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Socket shielding concept in implant Placement: A neoteric approach

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Abstract

Implant dentistry has been a promising branch offering functional and esthetic replacement of missing tooth or teeth. Post extraction soft and hard tissue loss has a negative impact on implant positioning and its overall esthetic outcomes especially when it comes to esthetic zones such as maxillary anterior teeth. In order to combat these effects arising from extraction, socket shield technique has been introduced. The technique involves retention of buccal fragment of root and careful removal of palatal half of root followed by immediate implant placement. Several approaches have been described in the literature to preserve the ridge like the hard and soft tissue augmentation with GBR, bone substitutes but socket shield technique proves to be cost effective and minimally invasive. The principal, classification, surgical aspects, indications and contraindications, modification of socket shield technique shall be discussed in this review article.

Keywords: Socket shield technique, Root submergence, Buccal shield, Implant in esthetic zone, Ridge preservation, Root membrane, Anterior esthetic implant

1. Introduction

Dental implants has emerged as an excellent, predictable option in replacement of missing single teeth since few decades. In aesthetically demanding areas like maxillary anterior region, it becomes essential to preserve the anatomy and architecture of the alveolar bone and the overlying soft tissue in order to attain the emergence profile and natural appearance. It is known that tooth extraction leads to vertical and horizontal dimensional changes in bone as well as the soft tissues which interferes with accurate positioning and esthetic outcomes in implant dentistry. Gingival grafts, bone regeneration with grafting materials and membranes are options to compensate the effects of extraction in implantology. Hurzeler *et al.* in the year 2010 described the Socket Shield Technique for complete preservation of soft, hard tissues and immediate implant placement in esthetic zones of oral cavity [1].

This technique also aims to preserve the periodontal ligament associated with buccal part of root by sectioning and extracting only the palatal portion followed by immediate placement of implant. Thus the preservation of the periodontal ligament and the supra-crestal attachment of the tooth on the buccal aspect in combination with immediate implant placement will prevent remodelling of buccal bone. It has been stated that retention of buccal root will result in osseointegration and absence of complications like inflammation or resorption of tissues [1].

Modification of socket shield technique was developed recently like Partial extraction therapy [2, 3] by Gluckman *et al.*, Modified Socket shield Technique [4] by Han *et al.* in 2018. Modified socket shield technique [5] by Glocker *et al.* suggested preservation of shield of root in interproximal area preserved the interimplant papilla.

Despite of the fact that socket shield technique maintains the integrity of the bone and soft tissue enhancing the esthetic demands, there are some limitations such as good clinical skills and training are required to practise this procedure. Also some time and patience of clinician will be required to prevent the mobility of the buccal root shield during the procedure so as to ensure a promising esthetic result with socket shield technique.

2. History

The fact that tooth extraction is followed by dimensional changes in contour, form and size of the alveolar ridge is well stated by many researchers [6]. Following extraction the blood vessels of periodontal ligament is severed which in turn causes resorption of the alveolar ridge which is more pronounced on the buccal than on the lingual aspect of the extraction socket [7] which results in devastating effect on overall esthetic outcome in implantology. To combat these undesirable consequences of tooth extraction, researchers have evolved with various treatment approaches like immediate implants [8], graft materials [9], barrier membranes [10] Root retention irrespective of its vitality and decoronation of an ankylosed tooth preserves the bone and promotes vertical bone growth. O'Neal *et al.* in 1978 proved that the coronal surface of submerged roots showed new cementum and connective tissue which separates the dentin from the new bone [11]. The Root submergence technique [12] allows complete preservation of the alveolar bone by maintaining the periodontal ligament in the pontic site to create an aesthetic effect. Similar studies also prove the efficiency of placing implant adjacent to ankylosed root without any pathological effect [13].

Hurzeler *et al.* [1] in the year 2010 gave a proof-of-principle report on the socket-shield technique by histologic and backscatter scanning electron microscopic evaluation of the effect of partial root retention which he later named as the socket-shield technique in combination with immediate implant placement in beagle dog after four months of implant placement. The technique involved hemisecting the third and fourth mandibular pre-molar and retaining the 1.5 mm thick buccal fragment of the distal root 1 mm coronal to the buccal bone plate. A titanium implant was placed lingual to that tooth fragment either with or without contact to the buccal tooth fragment following application of enamel matrix derivate and a healing abutment was connected. It was detected that all four implants were osseointegrated with physiologic periodontal ligament on buccal aspect and lingually with newly formed cementum. He thus concluded that socket shield technique may be beneficial in preserving the buccal bone plate.

3. Principle of socket shield technique

The socket shield technique involves preserving the coronal third of buccal surface of root to create a buccal shield by modifying the root of the tooth indicated for extraction and carefully extracting the palatal aspect such that remaining facial root fragment remain intact in situ with relation to buccal bone, subsequently immediate implant placement is performed thereby preserving the periodontal apparatus along with its vascularization, attachment fibers, cementum thereby preventing the post-operative facial bone loss and preserving esthetics¹.

4. Indications

1. Esthetic zones of oral cavity especially in the anterior maxilla because the thin buccal bone receives its vascular supply from the periodontal ligament.
2. Anterior area of maxilla and mandible with compromised, Nonresorbable tooth.
3. Areas where interdental papilla between implants must be preserved.
4. In cases of immediate placement of implants in extraction socket where buccal plate of bone preservation is necessary for implant esthetics.

5. In buccofacial fractures of teeth without periapical pathologies.

5. Contraindications

1. Systemic diseases where extraction procedures are contraindicated (uncontrolled diabetes, radio/chemotherapy, immunocompromised condition).
2. Local factors which involves the tooth like:-
 - a. Root caries on buccal aspect.
 - b. Teeth with internal or external resorption [14]
 - c. Horizontal fracture of tooth below bone level
 - d. Mobility of tooth
 - e. Widening of periodontal ligament
 - f. Loss of buccal bone due to vertical fracture or periodontitis.

6. Classification of Socket Shield Technique [15]

This classification has been proposed depending on the position of the shield in the socket.

Type I: Buccal shield

A case can be classified as buccal shield when the shield lies only in buccal part of the socket, (between proximal line angles of tooth). It is indicated in single edentulous site with both mesial and distal tooth present [15]



Fig 1: Vertical bisection of the root

Type II: Full C buccal shield

A case can be classified as Full C Buccal shield when the shield lies in buccal part and the interproximal part on both sides of the socket. This shield design is recommended for the following clinical scenarios:

- Existing implant on either side of the proposed site
- Missing tooth on either side without an implant
- Having implant on one side and missing tooth on the other side.

Type III: Half C buccal shield

A case can be classified as half C buccal shield when the shield lies in buccal part and one of the interproximal part. This design is recommended when there is tooth on one side and implant or a missing tooth on the other side.

Type IV: Interproximal shield

A case can be classified as interproximal shield when shield lies only in mesial or distal part of the socket. This design is indicated when there is buccal bone resorption requiring graft, and there is an adjacent side with missing tooth or an implant. Extraction of the complete tooth in such cases may lead to loss of the valuable interproximal bone.

Type V: Lingual-palatal shield

A case can be classified as Lingual-Palatal shield when the

shield lies on the lingual or palatal side of the socket. This type of shield design has few indications but could be considered for maxillary molars.

Type VI: Multiple buccal shields

A case can be classified as multiple buccal shields when it has two or more shield in the socket. It is indicated in cases with a vertical root fracture. There is evidence to show bone deposition in between fractured roots which could assist in holding the two fragments in place.

7. Instruments required ^[16]

1. Periotome
2. Black's excavator
3. Gingival scissors
4. Needle holder
5. Surgical forceps
6. Diamond bur

8. Procedure ^[16]

- I. Patient is administered local anesthesia.
- II. Clinical crown of the tooth is sectioned 1mm above the bony ridge with a diamond bur
- III. using long tapered fissure diamond bur the root is sectioned into two parts mesiodistally¹
- IV. Palatal root fragment is extracted with periotomes.
- V. Thus buccally the root and the bone is left intact.
- VI. Buccal root fragment is thinned out with a round diamond bur to a thickness of 2 mm.
- VII. Copious irrigation with saline must be done.
- VIII. Implant is inserted palatal to the socket shield by sequential osteotomy
- IX. Sockets can be closed with sutures.
- X. Post-surgical instructions like Chlorhexidine mouthwash can be advised to patient.

9. Advantages

- a. Preservation of buccal/ facial bone structures.
- b. Maintain aesthetics.
- c. Intact buccal shield also guides in placing implants in correct position.
- d. Complete osseointegration can be achieved and avoid formation of fibrous tissue around implant.
- e. This treatment is cost effective.

10. Disadvantages and complications

- a. Exposure of socket (internal or external) was most common complication ^[17, 18].
- b. Resorption of the retained root fragments.
- c. Perimplantitis ^[18]
- d. Non integration of implants
- e. Displacement of buccal lamellar bone ^[16].
- f. Long term behaviour of the buccal shield has not yet been completely clarified.

11. Variants of socket shield technique

a. Partial extraction therapy ^[2, 3]

Gluckman *et al.* renamed socket shield technique as partial extraction therapy.

His modification included the placement of particulate grafting material in the gapbetween the implant and the buccal portion of the root ^[2, 3].

b. Modified Socket shield Technique ^[4] (by Han *et al.*)

The modification was given by Han *et al.* in 2018 which

involved the variation in thickness of buccal shield and the height at which the root was retained with respect to bone crest. The thickness of the shield was kept at 1.5 mm, the most coronal portion of the residual root was placed at the bone crest level with no grafting material in the gap between the residual root and the implant.

- c. **Modified socket shield technique ^[5] (by Glocker *et al.*)**
Suggested preservation of shield of root in interproximal area preserved the interimplant papilla.



Fig 2: Horizontal cross-section of socket shield ^[2]

12. Discussion

It's been known that alveolar ridge preservation is possible by retaining root fragments in situ and keeping them covered by mucosa. Retained root fragments assisted in both the preservation of root volume as well as in vertical bone growth coronally.

Hurzeler *et al.* (2010) histologically and under backscatter scanning electron microscopy evaluated a beagle dog treated by socket shield technique. They concluded that retaining the buccal aspect of the root during implant placement does not appear to interfere with osseointegration and may be beneficial in preserving the buccal bone plate¹.

Abadzhiev *et al.* (2014) compared conventional immediate implant placement including hard and soft tissue grafting with socket shield technique in 25 patients. It was found out that conventional approach was inferior in terms of the esthetic outcomes and tissue changes.

Kan *et al.* have reported a case with a modified shield technique where the shield was located in the interproximal areas. This resulted in interimplant papilla, bone level and the periodontium preservation ^[19].

Cherel *et al.* observed complete preservation of the papilla between two neighboring central incisors without any adverse events at eleven months after implant placement using modified socket shield technique ^[20].

Gluckman *et al.* also used the modified socket shield technique for a situation with two implants besides each other and reported aesthetically good result ^[21].

Glocker *et al.* (2014) used modified method of socket shield technique and delayed implant placement was planned in three cases. During re-entry after 6 months the new bone formation in the alveolar bone and the residual ridge was clinically evaluated as proof of principle. Nevertheless it was demonstrated that the bone was clinically preserved with this method ^[5].

The intentional retention of the buccal aspect of the root with its periodontal apparatus followed by immediate implant placement can lead to predictable and sustainable osseointegration of implants placed in the maxillary anterior region of healthy adults^[22].

Even though this technique has shown positive results in previous studies, there are few possible risk factors involving lack of thorough knowledge regarding consequences of socket shield technique. The most important is the possible risk of resorption of retained root fragment. Few studies have used enamel matrix derivative to induce cementum formation on inner side of root fragment which inhibit its resorption. Moreover, inflammation, caries and pocket formation can complicate the outcomes of treatment. Though a few set of instruments are needed for this technique, it's often technique sensitive. Also, extrusion of retained root fragment can be a possible risk factor regarding this method. More comparative and long term follow up studies are inevitable to prove the long term prognosis of the treatment.

13. Conclusion

The socket shield technique is a promising approach in aesthetically challenging implant cases. The negative impact resulting from tooth extraction like alveolar ridge resorption as well as recession of gingiva will lead to an unesthetic implant outcome especially in aesthetically driven zones in anterior maxilla. Alveolar ridge preservation through root retention especially by maintaining the buccal part of root followed by immediate implant placement is a minimally invasive and a cost effective method in comparison with the grafting to achieve a complete preservation of bundle bone on the buccal aspect leaving the shield of root intact buccally. Moreover the modified socket shield technique by Han *et al.*^[4] described that this technique is safe and successful procedure with high implant survival and negligible failure rates. Though studies have concluded that socket shield technique provides a promising treatment adjunct to reduce the management of risks of extraction and preserve post extraction tissue in aesthetically challenging cases. Further studies are required to provide a long time outcome with this technique. Hence it's imperative to have more such studies to assess the long term success of this neoteric technique.

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