

**Effect of Height and Thickness of Remaining Root Segments on the Success of Socket Shield Technique- A Systematic Review**

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**Type of Publication:** Review Article

**Conflicts of Interest:** Nil

**Abstract**

**Introduction:** The quantity of resorption is more marked in the buccal aspect of the alveolar ridge in post-extraction cases, resulting in almost 56% loss of the residual alveolar ridge due to resorption of the buccofacial ridge contour. There are no consensus present in the literature which states the remaining thickness and height of the root necessary for the success of the socket shield technique.

**Aim:** This paper aims to review the scientific data available on the socket shield technique and also the success of using this technique for preservation of bone height and thickness.

**Methodology:** Articles were searched from 2004 to March 2019 in PubMed, Google Scholar, EBSCO, Science Direct, and Research Gate. The study eligibility criteria were (1) the immediate placement of implants using the Socket shield technique (2) human and animal studies conducted with a minimum follow up of 6 months, (3) measurements of remaining bone dimensions.. Due to

the heterogeneity across all studies in all study designs, the data were not pooled and a meta-analysis was not performed.

**Conclusion:** Taking into consideration all factors reviewed in this regard along with the outcomes, it can be suggested that the socket shield technique effectively and efficiently helps in reducing the resorption of the bone and maintains the integrity of the soft tissue.

**Key words-**socket shield technique, immediate implant placement, thickness and height of remaining root segment.

**Introduction**

Dimensional changes are often seen in the alveolar ridge contour after the extraction of teeth. Collapse of the socket anatomy is the primary consequence following extraction. The main reason for bone loss to occur is due to the destruction of the bundle bone-periodontal ligament complex after the extraction or tooth loss.<sup>[1]</sup> Soft tissue contour is lost due to the collapse of the socket and black

triangles become visible between the teeth. This presence of black triangles makes it difficult to restore the anterior region with implant placement and markedly compromises the aesthetics. A clinical technique known as the “socket-shield technique” (SST ) or also known as root membrane, was developed by Hurzeler et al in an animal model, where they demonstrated the formation of cementum on implant surfaces placed in contact with intentionally retained roots.<sup>[2]</sup> In this technique, during the time of extraction, the coronal 1/3 of the buccal root was preserved after which an immediate implant was placed palatal to the root fragment. The root fragments function like a shield and preserve the resorption of the buccal bone. As a result of which, the teeth in the aesthetic areas, mainly maxillary anteriors, cannot be restored due to crown fracture or destructive caries in the cervical region.

#### **Indications**

- Single or multiple anterior teeth along with immediate implant placement
- Posterior region along with immediate implant placement.
- Post-extraction facial ridge loss is suspected in an attempt to maintain the alveolar ridge.
- In cases with adjacent implants, the interdental papilla can be preserved by SST

It is quite helpful in maintaining pink and white aesthetics in the anterior region in critical cases such as patients with a high lip line.<sup>[3-5]</sup>

#### **Contraindications**

- Teeth with widening of the periodontal ligament (PDL), periodontal disease or mobility.
- Teeth with horizontal fractures or vertical root fractures below bone level and in teeth with internal or external resorption.
- Mobile teeth and in teeth with large periapical lesions and teeth which are out of the arch.<sup>[6]</sup>

In the past few years the socket shield technique has emerged as one to help slow down the process of resorption.

#### **Classification**

It is proposed that the classification of SST technique will help in understanding the clinical application of this technique depending on the position of the shield in socket.<sup>[3]</sup>

#### **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

#### **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

**Materials and Methodology-** This systematic review protocol was registered in the PROSPERO database under the ID number 154289. The review is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines

**Structured question:** The question was asked if there is success after adopting the socket shield technique to preserve the thickness and height of the residual bone ?

**PICOT analysis:** The effect of socket shield technique on the residual bone width was studied using a population, intervention, comparison and outcome (PICO) structure.

**Population:** Participants who have undergone immediate implant placement including humans as well as animals with the use of socket shield technique.

**Intervention:** Socket shield technique performed during immediate implant placement.

### **Comparison**

- a) Participants who have undergone immediate implant placement without the use of socket shield technique.
- b) Participants who have undergone immediate implant placement with the use of socket shield technique.

**Outcome:** Success of the socket shield technique on the height and thickness of the residual root segment

**Time:** This study has collected articles from 2004- 2019

**Search strategies:** An electronic search in a structured form restricted from 2004 to march 2019 including the following databases: Research Gate ,Science Direct, Google Scholar, EBSCOhost, Medline/Pub Med. Hand searches of different journals related to dental implants were performed to find studies related to the topic of interest, including *Clinical Implant Dentistry and Related Research*, *Clinical Oral Implant Research*, *Journal of Oral Implantology*, *Implant Dentistry* and *European Journal of Periodontology*.

### **Selection criteria**

**Inclusion Criteria:** Articles that comprise of use of socket shield in immediate implant placement, animal studies, case reports, and clinical trials were included. Only articles which are available in English were included.

**Exclusion Criteria:** Articles not written in the English language were excluded. Articles not related to SST for implant placement were excluded. Articles with studies less than 6 months follow up were excluded.

### **Outcome**

#### **Primary outcome**

1. Effect of height and thickness of remaining root segments on the success of socket shield technique.

#### **Secondary outcome**

2. To determine the Survival rate of implants using socket shield technique

### **Results**

The flowchart for the screening of articles for their eligibility to be included in the systematic review is presented in Figure 1.

Initial literature identified through database searching resulted in 50 articles related to the socket shield technique.

Each reviewer further screened the articles and removed the duplicate articles and other articles not related to the question raised

Finally, articles consisting of full texts and abstract were included in the present systematic review.

Fig 1: Screening of articles for their eligibility to be included in the systematic review.

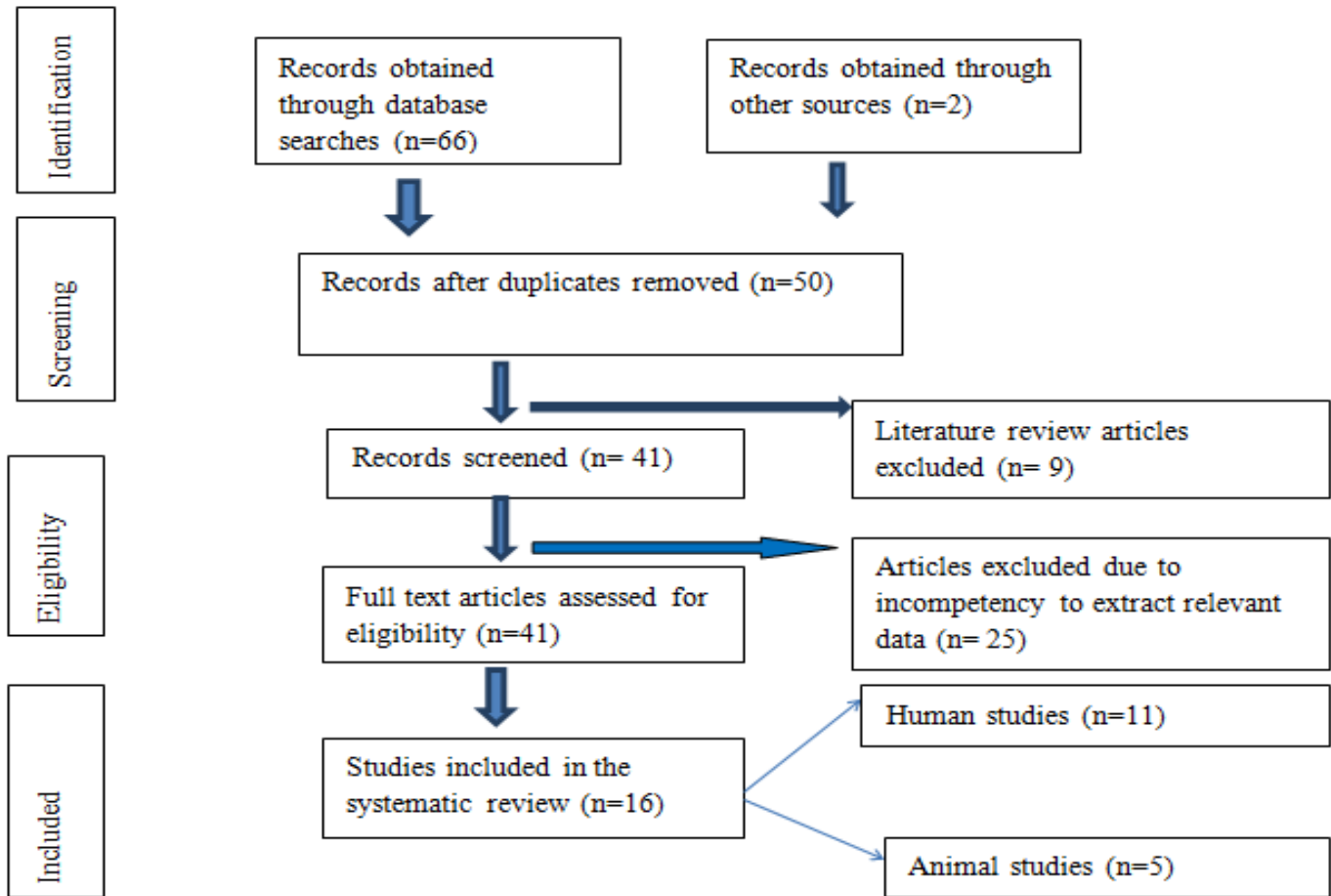


Table 1: Summary of the articles included in the systematic review.

A]Animal studies

S.N.	Author	Year of Study	No. of Implants	Participants	Result
1.	Hurzeler et al <sup>[10]</sup>	2010	4	A beagle dog.	No histologic inflammatory reaction no resorption
2.	Baumer et al <sup>[11]</sup>	2015	12	Beagle dogs.	Mean loss of 0.88 mm+1.67-0.15
3	Guirado et al <sup>[7]</sup>	2016	36	6 foxhound dogs	Recommended buccal bone- 3mm, remaining root fragment - 2mm.
4	Zen Tan et al <sup>[8]</sup>	2018	4	4 beagle dogs	Recommended thickness of the root plate is in the 0.5-1.5 mm range

B] Human Studies

S.N.	Author	Type of Study	Year	No. Of Implants Placed	Follow Up Period	Survival Rate	Result
1	Kan et al <sup>[16]</sup>	Case report	2013	1	1 year	100%	Preservation of bone level and interimplant papilla
2.	Sirompas et al <sup>[15]</sup>	Retrospective study	2014	46	40 months	100%	Mean crestal bone loss on mesial and distal aspect- 0.18±0.09 and - 0.21±0.09 mm, respectively
3	Baumer et al <sup>[14]</sup>	Retrospective study	2017	10	6 months	–	Mean tissue loss on the --0.21 -0.18 mm at the mesial and 0.17 - 0.36 mm at the distal aspect
4	Gluckman et al <sup>[13]</sup>	Retrospective study	2018	128	4 years	96.1%	Complication was Internal exposure of implant
5	Siormpas et al <sup>[12]</sup>	Retrospective study	2018	250	10 years	98%	Periimplantitis
6	Serhat Aslan <sup>[18]</sup>	case report	2018		1 year	100%	Palatal side mean bone loss -1.21 buccal side -0.02mm
7	Hinze et al <sup>[19]</sup>	Cohort-case series study	2018	17	5 year	100%	Mean buccal bone loss <0.05. soft tissue volume change - 0.05 mm (- 0.07 +_0.16 range - 0.37 to +0.32)
8	Andoni Jones <sup>[20]</sup>	Case report	2019	1	1 year	100%	maintained tissue volume, colour, and contour
9	M Troiano <sup>[21]</sup>	Prospective case study	2014	10	6 months	100%	Crest bone loss around the implants - 1.3 ±0.2 mm, i.e. 0.7 mm on average

## **Discussion**

This systematic review aims at identifying the best possible outcome for the success of socket shield technique. Eligible studies were identified from electronic databases, and 13 studies were included for the final review including both animal and human studies. Since there was a limitation to the number of studies carried out regarding the exact thickness and height of the remaining root segment, this remains the drawback of the systematic review. Studies carried out in animals have concluded that if the thickness of the buccal bone is 3mm, and the thickness of the remaining root fragment is 2mm, the socket shield technique is more predictable and the bone contours can be maintained.<sup>[7]</sup>

Reports have shown that there is decrease in the the absorption of alveolar ridge if the thickness of the root fragment increases, or when the thickness of the root plate is in the 0.5-1.5 mm range. And he reported no differences in buccal plate preservation between equicrestal and 1 mm-high shields.<sup>[8]</sup> grafting has been a controversial factor in socket shield technique. Whether to graft or not, is a question amongst many practioners.

Study carried out in dogs have drawn conclusions that if the distance between the implant surface and socket wall is 0.5-1 mm, there is no need for bone graft to fill the space but, if this space is more than 1 mm, grafting is indicated.<sup>[9]</sup> Implant osseointegration is the most important factor for success of socket shield technique. Buccal bone thickness need not interfere with this process. In a study carried out ,conclusions have been made that retaining the buccal aspect of the root during implant placement does not appear to interfere with osseointegration . He added that this may be beneficial in preserving the buccal bone plate. Also the buccal root fragment is left 1 mm supracrestal. This was done so as to keep the supracrestal fibers that attach to the gingiva intact so that there are

minimal changes in the soft tissue volume.<sup>[10]</sup> The exposure of the shield placed to the outer environment can lead to soft tissue damage and prosthesis fabrication. In a study conducted, it was observed that, that if the socket shield is too long it can interfere with the prosthesis because, if the clinician is not careful, it can be pressed or even mobilized when the restoration is being prosthetically screwed.<sup>[13]</sup> An insufficiently reduced shield can also become exposed to the sulcus and require an intervention to further reduce it, as it is mandatory to have soft tissue coverage.

Radiographic images to check for the bone loss at the implant site have been used in a study. The author concluded that, Mean tissue loss on the facial side in orofacial direction was 0.21 -0.18 mm. Average recession at implants was 0.33 -0.23 mm and at neighbouring teeth 0.38 -0.27 mm. Mean loss of the marginal bone level at the implant shoulder amounted to 0.33 -0.43 mm at the mesial and 0.17 - 0.36 mm at the distal aspect of the implants. A mean pink aesthetic score of 12 was recorded.<sup>[14]</sup> Blood supply of the buccal bone plate comes not only from the PDL but also from the interdental septum.<sup>[17]</sup> Theoretically, the proximal root segment can retain the proximal PDL to offer blood supply to the interdental septum and then offer blood supply to the buccal bone plate to reduce atrophy of the buccal bone plate. In A report of a case of open flap approach rather than flapless approach to improve the visibility of the partial extraction and to minimize potential complications derived from an inadequate shield preparation ,the thickness of shield was thinned down to about 1 to 2 mm and reduced to crestal level. And a gap was left between the buccal shield and the implant, which was intentionally not filled. No adverse effects such as soft tissue scarring were visible after 1 year of loading, and tissue volume, colour, and contour were maintained during the

observation period.<sup>[20]</sup>Gluckman et al in 2018 in his study, evaluated 128 socket-shield cases in the aesthetic zone and posterior sites with up to 4 years of follow up and recorded a 96.1% survival rate.<sup>[13]</sup> 89.9% implants were placed in the maxilla and 10.01% in the mandible. He also reported the most common complication encountered was the internal exposure .That means, the coronal portion of the socket shield facing the implant crown and abutment penetrated the soft tissue.

### Conclusion

Within the limitations of the above systematic review, it is suggested that the modified socket-shield technique is effective for maintaining the alveolar bone. Root thickness in a range of 0.5-1.5 mm used in Socket shield technique showed successful results with decreased bone resorption and increased aesthetic results. More randomized controlled trials are needed to establish the clinical efficacy of this technique.

### Contributions

Three authors independently scrutinized the literature and if any controversy was raised, fourth author's opinion was sought to arrive at a mutual consensus for including the study in the review. The statistician was involved in statistical analysis and is trained in conducting systematic reviews.

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