EGYPTIAN DENTAL JOURNAL
www.eda-egypt.org
VOL. 68, 235:247, JANUARY, 2022
PRINT ISSN 0070-9484 • ONLINE ISSN 2090-2360
ORAL SURGERY
Submit Date : 08-10-2021 • Accept Date : 28-11-2021 • Available online: 30-1-2022 • DOI : 10.21608/edj.2021.99597.1819

# COMPARISON BETWEEN IMMEDIATE IMPLANT PLACEMENT IN THE AESTHETIC ZONE WITH AND WITHOUT SOCKET SHIELD TECHNIQUE

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## *ABSTRACT*

**Objectives:** The aim of this study was to compare the clinical and radiographic outcomes of the socket shield technique (SST) versus the conventional technique for immediate implant placement.

**Material and Methods:** Twenty patients who reported with a single non-restorable maxillary tooth in the esthetic zone were included in this study and randomly assigned to one of the two groups: **Group A:** (study group) comprising SST with immediate implant placement and **Group B:** (control group) comprising conventional technique for immediate implant placement. All patients were evaluated clinically and radiographically at implant placement time, after 3 months, and 6 months regarding implant stability, peri-implant pocket depth (PPD), modified sulcus bleeding index (mSBI), and marginal bone loss (MBL). All clinical and radiographic data were subjected to statistical analysis.

**Results**: The mean vertical bone loss was 0.399±0.093 and 0.953±0.354 mm for the study and control groups, respectively. The mean horizontal bone loss was 0.322±0.066 and 0.528±0.065 mm for the study and control groups, respectively. There was significant difference between both groups regarding vertical and horizontal bone loss. The ISQ for the study group significantly increased from 61.20±5.01 to 71.30±1.70, while in the control group it significantly increased from 58.90±2.85 to 69.20±5.85 with no significant difference between the two groups. There was no significant difference between the two groups regarding mSBI with significant difference regarding PPD.

**Conclusion:** The socket shield technique is alternative minimally invasive procedure to preserve the buccal bone and improve treatment outcomes with immediate implant placement.

**KEY WORDS:** Aesthetic zone, bone loss, immediate dental implant, socket shield technique.

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## INTRODUCTION

Preservation of soft and hard tissues after tooth extraction and immediate implant placement is considered as one of the main hardships in implantology. Resorption of thin buccal plate of bone is due to periodontal ligament loss with its blood supply. [1] These inevitable volumetric tissue changes after extraction of teeth are part of the remodeling process, [2] and results in negative consequences when considering immediate placement of dental implant in the esthetic zone. [3]

In comparison to the palatal plate of the alveolar ridge, the decreased thickness of the buccal plate accentuates its degree of resorption after extraction, leading to 50% loss of buccolingual width and decrease in vertical height. Two-thirds of the buccal plate resorbs mainly in the first 3 months after tooth extraction. [4-6]

According to Chappuis et al. [7], a successful restoration requires a minimum of 2 mm thickness of intact buccal bone at the surgical site as well as a thick gingival biotype. This results in decreased recession risk of the buccal gingiva as well as acceptable width of the soft tissue profile at the neck of the implant prosthesis. [8] Nevertheless, many cases lack these conditions. [9] Meanwhile, some researchers confirmed that such thickness is often lower, already before the moment of the tooth avulsion. [8] Therefore, preserving and maintaining the bone anatomy and soft tissue architecture in the anterior region is essential for maintaining esthetics in implant-supported restorations. [10]

Consequently, research works have been concerned to find a solution that could prevent such volume changes, including socket preservation techniques[11, 12] and guided bone regeneration (GBR) procedures.[13, 14] Regarding immediate implant placement, several techniques have also been introduced including meticulous case selection, atraumatic tooth extraction,[8] flapless technique for implant placement, ideal 3-D implant positioning, [15] connective tissue grafting with simultaneous implant placement, [16] platform switching implant design, [17] dual zone technique (placement of bone graft materials in the buccal gap till level of gingival margin) [18] and immediate provisionalization. [19] However, none of these procedures is considered effective in preventing normal post-extraction bone remodeling as a result of loss of periodontal ligament and presence of thin buccal plate. [20]

For preservation of the buccal bone, many researches have been interested recently in placing implants close to intentionally retained roots. [21-24] A technique known as "socket-shield", to preserve the buccal bone after extraction, was first described by Hurzeler et al. [21] They intentionally retained a fragment of the buccal root at the time of extraction to act as a shield which preserved the vascular supply to the buccal plate, thus preventing its resorption; and consequently, an immediate implant was placed palatal to the root fragment. Their histological study on an animal model declared that cementum was formed on implant surfaces placed in contact with intentionally retained roots. [21]

The socket-shield technique is an alternative minimally invasive procedure that has shown a success rate of 96.5%. [25] It is recommended for badly decayed teeth in the anterior zone. [26] However, teeth affected by periodontal disease, mobility, large periapical lesion, vertical or horizontal root fractures under the bone ridge, and internal root resorption can influence the prognosis and are not indicated for SST. [10, 27]

The original protocol of the socket-shield technique (SST) has witnessed many modifications regarding time of implant placement,[24] location[28] and height of the shield,[29] whether to place grafting material[30] or not [23] and other terms such as the partial extraction therapy, [31] the root membrane technique, [23, 25] and the modified SST are introduced. [10]

Immediate implant placement with SST had acceptable results in many studies.[25, 26, 30, 32] However, there was considerable risk of complications.[25,30, 32] Interestingly, none of these studies compared this technique with conventional immediate placement of dental implant. Therefore, the aim of this study was to evaluate and compare the clinical and radiographic outcomes of immediate implant placement in the aesthetic zone with and without SST.

### Aim of study

The aim of this study was to compare between socket shield technique and conventional immediate placement of dental implant in the aesthetic zone.

## MATERIALS AND METHODS

This study was performed on twenty patients who had non restorable maxillary teeth in the esthetic zone indicated for extraction and immediate implant placement. The patients were selected from the Outpatient Clinic of the Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Mansoura University.

This study was conducted according to the Helsinki Declaration for medical protocol and ethics and was approved by the Ethical Review Board of Mansoura University. All patients were informed and signed an informed consent explaining the type of intervention and possible complications.

### Inclusion criteria

- Maxillary non restorable tooth in the aesthetic zone.
- Age ranging from 18-50 years.
- Good oral hygiene.
- Nonsmoking patients.
- Free from any associated pathological lesions.

### Exclusion criteria

### General contraindications

- Patients on chemotherapy or radiotherapy
- Patients with uncontrolled diabetes mellitus, autoimmune disease or any other systemic disorders that interfere with bone healing.
- Pregnancy
- Bruxism.

### Local contraindications

- Tooth with vertical root fracture on the buccal aspect.
- Tooth with horizontal root fracture below bone level.
- Tooth with internal or external resorptions affecting the facial root aspect.
- Tooth mobility caused by traumatic occlusion, diseased periodontium, etc.
- Caries affecting the facial root aspect.

### Patients classification

Patients were randomly divided into two equal groups using computer software: numbers were concealed in closed envelops.

**Group A (study group)**: included ten patients who underwent SST with immediate implant placement.

**Group B (control group):** included ten patients who underwent conventional technique for immediate implant placement.

### Preoperative phase

Detailed history of all patients was recorded and thorough clinical and radiographic examination were performed as follows:

**Clinical examination:** The patients were examined extra and intra orally for caries examination,

gingival health, fracture, mobility or pain of tooth to be extracted.

**Radiographic examination:** periapical radiograph was done first to evaluate the status of the tooth to be extracted **(Fig 1A, 1B),** then cone beam computed tomography (CBCT) * was done for every patient to evaluate proximity of the tooth to be extracted to nasal cavity or maxillary sinus, assess buccal bone height and thickness, exclude any associated pathological lesions, and select proper implant size for every patient.

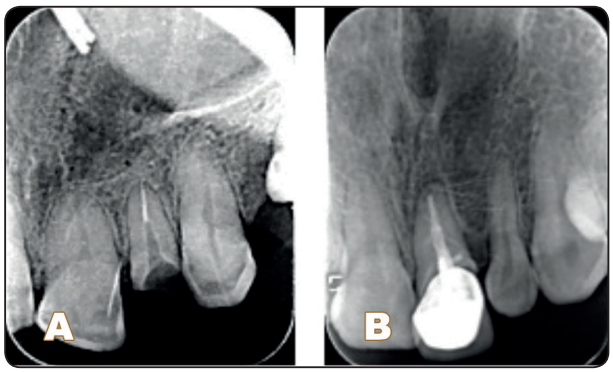


Fig. (1) : A): A preoperative periapical radiograph for the study group. B): A preoperative periapical radiograph for the control group.

Immediately before surgical intervention, rinsing with anti-septic mouthwash rinse** was performed for all patients. For all procedures, the surgical field was anesthetized with local infiltration anesthesia using Mepivacaine Hydrochloride 2% and Levo-nordefrin 1: 20,000.***

## Surgical Procedures

**In Group A (study group):** Under copious irrigation, the crown of the non-restorable tooth was decoronated with a chamfer diamond bur and a large-head round diamond bur. This step was skipped in already decoronated teeth due to caries or fracture. Successively increasing diameter of Gates Glidden burs were used up to apical region to widen the root canal and remove all of its contents. Following the same path created by Gates Glidden, a long shank high-speed root resection bur was used for complete sectioning of the root mesio-distally into facial and palatal segments **(Fig 2A)**. Periotome or forceps were used to luxate the palatal fragment of the root **(Fig 2B, 2C)**. Finger support on the facial shield could verify if there is any movement during extraction of the palatal segment. Then, thorough debridement, curettage, and rinsing with copious saline irrigation were done to remove any remnants of pathological tissues within the socket apex. Thereafter, the facial root portion was refined creating a crescent-shaped concavity conformed to the facial aspect of the alveolar ridge with a thickness of about 2 mm to ensure resistance to fracture and resorption. The coronal aspect of the root segment was reduced to 1 mm above the level of facial bone crest and beveled with large head round diamond bur for a better emergence profile **(Fig 2D)**. After socket shield preparation, the implant bed was initially prepared with a pilot drill. The osteotomy was then enlarged with subsequent drill till reaching the final drill suitable to the size of the implant. The length of the implant should extend 2-3 mm beyond the root apex on the palatal wall to achieve sufficient initial stability from the periapical bone. Following implant bed preparation, a selected implant**** was placed palatally to engage the palatal bone without contacting the shield **(Fig 3A)**. The gap between the implant and the shield was left empty to enable blood clot formation. Then, a healing abutment was screwed into the implant **(Fig 3B)**.

**In Group B (control group):** The available alveolar bone was preserved by atraumatic extraction using periotomes and forceps. After tooth extraction, the socket was debrided gently

* Cone beam computed tomography: (i-CAT Inc.,Hatfield, PA, US)
** Hexitol Chlorhexidine HCl 1.25%, by Hexitol® mouthwash: Arab Drug Company (ADCO), Cairo, Egypt).
*** Scandonest; Septodont, France.
**** Two pieces root form endosseous implant. Neobiotech system. Seoul. Korea.

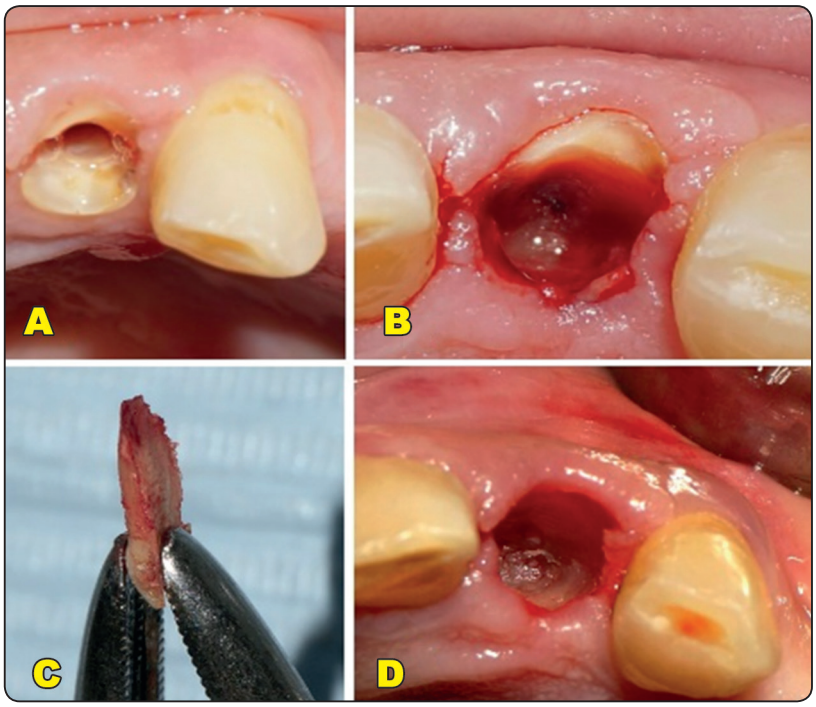


Fig. (2) Socket Shield Technique

Group A:

A): A photograph showing sectioning of the root in a mesiodistal direction.

B): A photograph showing the socket after removing the palatal root part.

C): A photograph showing the extracted palatal root part.

D): A photograph showing the reduction of buccal root part

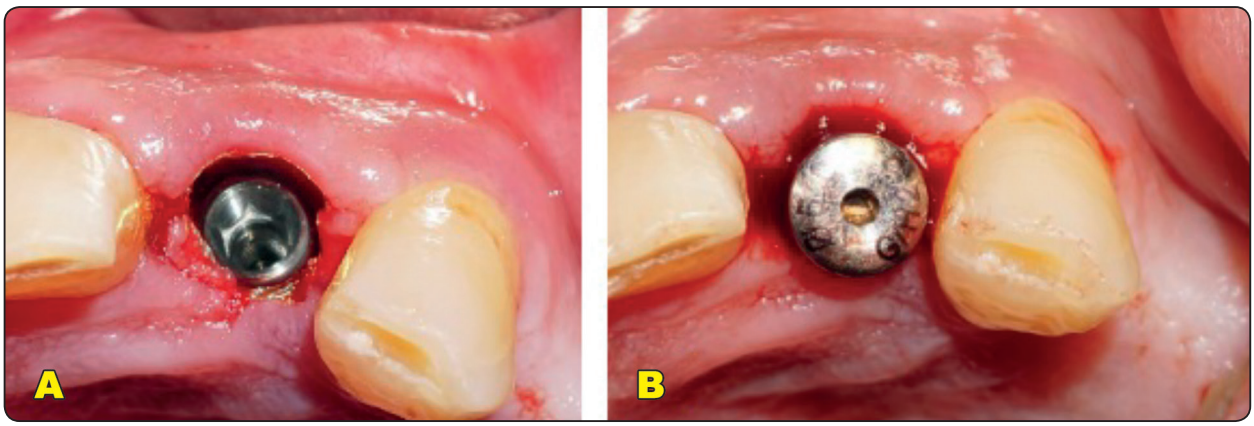


Fig. (3) Group A: A): A photograph showing the dental implant placement. B): A photograph showing the placement of the healing abutment.

using curettes, and irrigated by physiologic saline solution. The osteotomy site was prepared using the palatal aspect of the socket to ensure the emergence profile was in the line with the adjacent teeth. This would typically leave a small gap between the labial plate and the implant. The implant was then placed 2 to 3 mm apical to the bone crest engaging the apical bone (Fig 4). Finally, a healing abutment was screwed.

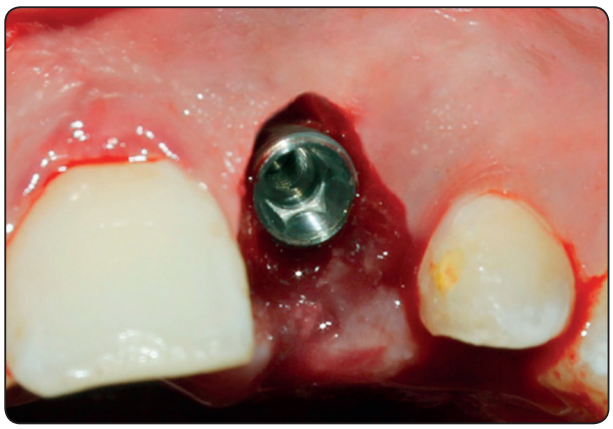

Fig. (4) : Group B: A photograph showing palatal implant placement leaving approximately 2 mm jumping gap.

* Augmentin® 1 g Tablet by Galaxosmithkline co ltd, USA.

**Post- surgical phase**

Postoperative medications included antibiotic tablets containing Amoxicillin /clavulanic acid*: 1 g twice daily for 5 days. Analgesic with nonsteroidal anti-inflammatory drugs**: 50 mg tablets 3 times daily for 5 days. All patients were asked to apply cold packs extra-orally every 10 minutes for 2 hours during the first day. Chlorohexidine mouth wash*** was started to be used on the 2nd day postoperatively for 2 weeks.

**Prosthetic rehabilitation**

Four months after implant placement, the healing cap was removed and patients in both groups received a final porcelain fused to metal crown **(Fig 5A, 5B).**

**Measurement of the outcomes**

All patients were seen at regular time interval for evaluation immediately, 3 months, and 6 months after surgery.

***A. Clinical Evaluation***

**Implant stability:** Was measured at the time of implant insertion and at 6 months after surgery using Ostell***. Smart peg (type 7) was attached to the implant and the resonance frequency analysis (RFA) value was measured 4 times in 4 directions (every 90°). The result was expressed in implant stability quotient (ISQ) and averaged for each implant.

**Peri-implant probing depth (PPD):** The depth of gingival sulcus was measured at 3 and 6 months after surgery as the distance from the gingival margin to the base of the pocket buccal, distal and mesial using a plastic graduated probe. The probe should be inserted in a line with the vertical axis of the implant. The probe was inserted until the blunt edge of the probe contact the base of the pocket. The buccal pockets were measured at the midline of the implant. The mesial and distal pockets were measured from the buccal aspect as close as possible to contact points. Measurements were recorded to the nearest 0.5 mm.

**Modified sulcus bleeding index (mBI)**

Clinical signs and symptoms of inflammation of peri-implant mucosa were graded using criteria of modified sulcus bleeding index (mBI) by mombelli et al. [33,34] where;

- 0 means no bleeding.
- 1 means isolated bleeding spots visible.

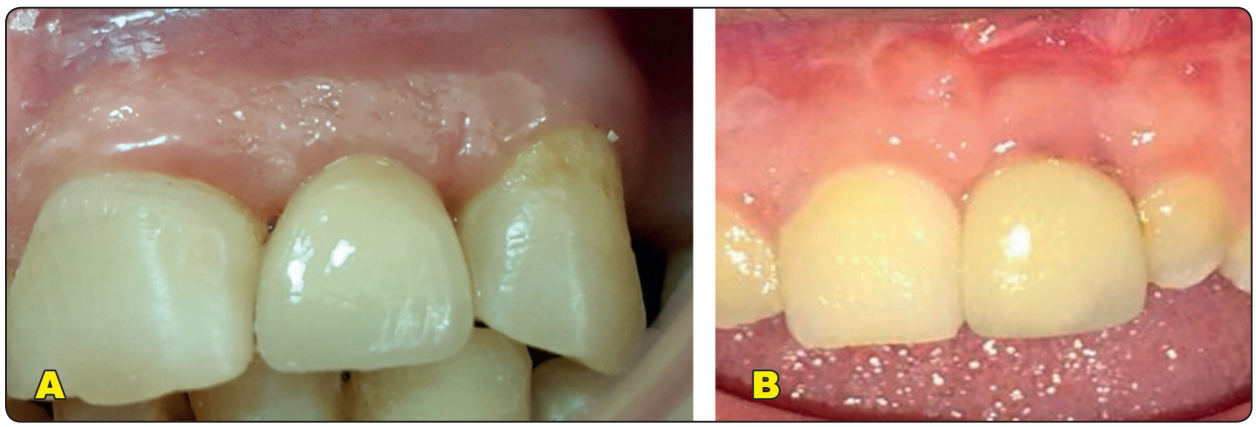


Fig. (5): A: A photograph showing the final restoration of Group A. A photograph showing the final restoration of Group B

* Olfen 50 SR. Medical Union Pharmaceuticals Co. (MUP) – Egypt. Under Licence from: Mepha Ltd. – Switzerland.
** Hexitol Chlorhexidine HCl 1.25%, by Hexitol® mouthwash: Arab Drug Company (ADCO), Cairo, Egypt).
*** Osstell AB, Gothenburg, Sweden

- 2 means blood from a confluent red line mucosal margin.
- 3 means heavy or profuse bleeding.

### *B. Radiographic Evaluation*

**For vertical bone height:** the implant was used as a reference by adjusting the cross-section in its center. On the cross-sectional view, a line was drawn just parallel to the implant, starting at the crest of the labial plate of bone and ending at the apical level of the implant; height was recorded in millimeters immediate postoperative and at 6 months and the difference between both readings corresponded to vertical bone loss **(Fig 6A, 6B, 7A& 7B)**

**For horizontal bone level:** a line was drawn from the shoulder of the implant at fixed distance to the outer margin of the labial plate of bone to record the horizontal bone level for each implant in both groups. The difference between horizontal bone levels immediately postoperatively and after 6 months represented the horizontal bone loss.

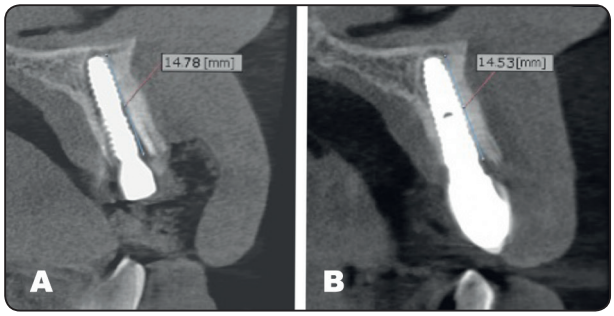


Fig. (6): Group A) A: An immediate postoperative cross-sectional image of CBCT. B): A cross-sectional CBCT image taken 6 months postoperative.

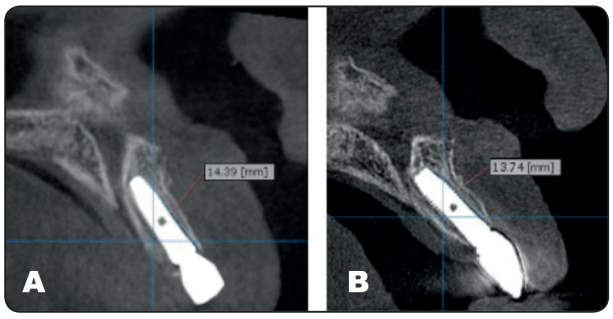


Fig. (7): Group B: A): An immediate postoperative cross-sectional image of CBCT. B): A cross-sectional CBCT image taken 6 months postoperative

### Statistical Analysis

The IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp was used for data analysis. The qualitative data were described in terms of number and percent. Median (minimum and maximum) described the quantitative non-parametric data, whereas mean, standard deviation (after utilizing Shapiro–Wilk for testing normality) were used to describe the parametric data. The threshold of significance was fixed at 5% level. When $p \leq 0.05$, results were considered significant.

### Data analysis

### Qualitative data

- Monte Carlo test as correction for Chi-Square test when more than 25% of cells have count less than 5 in tables (>2*2).

### Quantitative data between groups

### Parametric tests

- Student t-test was used to compare 2 independent groups. While the Paired t test to compare between 2 studied periods.

## RESULTS

Twenty patients with a mean age of 30 years were included in this study. According to the survival criteria, twenty implants were successfully osseointegrated.

### Vertical bone loss

The mean vertical bone loss after 6 months for group A was 0.399 ±0.093 mm and for the group B was 0.953±0.354 mm with statistically significant decrease ($p<0.001$) in vertical bone loss after 6 months in the socket shield group when compared to the control group. **(Table 1)**

**Horizontal bone loss**

The mean horizontal bone loss after 6 months for group A was 0.322 ±0.066 mm and for group B was 0.528±0.065 mm with statistically significant decrease (p<0.001) in the horizontal bone loss in the socket shield group compared to the control group. **(Table 1)**

TABLE (1): Comparison of vertical & horizontal bone loss between studied groups

| | Control Group n=10 | Socket shield group n=10 | Test of significance (Student t test) |
|---|---|---|---|
| Vertical Bone loss | 0.953±0.354 | 0.399±0.093 | t=4.78 p<0.001* |
| Horizontal Bone loss | 0.528±0.065 | 0.322±0.066 | t=7.0 p<0.001* |

**Implant stability**

**Group A:** the mean ISQ values were 61.20±5.01 at the time of implant placement and 71.30±1.70 after 6 months with statistically significant increase in stability by time (p<0.001). **(Table 2)**

**Group B:** the mean ISQ values were 58.90±2.85 at the time of implant placement and 69.20±5.85 after 6 months with statistically significant increase in stability by time (p<0.001). **(Table 2)**

Comparing the two groups, there was no significant difference between them regarding implant stability at time of implant placement or after 6 months. **(Table 2).**

TABLE (2): Comparison of Implant stability between studied groups and within the same group in both groups

| Time of follow up | Control group n=10 | Socket shield group n=10 | test of significance (Student t test) |
|---|---|---|---|
| Immediate post operative | 58.90±2.85 | 61.20±5.01 | t=1.26 p=0.223 |
| 6 months | 69.20±5.85 | 71.30±1.70 | t=1.09 p=0.290 |
| Paired t test | p<0.001* | p<0.001* | |

**Peri-implant pocket depth**

**Group A:** The mean PPD values at 3 months were 1.35±0.47, 1.70±0.349, and 1.75±0.35 mm measured at midbuccal, mesial, and distal points respectively. The mean PPD values at 6 months were 1.40±0.459, 1.85±0.41, and 1.85±0.24 mm measured at midbuccal, mesial, and distal points respectively. **(Table 3)**

**Group B:** The mean PPD values at 3 months were 2.55±0.437, 2.60±0.39, and 2.40±0.39 mm measured at midbuccal, mesial, and distal points respectively. The mean PPD values at 6 months were 2.85±0.24, 2.85±0.47, and 2.7±0.48 mm measured at midbuccal, mesial, and distal points respectively. **(Table 3)**

TABLE (3): Comparison of Peri-implant probing depth between studied groups

| **Peri-implant probing depth** among studied Surfaces | time of follow up | Control group n=10 | Socket shield group n=10 | test of significance (Student t test) |
|---|---|---|---|---|
| Mid buccal | 3 months | 2.55 ± 0.437 | 1.35 ±0.47 | t=5.88, p<0.001* |
| | 6 months | 2.85 ± 0.24 | 1.40 ±0.459 | t=8.83, p<0.001* |
| Mesial | 3 months | 2.60 ± 0.39 | 1.70 ±0.349 | t=3.88, p= 0.001* |
| | 6 months | 2.85 ± 0.47 | 1.85 ± 0.41 | t= 9.71, p<0.001* |
| Distal | 3 months | 2.40 ± 0.39 | 1.75 ± 0.35 | t= 8.83, p<.001* |
| | 6 months | 2.7 ± 0.48 | 1.85 ± 0.24 | t=7.78, p<0.001* |

TABLE (4): Comparison of modified sulcus bleeding index between studied groups

| Time of follow up | Modified sulcus bleeding index | Control group n=10 (%) | Socket shield group n=10 (%) | Test of significance Monte Carlo test |
|---|---|---|---|---|
| 3 months | 0 | 4(40.0) | 5(50.0) | MC |
| | 1 | 5(50.0) | 3(30.0) | P=0.624 |
| | 2 | 1(10.0) | 2(20.0) | |
| 6 months | 0 | 3(30.0) | 4(40.0) | MC |
| | 1 | 5(50.0) | 6(60.0) | P=0.327 |
| | 2 | 2(20.0) | 0 | |

Comparing the two groups, there was a significant difference between them concerning the mean PPD values at 3 and 6 months (p<0.001). **(Table 3)**

**Modified sulcus bleeding index:**

There was no statistically significant difference between the two groups regarding mSBI values at 3 months P=0.624 and at 6 months P=0.327. **(Table 4)**.

## DISCUSSION

It is a great challenge to place implant in the esthetic zone. The concept of the socket shield technique depends on leaving a thin shelf of dentin in the socket to preserve bony architecture. [6] This study was to compare the socket shield technique with the conventional immediate implant placement.

In the present study, no implant was lost. All the twenty implants were osseointegrated successfully without any complications with a survival rate of 100% and excellent soft tissue healing. This was similar to Gluckman et al. [30] and Siormpas et al. [25] who reported dental implant survival rate of 96.1% and 98% for immediate implant placed with socket shield (SS) respectively.

Marginal bone level around the implant is considered as a key factor that monitors the peri-implant health. In the present study, the mean vertical bone loss after 6 months for the socket shield group was 0.399 ±0.093 mm and for the control group was 0.953±0.354 mm with statistically significant decrease (p<0.001) in vertical bone loss after 6 months in the socket shield group when compared to the conventional technique. This was in accordance with Bramanti et al. [35] who also compared SST with the conventional technique in a 3-year follow up and found that MBL with SST was significantly less (0.6 mm) compared with the conventional technique (1.1 mm). Mitsias et al. [36] reported an absence of buccal bone loss at 5 years follow-up using the socket shield technique. Zhang et al. [37] noticed that the height of buccal bone, when a labial root shield was retained, was significantly higher when compared with control groups that had the entire root removed. In agreement with our study, Hinze et al. [38] showed that the average facial bone collapse after 3 months from SS immediate implant placement was 0.07 mm.

In contrast to our results, Guirado et al. [39] in their histological study stated that regardless of the thickness of the socket-shield, 3.13 mm to 6.01 mm of crestal bone loss was noted at 4 months. Also, Schwimmer et al. [40] despite providing the first histological evidence in humans that bone may fill the space between the root and the implant surface, crestal bone loss, peri-implantitis, increased probing depth were found in relation to the implant but it was not clear whether peri-implant bone loss was due to retained root fragments, as bone loss was also found at distal aspects of the implant.

In the present study, it was found that the mean

horizontal bone loss after 6 months for the socket shield group was 0.322 ±0.066 mm and for the control group was 0.528±0.065 mm with statistically significant decrease ($p<0.001$) in the horizontal bone loss in the socket shield group compared to the conventional technique. This finding was in accordance with a recent randomized controlled clinal trial that reported a significant increase in the buccal plate width by using SS technique in comparison with conventional flapless immediate implant placement. [35] The present study was also comparable to Abd-Elrahman et al. [41] who reported that the range of horizontal bone loss was 0 to 0.26 mm for the socket shield group after 6 months. Also, Barakat et al. [42] reported that the mean horizontal bone loss after 7 months was 0.10 ± 0.03 mm. Maintenance of the ridge width was attributed to preserving periodontal ligament that minimizes post-extraction physiological bone remodeling. [20]

Moreover, scientific evidence has shown that immediate implant placement alone does not antagonize the biologic response of the extraction socket. [5, 16, 43] Araujo et al. [5] showed that bone resorption after immediate implantation was comparable to that of untreated extraction sockets. Vignoletti et al. [43] have demonstrated that immediate implant placement after tooth extraction is followed by bone resorption of about 2 mm vertically. Grunder [16] demonstrated that horizontal resorption of the labial soft tissue was obvious when placing an implant simultaneously with tooth extraction, and suggested that a subepithelial connective tissue graft should be used.

Regarding implant stability, our study reported that there was no statistically significant difference in implant stability between the two groups with time. On the contrary, there was statistically significant increase in ISQ values within the same group through the follow up intervals in both groups. This was in agreement with Abd-Elrahman et al. [41] who found that the mean ISQ for the study and control groups significantly increased after 6 months with no significant difference between both groups. Moreover, Barakat et al. [42] who evaluated immediate implant placement with SST demonstrated a significant increase in implant stability between time of surgery and 4 months. On the other hand, a clinical study which assessed SST for immediate implantation reported that there was no significant continuous increase in ISQ value over 1 year follow up after implant placement. [10] It is recommended that the ISQ level should be calibrated for each implant system separately as the disparity between studies regarding the implant system used may affect these results.

In the present study, patients in the SST group had statistically significant lower values of PPD compared with patients in the control group at both 3 and 6 months. This result agreed with a recent study which evaluated PPD at 12 and 24 months and found significantly lower values for PPD associated with SST compared immediate implant placement by the conventional technique. [44] Thus, the socket shield with its attached PDL provide better environment that alters the immunity and bacterial invasion.

Regarding the mean mSBI values, our study reported that there was no significant difference between the groups over the treatment time. All patients in our study demonstrated healthy soft tissue conditions. This was in accordance with Bäumer et al. [17] who found excellent soft tissue healing with SST and peri-implant probing revealed healthy conditions. On the other side, Gharpure et al. [45] stated that the socket shield is associated with several types of complications such as deep probing pockets, risk of infection, recession, crestal bone loss, and implant exposure.

Gluckman et al. [30] reported that the space between the implant and the buccal portion of the root fragment should always be filled with graft material. Habashneh et al. [46] and Bramanti et al. [35] recommend filling the space with a heterologous graft material to further reduce bone resorption. However, Siormpas et al. [23] suggested that it is not necessary to graft the space between the residual

buccal root fragment and the dental implant which was in consistence with our study in which no bone substitute was added in the gap between the shield and the implant. Botticelli et al [47] have reported significant closure of the marginal gap between the socket walls and the implant through new bone formation even in ungrafted sites. This concept is supported by recent histological data showing that, without the use of biomaterials, new bone grows in the space between the dentin fragment and the dental implant. [39]

## CONCLUSION

The socket-shield technique for immediate dental implant placement in the esthetic zone seems to be a successful and minimally invasive technique in maintenance of labial bone dimensions and consequently the overlying soft tissue. However, it is a sensitive technique that needs the practice to be executed properly.

### Abbreviation

SST: socket shield technique

SS: socket shield

MBL: marginal bone loss

PPD: peri-implant pocket depth

mSBI: modified sulcus bleeding index

### No conflict of interest.

No funding was received for this study.

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