REVIEW ARTICLE

The Socket Shield Technique – A Review

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Abstract

Tooth extraction leads to resorption and remodeling of the alveolar ridge. Bone alteration especially is important for aesthetic outcomes. Various techniques are performed in the extraction socket that helps to maintain alveolar ridge contour. Ridge preservation techniques partly compensate, but bone alteration cannot be avoided. Root submerged and socket shield techniques are solutions in the aesthetic zone. Root submergence technique was created to maintain the alveolar ridge, it was performed with endodontically treated or vital roots. The socket shield technique is also known as a partial extraction therapy or root membrane technique. This technique includes leaving the buccal part of the root during the implant placement. Retained root fragment prevents the buccal bone resorption because healthy periodontal tissues ensure that buccal bone gets sufficient blood supply. This helps to minimize crestal bone contour changes following tooth extraction and immediate implantation. The aim of this article is to review the socket shield technique.

Keywords*: The socket shield technique, root submerged technique, immediate implantation*

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Introduction

People lose their teeth for various reasons. After tooth loss, alveolar ridge resorption and remodeling occurs and then aesthetic prosthetic mouth rehabilitation becomes a real challenge for a dental practitioner. Toothextractionleads to dimensionalchangesthatoccurintheboneduringnormalhealingperiods [(1)]. Alveolar defects heal in 2 to 3 months, and then the bone forms a mature trabecular pattern [(2)]. However, undisturbed wound healing in the extraction socket will generally result in dimensional changes in the alveolar bone. Tan et al. evaluated dimensional changes in the alveolar ridge's hard and soft tissue 12 months after tooth extraction. It was estimated that more dimensional changes in horizontal resorption occurred when compared with vertical changes. After three months of healing, horizontal reduction of the alveolar crest was 32%, and after 6 to 7 months horizontal reduction was 29% -63%, vertical reduction buccally was 11%- 22% after six months of healing [(3)]. Resorption of the height is more pronounced at the buccal bone than in the lingual bone. Animal studies have shown that during the early phase (eight weeks following tooth extraction), resorption was observed on both the buccal and lingual/palatal bones. The reduction was more significant at the buccal bone than in lingual/palatal bone [(4)]. The buccal bone reduction is especially important for aesthetic outcomes.

These findings are important because both vertical and horizontal reduction of alveolar bone may complicate the restorative procedures. In order to prevent hard and soft tissue structural alterations clinicians use alveolar ridge preservation techniques [(5)]. Ridge preservation is considered any procedure that helps to minimize the resorption of the ridge and induce bone formation in the extraction socket [(5)]. Many different techniques are applied for ridge preservation, which includes different materials for bone augmentation allografts, xenografts [(6)] and membranes [(7)]. However, nowadays using ridge preservation techniques help to partly maintain the alveolar ridge, but not prevent alveolar bone resorption. Immediate implantation is considered to shorten treatment time and minimize the number of surgical procedures. However, immediate implant

placement in extraction sites does not prevent the alveolar bone from resorption. Botticeli*et al;* found that after four months of healing following immediate implant placement, horizontal resorption of buccal bone was up to 56%[8]. It may result in a poorer aesthetic outcome. For this reason, socket shield and root submerge techniques can be solutions with respect to the aesthetic aspect. A retained root helps prevent the buccal bone from resorption and maintains the alveolar ridge. Maintaining a healthy periodontal ligament ensures that alveolar bone receives sufficient blood supply that helps to keep the crestal bone without dimensional changes [9,10].

Root submerge technique

The root submergence technique is a therapy in which decoronated root preserves the pontic site of the alveolar bone from dimensional vertical and horizontal changes. This technique was created in order to maintain the alveolar ridge and prevent bone resorption. In the literature, there are clinical studies of root submergence performed with endodontically treated or vital roots[11–13]. O' Neal et al; conducted a clinical trial with 16 premolars from four dogs that were treated endodontically and reduced 2 mm below the alveolus and Histological evaluation was done over a period of 30 to 120 days. Complete bone coverage was observed in the specimen at 60 days. Also, new osteocementum and connective tissue separating the dentin and new bone were revealed [12]. Usually, pontic sites cannot recreate aesthetic soft tissue frames because of bone resorption, which is followed by tooth extraction. In three clinical cases of the root submergence technique for the pontic site in order to create ideal soft tissue contours, Salama et al. presented successful results. In all cases, retained residual roots were allowed to preserve the alveolar ridge and created aesthetic interdental papillae [10]. These findings suggest that the root submerge technique could be used in the aesthetic region for pontic site contour preservation [14].

Socket shield technique

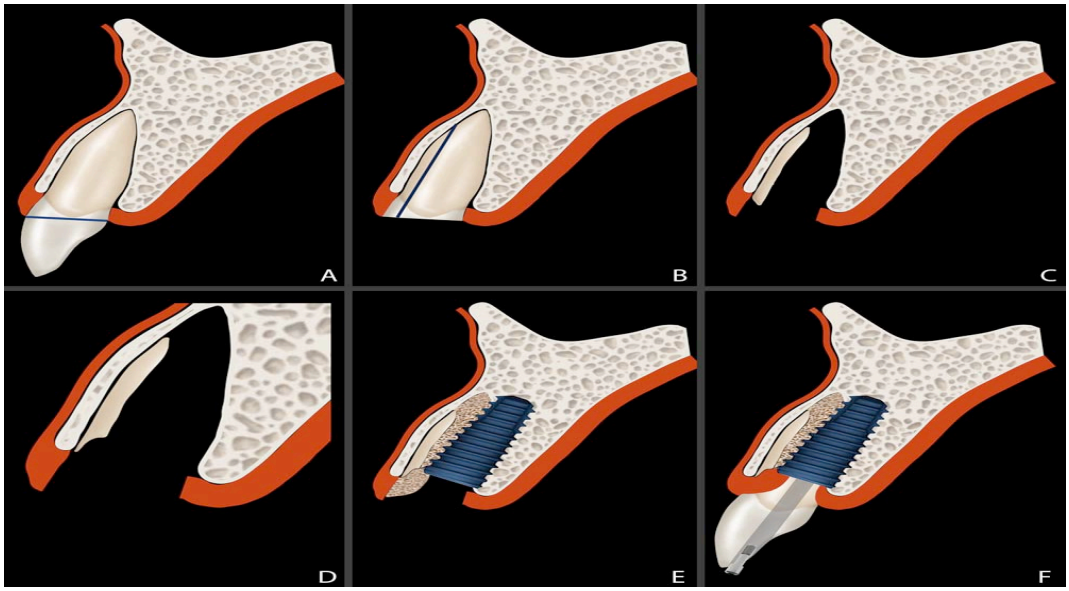
The socket shield technique was first introduced by Hürzeler et al. One dog was used for an experiment in which the mandibular premolars were hemisected and residual tooth fragments were removed on the mesial, distal, and lingual region. The buccal part of the root was retained during the immediate implant placement. Four implants were placed lingually to the tooth fragment, two of them in direct contact with buccal root fragment. An enamel matrix derivate before implantation was placed in the internal part of the root. After four months, the specimens were prepared for histological evaluation. The buccal part of the root was attached to the alveolar bone, implants were osseointegrated without inflammatory reaction. New formed cementum was observed between implant fixtures and root fragments. The buccal bone plate was free of any resorption process [9]. The socket shield technique is also known as a partial extraction therapy or root membrane technique [15–17]. Usually, this technique is used in the aesthetic area the authors suggest using the socket shield technique when maxillary front teeth need to be extracted due to traumas, vertical or horizontal root fractures, root caries. or internal resorption[17–21].

The socket shield technique is described and illustrated below (Fig. 1).

1. First step: the decoration of the tooth at the gingival level. (Fig. A)
2. Second step: vertical mesiodistal sectioning of the tooth root. The endodontic instrument may be used to evaluate the orientation of the root, which must be followed during bisection of the root into the lingual and palatal sections [16]. (Fig. B)
3. Third step: after lingual and palatal parts are divided, the palatal section is elevated and extracted. The labial part is probed in order to check if it is stable after the socket is rinsed. The thickness of the labial fragment should be reduced to 1.5 to 2 mm [14,16]. (Fig. C)
4. Fourth step: the coronal part of the root is reduced to the crestal bone level. The inner coronal part of the shield is reshaped in order to make a lingual slope. It provides the necessary space for prosthetic components [16,22]. (Fig. D)
5. Fifth step: after socket osteotomy and implant bed formation, the implant is inserted in the bed. The buccal gap between the implant and the shield may be preferably grafted with bone graft materials [16]. (Fig. E)

6. Sixth step: provisional restoration placement. After three months of healing, a definitive/final crown is installed [19]. (Fig F)

Fig 1: showing step by step socket shield technique [23]



Researchers have also suggested modifications of this technique. One of them was introduced by Bäumer and colleagues. Bäumer *et al;* investigated the socket shield technique on three dogs. The buccal fragment of the root was separated in a vertical direction, and implants were placed lingually to this fragment. This modification of the socket shield technique was used to evaluate whether this technique also worked with vertical fractures in the buccal fragment. In this study, the enamel matrix derivate was not applied. After four months, a histological evaluation showed healthy periodontal tissue, and no resorption was noticed on the buccal alveolar crest. New bone formation was observed in the gap between the dentin and the implant [24].

Discussion

There is still not enough evidence to fully support the socket shield technique with concurrent implantation. Only a few papers showing variable data of bone loss are available. In the literature, there are only a few clinical studies with >12 months follow-up after using the socket shield technique. Most of the studies demonstrated promising results. The implants survival rate reached from 96.1% to 100% [17,23,25–30]. An analysis demonstrated a low degree of contour changes in all of the clinical studies from 24 to 60 months of follow-ups. In a case-control study in 2014, a medium vertical bone loss of 0.8 mm was reported in 26 implants from 25 patients after two years of follow-up. Because of this technique, soft or hard tissue grafting was not necessary for most of these patients. Studies show a significant difference in aesthetic impact when comparing the socket shield to the conventional technique [29].

There are several advantages to the socket shield technique: (1) cost reduction and (2) the number of clinical appointments is minimized [19]. If grafting is not an aesthetic requirement to compensate for the bone loss, the treatment becomes patient-friendly. However, there are some uncertainties as to whether additional grafting materials should be used. Some authors suggest always filling the buccal gap between the implant and residual root with bone substitutes [15,16,31], while in the first proof of the principle report, an enamel matrix derivate was used [9]. Other authors present good results when no grafting materials were added to the space between the implant and root [18,24,30]. Clinicians try to avoid bone volume loss by leaving root remnants [32]. In a clinical study with 2000 patients, the authors reported that 16.2% of the root remnants resulted in pathological condition signs, especially when exposed to the oral environment [33]. The root submerges technique still remains a controversial issue. The

uneventful healing of sockets with root fragments has been well documented. Both vital tooth retention and submergence of endodontically treated roots have been recommended in order to prevent excessive resorption of the residual ridge. This concept has been recently applied to teeth- or implant-supported fixed prostheses for pontic site development. Based on this background, a decision was made to leave the canine roots instead of performing a more invasive surgical procedure for extracting them. One of the main factors for the socket shield technique success is that the root fragment does not come in contact with the external medium, an event that could facilitate an infection and also be an aesthetic problem [34,35].

However, in 1978, Welker *et al;* submerged 12 roots with mucosal coverage, four of them non-vital and eight-vital. Three complications (two in the vital teeth and one in the non-vital tooth) were observed. All of them consisted of mucosal perforation. Clinical evaluation showed no further reduction of the alveolar ridge over the covered roots [11]. In the literature, more complications such as cyst formation, alveolar bone atrophy, or pulp inflammation have been reported[13]. Most histological evaluations are done on animals, and it has been found that new cementum or bone forms between the implant surface and internal dentin [9,21,24,28,36]. Until now, there are only a few histological reports done on human tissues, and in these studies, the gap between implant and root fragment was filled with mature alive bone [17,37]. Hence, we may conclude that further investigations with increased patient numbers and long-term follow-ups should be performed.

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Conclusion

The socket shield and root submerge techniques do not have enough clinical evidence to support their use as routine clinical options. If the proper clinical requirements are met and the technical handling of the operator is appropriate, these techniques could minimize buccal tissue resorption and make the procedure more patient-friendly.

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