare the root of a tooth indicated for extraction in such a manner that the buccal / facial root section remains in-situ with its physiologic relation to the buccal plate intact. The tooth root section's periodontal attachment apparatus (periodontal ligament (PDL), attachment fibers, vascularization, root cementum, bundle bone, alveolar bone) is intended to remain vital and undamaged so as to prevent the expected post-extraction socket remodeling and to support the buccal / facial tissues. Hereafter a case is presented where the SS technique was carried out at implant placement and the results from the case followed up at 1 year post-treatment demonstrate the degree of facial ridge tissue preservation achieved.

Figure 1: The preoperative view with an interim restoration at 21.

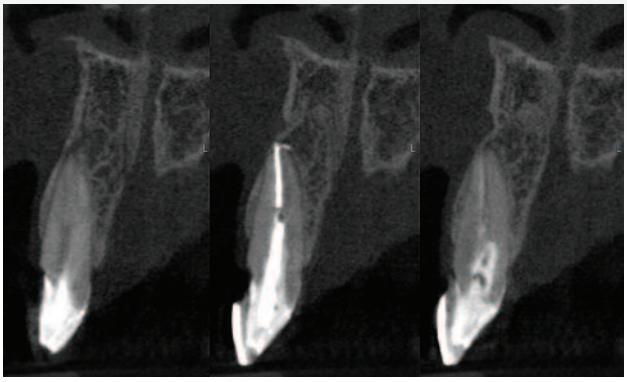

Figure 2: Preoperative CBCT scans of tooth 21.

Figure 3: The lack of ferrule and coronal dentine was evident.

Figure 4: The tooth root sectioned mesiodistally.

Case report

A 43 year old male patient presented for definitive treatment of a heavily restored left maxillary central incisor. The patient was a non-smoker with a non-contributory medical history. The tooth had been root treated and after several years required frequent recementation of a post-core crown restoration. The patient had high functional demands and moderate aesthetic expectation. At the first visit the patient presented with an interim restoration fixed to the remaining tooth root (Figure 1). Treatment options included A) root submergence of tooth 21 with a fixed partial denture (FPD) or removable prosthesis, B) crown lengthening of tooth 21 with lengthening also of 11 for symmetry, followed by reconstruction of the post-core and crown, C) orthodontic extrusion of tooth 21 and reconstruction of the restoration, D) implant therapy with a crown restoration. In consultation with the patient considering costs, duration of treatment and prognoses, implant therapy was opted for. To offset the expected post-extraction ridge resorption the SS technique was planned for simultaneous to immediate placement and provisionalization. Preoperative cone beam computed tomography (CBCT) indicated sufficient width palatal to the planned facial root section to accommodate a 4 x 13 mm implant with the option for screw-retention (Figure 2).

Following local anaesthesia of the treatment site the crown restoration of tooth 21 was removed and the lack of ferrule and supporting coronal tooth tissue could be appreciated (Figure 3). The root was then sectioned in a mesiodistal direction along its long axis as far apical as was possible using a long shank root resection bur (Komet Dental, Germany) coupled to a hydrated high-speed handpiece. Sectioning divided the tooth root into facial and palatal halves with the intention of preserving the facial root section unmanipulated and attached to the tooth socket (Figure 4). Periotomes were then inserted between the palatal root section and the alveolar socket wall to sever the PDL and

this section of root was then carefully delivered with so as not to disturb the facial root section. The remaining root section was then reduced coronally to 1 mm above the alveolar crest, and thinned slightly to a concave contour by careful application in an apico-coronal and mesiodistal direction with a long shanked round diamond bur (Komet Dental, Germany). The tooth socket's palatal wall and apex were then curetted to remove any tissue or infective remnants and the root section was checked for immobility with a sharp probe. With the preparation steps complete, the tooth root hereafter was known as the socket-shield (SS) (Figure 5). An osteotomy was then sequentially prepared and a 4 x 13 mm internal conical connection implant (AnyRidge, MegaGen) was inserted palatal to the SS via a prosthodontically planned surgical guide with the implant table 2 mm below the facial crest. The jump gap was grafted with a xenogeneic bone particulate (Osteobiol, Tecnoss) (Figure 6). The implant gained primary stability from bone apical and palatal sufficient to immediately restore with a provisional restoration, and confirmed by implant stability quotient (ISQ) readings in the 70s. A provisional crown was then constructed chairside with an emergence profile to support the coronal tissues whilst ensuring adequate space between the SS and the provisional, thus creating an "S-shaped" emergence (Figure 7). This is essential to allow the soft tissue to grow between the provisional and the SS. Failure to do this would lead to a SS that is not covered with soft tissue.

Healing was uneventful with no signs of infection or other complication at the 1 week and 1 month follow up visits (Figures 8, 9). After 3 months of healing the patient returned for confirmation of osseointegration and to continue with the restorative phase of the treatment (Figures 10, 11). ISQ readings were 73M, 73D and objectively demonstrated successful osseointegration. The implant was then restored by a screw-retained metal-porcelain crown restoration (Figure 12). The patient was satisfied with the aesthetic and functional outcomes achieved. At the 1 year follow up visit

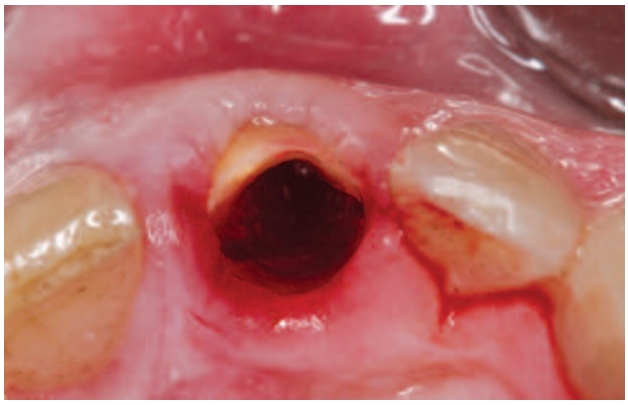

Figure 5: The prepared socket-shield.

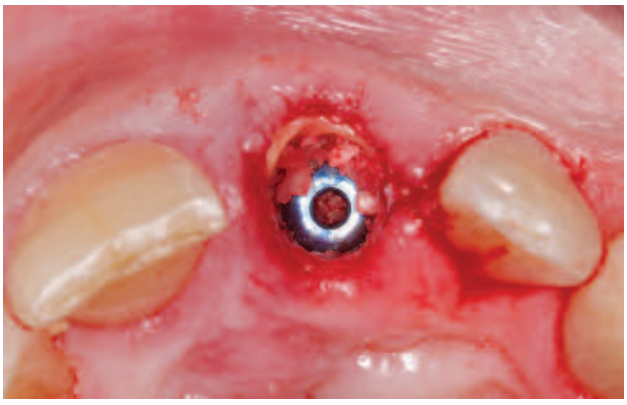

Figure 6: The jump gap between socket-shield & implant grafted.

Figure 7: The provisional being tried in.

Figure 8: The 1 week follow up.

Figure 9: The 1 month follow up visit, occlusal view.

Figure 10: 3 Months postop at the start of restorative treatment.

Figure 11: 3 Months postop with the facial ridge very well maintained.

Figure 12: Maintenance of the facial tissues with the final crown in place.

Figure 13: Soft tissue contours comparable to tooth 11.

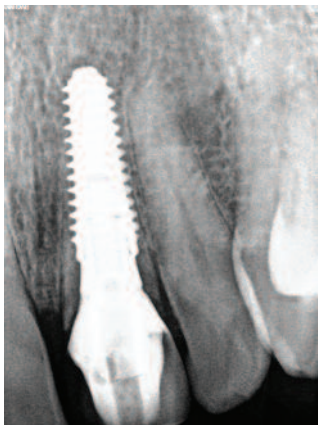

Figure 14: Periapical view of the implant & crown 21.

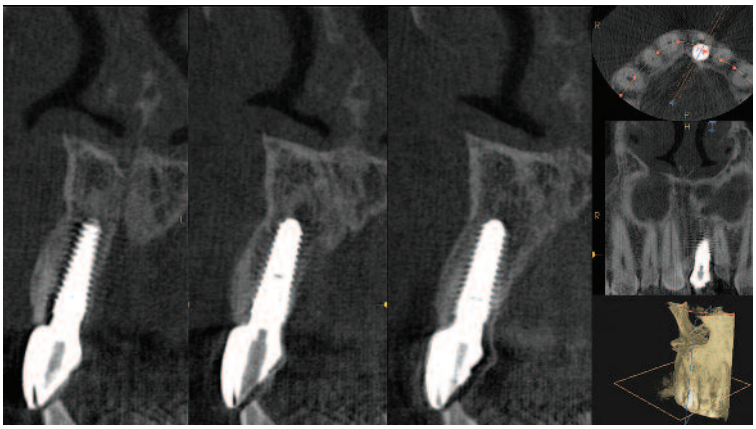

Figure 15: CBCT at the 1 year follow up. Note the bulk of tissue facial to the implant.

the soft tissue contours at the implant restoration remained comparable to the neighbouring central incisor and no noticeable tissue recession nor other complication could be observed (Figure 13). The periapical radiograph illustrated the bone height interproximal to the implant and tooth 11, and the relationship between the SS and the implant (Figure 14). The postoperative CBCT scan illustrated clearly the bulk of tissues facial to the implant (Figure 15).

Table 1: Comparative tabulation of procedures to manage the effects of post-extraction resorption adjunct to implant therapy

Advantages	Disadvantages
GBR	
Tissues gains	Surgically invasive (autogenous)
Well supported in the literature	Technique sensitive
	Additional healing time
	Additional co-morbidity
	Additional expense (xeno / allograft)
	Additional risk of infection / complication
	Vertical gains are challenging
Sub-epithelial connective tissue graft	
Reliable, predictable	Surgically invasive (autogenous)
Well supported in the literature	Technique sensitive
No additional material cost	Additional healing time
	Additional co-morbidity
Socket-shield technique	
No additional material cost	Not yet reliable or predictable
No co-morbidity	No long-term data yet
Single surgery	Technique sensitive
Applicable in sites with endodontic apical pathology	

Discussion

The results from the case reported here are consistent with the original report by Hürzeler and coworkers, that retention of the buccofacial root section at immediate implant placement achieved osseointegration without resorptive response of the ridge buccofacial to the implant.[4] The technique offers a viable solution when managing the post-extraction ridge and its complications associated with immediately placed implants. Prior to the SS technique, the implant surgeon conventionally was to select between an immediate placement protocol with an augmentation of the jump gap, with or without bulking of the buccofacial soft tissues, or a delayed approach with additional surgical intervention to correct an existing ridge defect.[5] Overbuilding the ridge buccal / facial to the implant by guided bone regeneration and soft tissue augmentation can only partly compensate. A wealth of literature supports these ridge management techniques but an amount of shrinkage with healing is to be expected. Moreover, healing is not without complication by infection and complete failure with a worse outcome is possible. Alternatives are thus desired and the benefits of the SS technique can be appreciated (Table 1).

First reported in 2010 the SS technique had progressed from concepts introduced in the 1950s that the retention of a tooth limits tissue alterations following extraction. The submergence of tooth roots was introduced originally to preserve alveolar ridge volume beneath removable full prostheses.[6,7] Malmgren and coworkers had also more than 3 decades ago reported successful tissue regeneration around submerged tooth roots.[8] Thereafter, submerging a tooth root for pontic site development has become a well-documented treatment. Salama and coworkers reported on preserving the entirety of the attachment apparatus as well as complete preservation of the alveolar ridge when developing pontic sites beneath FPD.[9] This technique typically decoronates the tooth at the bone crest or preferably

Table 2: Review of the available literature on the socket-shield technique

Year	Author(s)	Study
2015*	Bäumer et al.[5]	Animal histology of 3 cases of socket-shield with vertical fractures
2014*	Siormpas et al.[13]	46 Case series of the "root-membrane technique" with follow up varying 2-5 years
2014	Holbrook[29]	Case report: Guided implant placement with socket-shield
2014*	Cherel & Etienne[15]	Case report: Modified socket-shield for papillae preservation
2014*	Glocker et al.[16]	Case series: Modified socket-shield for ridge preservation, delayed placement
2013*	Kan & Rungcharassaeng[14]	Case report: Proximal socket shield for papillae preservation
2013	Chen & Pan[12]	Case report: Socket-shield with immediate implant placement
2010	Hürzeler et al.[4]	Animal histology of 1 case of socket-shield technique, & 1 human clinical case of implant restoration with socket-shield

* Not the actual socket-shield technique, but a version thereof

1 mm above it so as to preserve the supracrestal fibers with epithelial and connective tissue attachment. By comparison, ridge preservation techniques may reduce the amount of ridge resorption but cannot prevent the loss of interdental bone and papillae. Preservation of supracrestal fibers however can better develop pontic sites by in turn preserving the papillae. And thus it has been shown that the retention of part of the tooth contiguous with the PDL, its fibers and reticulate vascularity interconnected with bundle bone, eludes the physiological remodeling of an extraction socket and the alveolar crest. These delicate tissues can be preserved – PDL, bundle bone, buccofacial plate, and overlying keratinized mucosa.[10] It can be postulated that retention of part of the tooth as a SS eludes the body from realizing the tooth has been extracted and circumvents the normal events of physiological healing that would resorb the alveolar socket.

The resorption of a post-extraction socket is the direct result of trauma to the bone-PDL-tooth complex. Bundle bone born from a functionally loaded PDL is lost following extraction and sees an almost certain recession of residual buccofacial tissues.[11] Complete maintenance of ridge volume after tooth extraction with preservation techniques utilizing currently available materials as a primary prevention is not yet possible.[5] However, as stated before, the retention of tooth roots in the alveolar process can preserve the ridge tissues. Histologically this was demonstrated by Hürzeler and coworkers.[4] Their report confirmed the retained attachment of the SS to the buccal plate via a physiologic PDL free of any inflammatory response. The buccal plate crest showed an absence of osteoclastic activity – an absence of active remodeling. The coronal soft tissue demonstrated a physiologic junctional epithelium also free of any inflammatory response. The clinical outcome of Hürzeler and coworkers' report presented the successful osseointegration of an implant placed simultaneous to the SS technique and a restoration with aesthetics indistinguishable from the adjacent maxillary central incisor. Whilst the authors reported preservation of the buccofacial tissues, it should be noted that absolute preservation has not yet been shown. The authors later reported a mean of 1 mm horizontal loss after final restoration, Chen and coworkers reported 0.72 mm of buccal resorption.[5,12]

In spite of the histological and clinical findings to date and the prospects of the SS technique, to safely apply a newly introduced treatment in everyday practice data from long-term clinical studies are required and at present this data is not yet available. Only one case series with a 2 year or more follow up of a significant number cases exists in the literature.[13] However, that technique differed significantly. The authors had prepared the implant osteotomy directly through the intact tooth root and thereafter prepared what they termed the "root-membrane". That said, the study is a significant contribution to literature on these techniques. Very few case reports currently exist and this case reported here to the authors' knowledge is the ninth (Table 2). Of the reports currently available most have also deviated from the original protocol. The modified / proximal socket shield reported by Kan & Rungcharassaeng had the jump gap grafted with a xenograft material, the facial soft tissues augmented. [14] In their report the methodology further differs by sectioning the

SS into mesial and distal sections for the purpose of papillae preservation. Cherel & Etienne also reported papillae preservation by a modified SS sectioned in a similar manner.[15] The methodology of this case report replicated the orginal technique's working groups' revision to graft the jump gap, whilst omitting the application of an enamel matrix protein derivative.

Concluding remarks

The SS technique offers a promising solution to the difficulties encountered when managing the post-extraction tissues. This case report of immediate placement simultaneous to the SS technique is among the first to demonstrate with a 1 year follow up successful preservation of post-extraction tissues coinciding with successful restorative implant treatment. The void in the literature reporting on the technique's long-term success requires prudent participation of clinicians to contribute to the knowledge base before the procedure can be routinely prescribed for ridge preservation simultaneous to immediate implant placement. At present the technique is highly promising and holds significant potential for the field of aesthetic and restorative implant dentistry.

Declaration

The authors declare no conflict of interest.

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