



## SOCKET SHIELD TECHNIQUE VERSUS STICKY BONE IN IMMEDIATE DENTAL IMPLANT IN ESTHETIC ZONE

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### ABSTRACT

**Objective:** The present study was performed to evaluate immediate implant placement with socket-shield technique versus using bone graft filling the jumping gap in the form of sticky bone in maxillary aesthetic zone. **Subjects and Methods:** Sixteen patients were included in this study (n=16), they were divided into two groups: group (I): eight patients were subjected to socket shield procedure with immediate implant placement. Group (II): eight patients were subjected to immediate implant placement with sticky bone in the jumping gap. After surgery each patient were evaluated clinically for: pain values, esthetic results using pink esthetic score (PES) and implant stability using Osstell device. All patients received immediate and 6 months postoperative CBCT to assess bone density and the dimensional changes in the labial bone plates. **Results:** The mean vertical bone loss value after 6 months in group I was  $0.28 \pm 0.13$  mm contrary to group II which was  $0.46 \pm 0.19$  mm which was statistically significant. The mean horizontal bone loss value after 6 months in group I was  $0.17 \pm .099$  mm while in group II it was  $0.25 \pm 0.13$  mm which was statistically not significant. **Conclusion:** Both socket shield technique and using the sticky bone to fill the jumping gap preserved the labial bone thickness and height with superiority of socket shield in preservation of its height.

**KEYWORDS:** Immediate implant; Socket shield; Sticky bone

### INTRODUCTION

Marked dimensional reduction of the alveolar ridge width and height represents a physiologic sequela after tooth extraction. This resorption was pronounced clinically and histologically at the buccal part of the ridge more than the lingual part<sup>(1,2)</sup>.

Several approaches have been described for contouring the socket alterations caused by tooth extraction: implant placement directly after

extraction; positioning of the implant on the palatal wall; performing the surgery using the flapless technique to maintain vascularization; and using soft tissue or bone grafts to maintain the dimension of the ridge by socket augmentation<sup>(3-7)</sup>.

Hürzeler in 2010<sup>(8)</sup> introduced a new approach for immediate implant by leaving buccal root fragment adjacent to the buccal crestal bone. Placing an immediate implant engaged to the palatal socket wall to maintain the contour of the ridge. The implant can

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achieve osseointegration without any inflammations at peri-implant tissues. This technique preserved the buccal bone plate and tissue between the shield and implant healed with cementum formation. The clinical outcome demonstrated the socket shield technique prevented a noticeable alteration of ridge shape after tooth extraction. This technique has advantages of minimally invasive, preserved tissue contour and no need of bone substitute materials. However, it is a sensitive technique in nature<sup>(9)</sup>. Tarnow et al proved that bone grafting at the time of implant placement into the gap in combination with a provisional restoration or a contoured healing abutment resulted in the smallest amount of ridge contour changes<sup>(10)</sup>.

Sohn et al. reported that sticky bone is easy to make and they are a very effective materials for the reconstruction of edentulous alveolar bone defect, based on the concept of minimally invasiveness on ridge augmentation<sup>(11)</sup>. Hence, the present study aimed to compare the socket shield technique with immediate implant vs using sticky bone graft filling the jumping gap with immediate Implant.

## SUBJECTS AND METHODS

The present study is performed to evaluate immediate implant placement with socket-shield technique versus using bone graft filling the jumping gap in the form of sticky bone in maxillary aesthetic zone. Patients were selected from those attending outpatient clinic of oral and maxillofacial surgery department at faculty of dental medicine, Al-Azhar University, Boys, Cairo. Ethical committee acceptance reference number was 94/104.

### Inclusion criteria:

Presence of a non-restorable maxillary anterior tooth indicated for extraction with good oral hygiene.

### Exclusion criteria:

Periapical or periodontal active infection involving the teeth to be extracted, patients receiving

chemotherapy or radiotherapy, alcohol or drug abuse, smokers, and patients who have uncontrolled systemic disorders such as uncontrolled diabetes mellitus.

### Patients were divided into two groups:

Group "I": 8 Patients ranged between 21 and 40 years with a mean age of  $29.875 \pm 7.586$  years where the male patients were 4 (50%) and female patients were 4 (50%) for socket shield procedure with immediate implant placement. Group "II": 8 Patients ranged between 23 and 41 years with a mean age of  $30 \pm 6.782$  years the male patients were 3 (37.5%) and female patients were 5 (62.5%) for were subjected to immediate implant placement with sticky bone in the jumping gap.

### Preoperative phase:

All patients underwent pre-operative clinical examination: Patient's data were collected; name, gender and age, medical and dental histories were taken. Also, all patients underwent standardized periapical radiograph to detect any pathosis and a pre-operative Cone beam computed tomography (CBCT) scans (Planmeca Promax 3D, Planmeca, Finland) was taken to evaluate The tooth root configuration, Vital structures related to the tooth, Vertical and horizontal dimensions of the alveolar bone and Bone density.

### Patient preparation for surgical procedure:

After extra oral disinfection of the surgical site, the patients were asked to rinse their mouths with Chlorohexidine HCL 1.25% mouthwash (Orovex mouthwash, Macro group, Egypt) immediately preoperatively. Local infiltration anesthesia [Articaine 4% 1:100,000 epinephrine] (Artinibsba 40 mg/0.1 mg/ml - epinephrine 1:100000, Spain) was used for all procedures. The extractions were done according to the type of group.

### 1. In Group "I": (Socket shield group)

The involved tooth Figure (1A) was decoronated using fissure carbide bur with copious irrigation at

least 1mm above the gingival level. Remaining root structure was sectioned using long shank fissure surgical carbide bur in gentle mesiodistal sweeping motion Figure (1B). Once the root was splitted, a fine periosteal was placed on the palatal portion of the root to luxate the palatal root portion Figure (1C). The palatal fragment was carefully dislodged buccally towards the space created by the surgical bur then carefully delivered using forceps Figure (1D). Then reduction of the coronal part of the root has been done to the bone level using large round diamond bur Figure (1F). Then, the bony walls of the socket were thoroughly debrided by careful curettage and irrigated with sterile saline solution Figure (1G, 1H).

The shield was further prepared with a long shank bur to become slightly thinner and concave. The final thickness of the shield was approximately half of the width from the root canal to the buccal surface of the root. Finally, the shield was smoothed off and all sharp edges are removed using a smoothening long shank diamond bur. The shield tested for mobility by gentle probing.

Sequential drilling was done according to manufacturer instructions Figure (1I). The osteotomy was directed palatal to the shield leaving a 2 mm gap approximately. The implant [Two-stage screw (OXY Implant, Via Nazionale Nord, 21a, 23823 Colico LC, Italy)] was placed in the correct 3D position, which was planned and executed as if there was no shield present. The implant was inserted 2 to 3 mm apical to the bone crest, engaging the socket's apical and palatal bony boundaries. The implant was also placed as far palatally as possible to increase the gap between the implant and the shield. The palatal position however was within the prosthetic envelope of the crown that will be fitted to the implant Figure (1K). Ratchet was used to insert the implant and tighten its bed in a clockwise direction. The tightening of implant using insertion torque of 50 Ncm. Smart peg abutment was applied to implant to determine and read the primary stability using sing

a resonance frequency analysis device (Osstell ISQ, Third generation, Gutenberg, Sweden) The healing abutment was screwed into the implant fixture Figure (1L).

## **II. Group "II": (Sticky bone group)**

The involved tooth Figure (2A) was atraumatically extracted using periosteal. Then the root was delivered using forceps Figure (2B and C). Following extraction of the tooth, the socket was thoroughly debrided by careful curettage and irrigated with sterile saline solution. In this study, sticky bone was prepared (mix of plasma rich in growth factors (PRGFs) and xenografts bone substitute) before implant installation to reduce the operation time. Before surgery, 10-cc of peripheral venous blood was drawn from the patient to two 5-cc sodium citrate containing plastic tubes. The blood was centrifuged at 460 rpm at room temperature for 8 minutes. After centrifugation, the blood was separated into 3 fractions: plasma containing mostly platelets (top layer), white blood cells layer "buffy coat" (middle layer) and red blood cells (bottom layer). PRGFs fraction is just above the "buffy coat". Plasma rich in growth factors was mixed with xenografts particles and calcium chloride allows for 5-10 minutes for polymerization in order to produce sticky bone graft. For acceleration of polymerization of PRGFs, fresh blood was taken from the site of implant osteotomy in oral cavity of patient was added to the mixture. Then this sticky bone was placed in the jumping gap Figure (2E), the healing abutment was screwed into the implant body Figure (2F). Postoperative medications included oral antibiotic, a dose of 1 g twice daily for 5 days (Amoxicillin/Clavulanic acid [Megamox: Jazeera Pharmaceutical Industries - Saudi Arabia. Imported by El Hekma Company, Egypt]) and an oral analgesic, a dose of 400 mg three times daily for 5 days (Ibuprofen [Brufen 400 mg. Abbott/Cairo, Egypt]). The patients followed strict oral hygiene measures and regular rinsing of Chlorhexidine 0.12% (Orovex mouthwash, Macro group, Egypt) mouthwash for

one week. The patients were followed up every other day for the first week, then weekly for the first month and 6 months postoperatively. For all the patients, CBCT scans immediately postoperatively and after 6 months, aided in the assessment of the horizontal and vertical bone loss which represents the primary outcome of this study. The sagittal views were used to measure the bone dimensional changes as follows: for the horizontal bone level, a line was drawn intersecting the implant apex and perpendicular to the implant platform. From that line, another line was drawn to the labial margin of the labial bony plate to record the horizontal bone level. For the vertical bone level, starting from the implant shoulder, perpendicular lines

were drawn to the bone crest labially the average was recorded for each implant in both groups Figure (3). The difference between horizontal bone levels immediately postoperatively and 6 months postoperatively calibrated the horizontal bone loss. The same modality was repeated to calculate the vertical bone loss. The secondary outcomes included the assessment of the implant stability which was measured immediately after implant placement and 6 months postoperatively, using a resonance frequency analysis device (Osstell ISQ, Third generation, Gutenberg, Sweden), and the PES evaluation, 6 months postoperatively, using the PES scoring system for dental implants; introduced by Furhauser<sup>(12)</sup>.

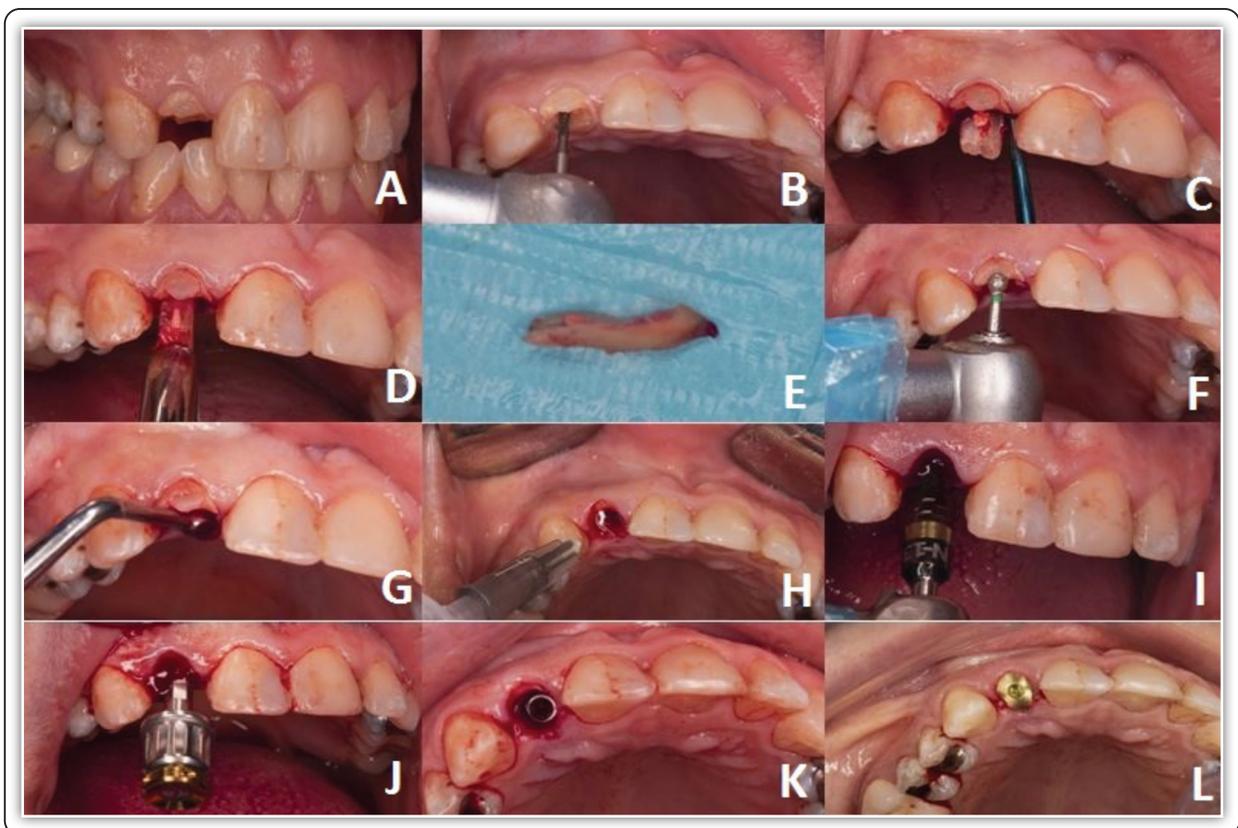


FIG (1) A; Preoperative situation B; Sectioning of the remaining root C; Luxation of palatal part using periosteal elevator D; Palatal fragment removal using forceps E; Removed palatal portion F; Debridement of the socket G; Irrigation of the socket H; Drilling for implant I; Implant insertion K; Implant placed palatal to the shield L; Healing abutment installed to implant.

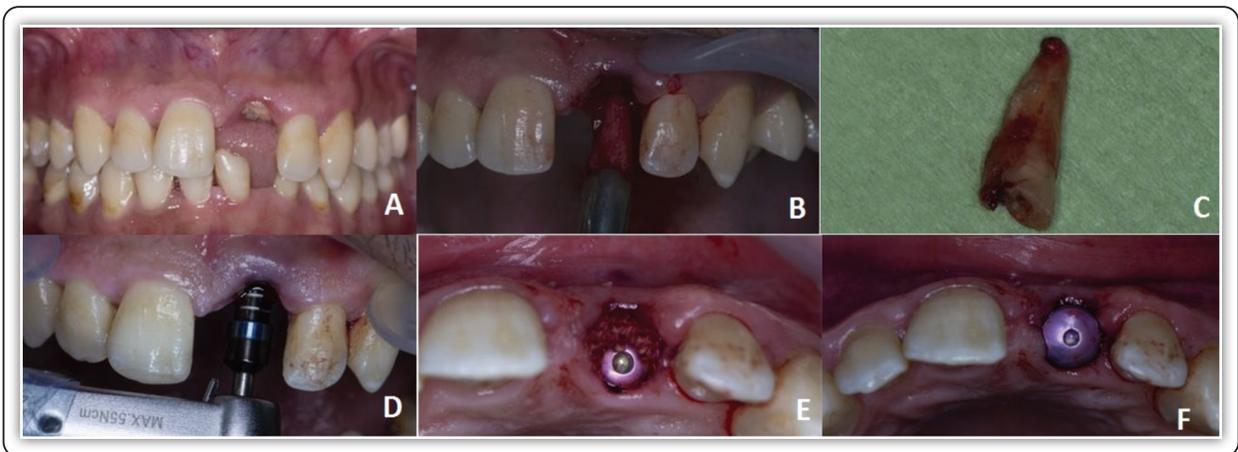


FIG (2) A; Preoperative situation B; Root extraction C; Extracted root D; Drilling for implant E; Implant in place with sticky bone filling the jumping gap F; Healing abutment installed to implant.

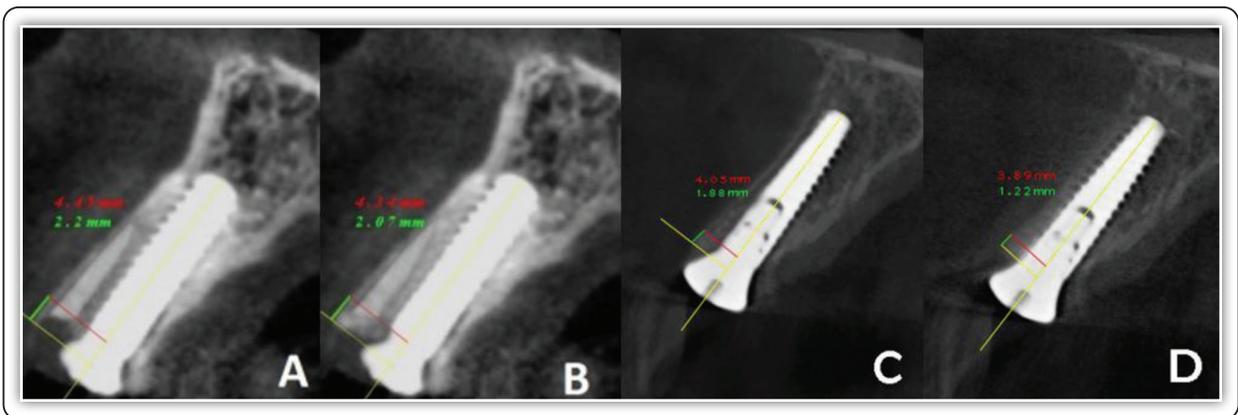


FIG (3) Horizontal and vertical bone level in group I & II. A; Horizontal and Vertical bone level in group I immediately postoperative. B; Horizontal and Vertical bone level in group II post 6 month. C; Horizontal and Vertical bone level in group II immediately postoperative. D; Horizontal and Vertical bone level in group II post 6 month. The red line shows the horizontal bone width and the green line shows the vertical bone length.

## RESULTS

### I. Clinical evaluation:

All patients had been examined periodically during the follow-up period up to 6 months. There were no post-operative complications. The patients complained of pain and discomfort during the first day of implant insertion. Pain was decreased by the third day and mostly disappeared at 1st week. There was no severe pain, huge swelling, suppuration or mobility detected during the time of evaluation. Clinical assessment showed good stability without any mobility and no signs of implantitis.

### II- Pink aesthetic score: (PES)

The mean value of PES was  $12.88 \pm 1.05$  in the socket shield group and  $11.25 \pm 0.97$  in the sticky bone group, with statistical significant difference between them ( $P=0.0094$ ) Table (1).

### III- Implant Stability Quotient: (ISQ)

Immediately after implant insertion, the mean value of implant stability quotient (ISQ) was  $59.13 \pm 5.16$  in the socket shield group and  $58.63 \pm 6.04$  in the sticky bone group. The mean value of ISQ at 6

months was  $82.76 \pm 1.92$  in the socket shield group and  $80.76 \pm 3.46$  in the sticky bone group. The difference between the two groups was statistically insignificant. ( $P= 0.87$  in primary stability)( $p=0.20$  after six months) Table (1).

## II. Radiographic evaluation:

All patients had been examined radiographically using Cone beam computed tomography (CBCT) it was done to evaluate horizontal and vertical dimensional changes to the labial bone following maxillary anterior single immediate implant placement.

### 1. Vertical bone loss:

In the socket shield group the mean vertical bone loss after 6 months was  $.28 \pm 0.13$  mm, while in the sticky bone group the mean vertical bone loss after 6 months was  $.46 \pm 0.19$  mm. with statistical significance differences between them ( $P=0.039$ ) Table (1).

### 2. Horizontal bone loss;

In the socket shield group the mean horizontal bone loss after 6 months was  $0.17 \pm .099$  mm, while in the sticky bone group the mean horizontal bone loss after 6 months was  $0.25 \pm 0.13$  mm. with statistical no significance differences between them ( $P= 0.16$ ) Table (1).

TABLE (1): Results for PES, ISQ, and vertical and horizontal bone loss in the studied groups at different time intervals.

| A. Pink aesthetic score :( PES)     |                  |                  |         |
|-------------------------------------|------------------|------------------|---------|
|                                     | Group 1          | Group 2          | P value |
| Median                              | 13               | 11               |         |
| Mean $\pm$ SD                       | $12.88 \pm 1.05$ | $11.25 \pm 0.97$ | 0.0094* |
| B. Implant Stability Quotient (ISQ) |                  |                  |         |
|                                     | Group 1          | Group 2          | P value |
| Immediate                           |                  |                  |         |
| Mean $\pm$ SD                       | $59.13 \pm 5.16$ | $58.63 \pm 6.04$ | 0.87    |
| 6 months                            |                  |                  |         |
| Mean $\pm$ SD                       | $82.75 \pm 1.92$ | $80.75 \pm 3.46$ | 0.202   |
| P value                             | 0.00000*         | 0.000001*        |         |
| C. Bone loss:                       |                  |                  |         |
|                                     | Group 1          | Group 2          | P value |
| 1. Vertical bone loss:              |                  |                  |         |
| Median                              | 0.26             | 0.49             |         |
| Mean $\pm$ SD                       | $0.28 \pm 0.13$  | $0.46 \pm 0.19$  | 0.039*  |
| 2. Horizontal bone loss:            |                  |                  |         |
| Median                              | 0.17             | 0.24             |         |
| Mean $\pm$ SD                       | $0.17 \pm .099$  | $0.25 \pm 0.13$  | 0.16    |

\*Significant at  $P \leq 0.05$ .

## DISCUSSION

Immediate implant placement is a well-recognized and successful treatment option following tooth removal<sup>(13)</sup>. Although the success rates for both immediate and delayed implant techniques are comparable, the literature reports that there would be loss of the buccal / facial ridge contour of at least 1 mm following immediate implant placement, this loss would possibly worsen in case of thin gingival biotypes. This deformity and ridge collapse can pose an aesthetic disaster in areas such as the anterior maxilla<sup>(14)</sup>. Hürzeler<sup>(8)</sup> introduced a new approach for immediate implant by leaving buccal root fragment in adjacent to the buccal crestal bone. Placing an immediate implant engaged to the palatal socket wall to maintain the contour of the ridge. The implant can achieve osseointegration without any inflammations at peri-implant tissues. This technique preserved the buccal bone plate and tissue between the shield and implant healed with cementum formation.

The clinical outcome demonstrated the socket shield technique prevented a noticeable alteration of ridge shape after tooth extraction. This technique has advantages of minimally invasive, preserved tissue contour and no need of bone substitute materials. However, it is a sensitive technique in nature<sup>(9)</sup>. Because of its technique sensitivity, the “socket-shield technique” can still not be generally recommended for clinicians in daily practice. One has to keep in mind that this technique is still in development. It is requiring to prepare the root to the form of a shield and to place an implant in the aesthetic zone flapless; the implant shoulder has to be placed perfectly in the three dimensional view.

The present study was performed to evaluate immediate implant placement with socket-shield technique versus using bone graft filling the jumping gap in the form of sticky bone in maxillary aesthetic zone.

Implant placement was done in the present study with flapless to avoid tissue reflection, that compromising the blood supply to the labial bone plate and to avoid increasing bone resorption, as described by Buser et al<sup>(15)</sup>.

Clinical and radiographic evaluation were done to evaluate success of implants. Clinically, pain was assessed in order to differentiate between socket shield technique and immediate implant placement sticky bone in jumping gap. In addition, resonance frequency analysis was done to determine implant stability. CBCT was used to assess bone loss and its density. Pink esthetic score used to compare esthetic outcomes between the two groups of our study. These parameter were used in the present study to evaluate and assess the dental implants in our study. Barakat et al.<sup>(16)</sup>, compared the immediate implant with and without socket shield technique in twenty patient and reported that all patient either study or control groups complained of mild to moderate pain which disappeared completely after 2<sup>nd</sup> and 3<sup>rd</sup> days.

In the present study, the pain was evaluated with VAS which increased in study group more than in control group. This pain may be due to the use of excess surgical maneuver and tooth cutting in shield technique. The PES results of the socket shield group agree with the PES reported by Baumer et al, where he reported a mean PES of 12<sup>(17)</sup>. Abdel-rahman et al<sup>(9)</sup>, reported that the mean value of PES was 12.6±1.19 immediately and decreased to 8.85±1.81 after 6 months for socket shield group, while it was 11.45±1.54 immediately and increased to 12±1.12 after 6 months for conventional immediate implant group. The decrease in the control group compared to the increase in the study group can be attributed to increased horizontal and vertical bone loss in the control group compared to the study group, which leads to reduced labial contour and incomplete papilla in some cases of the control group. In our study the mean value of PES was 12.88±1.05 for socket shield group and 11.25±0.97 for sticky

bone group. All implants in the present study were successful with primary and secondary stability assessed with resonance frequency analysis. The primary implant stability was  $59.13 \pm 5.16$  ISQ in the socket shield group and  $58.63 \pm 6.04$  in the sticky bone group. ISQ in the socket shield group and sticky bone group was increased to  $82.75 \pm 1.92$  and  $80.75 \pm 3.46$  respectively after 6 months. In Degidi's et al study<sup>(18)</sup>, all the implants were with an initial stability (ISQ) below 46 ISQ failed, while in those with ISQ over 60, osseointegration was successful. In the current study, cone-beam computed tomography was used to determine the bone loss in vertical and horizontal directions, immediately and 6 months post implant insertion.

Regarding the mean of horizontal and vertical bone loss in comparison between the socket shield technique and conventional technique the results shows significant statistical difference between two technique with more bone loss in conventional technique rather than socket shield techniques that's what was obvious in the work of Barakat et al , Abdel-Raheem et al and Abdelrahman et al<sup>(9,16,19)</sup>. In this study, vertical bone loss showed statistically significant difference between socket shield group and sticky bone group with increasing in bone loss in sticky bone group rather than socket shield group. But horizontal bone loss showed no statistically significant difference between the two groups.

## CONCLUSIONS

Therefore, it can be concluded that, Socket shield represents a promising technique to preserve the extraction site associated with implant placement, leading to the ultimate esthetic outcome imitating the natural emergence profile and preserving the soft and hard tissue. Both Socket shield technique and using sticky bone preserved labial bone thickness and height with superiority of socket shield in preservation of its height.

## REFERENCES

1. Araujo M, Lindhe J. Dimensional ridge alterations following tooth extraction. An experimental study in the dog. *J Clin Periodontol* 2005; 32:212-8.
2. Chappuis V, Engel O, Reyes M, Shahim K, Nolte L, Buser D. Ridge alterations post extraction in the esthetic zone: a 3D analysis with CBCT. *J Dent Res* 2013; 92:195-201.
3. Tonetti M, Cortellini P, Graziani F, Lang N, Abundo R, Conforti G et al. Immediate versus delayed implant placement after anterior single tooth extraction: the timing randomized controlled clinical trial. *J Clin Periodontol*
4. Bäumer D, Zuhr O, Rebele S, Schneider D, Schupbach P, Hürzeler M. The socket-shield technique: first histological, clinical, and volumetrical observations after separation of the buccal tooth segment – a pilot study. *Clin Implant Dent Relat Res* 2015; 17:71–82.
5. Guirado J, Troiano M, Lopez P, Fernandez M, de Val J, Marin J et al. Different configuration of socket-shield technique in peri-implant bone preservation: an experimental study in dog mandible. 2016; 208: 109–15.
6. Passoni B, Marques D, Araújo M, Araujo C, Piatelli A, Benfatti C. Influence of immediate/delayed implant placement and implant platform on the peri-implant bone formation. *Clin Oral Implants Res* 2016; 5:1–8.
7. Hämmerle C, Araújo M, Simion M. Evidence based knowledge on the biology and treatment of extraction sockets. *Clin Oral Implants Res* 2012; 23:80–2.
8. Hürzeler M, Zuhr O, Schupbach P, Rebele S, Emmanouilidis N, Fickl S. The socket shield technique: a proof-of-principle report. *J Clin Periodontol* 2010; 37:855–62.
9. Abd-Elrahman A, Shaheen M, Niveen A, Atef M. socket shield technique vs. conventional immediate implant placement with immediate temporization. Randomized clinical trial. *Clin Implant Dent Relat Res*. 2020; 22:602–611.
10. Tarnow D, Chu S, Salama M, Stappert C, Salama H, Garber D et al . Flapless Post extraction Socket Implant Placement in the Esthetic Zone: Part 1. The Effect of Bone Grafting and /or Provisional Restoration on Facial-Palatal Ridge Dimensional Change - a retrospective Cohort Study. *Int J Periodontics Restorative Dent* 2014; 34: 322-31.
11. Sohn D, Huang B, Kim J, Park W, Park C. Utilization of Autologous Concentrated Growth Factors (CGF) Enriched Bone Graft Matrix (Sticky Bone) and CGF-Enriched Fibrin Membrane in Implant Dentistry. *JACD* 2015; 7:11-29.
12. Furhauser R, Florescu D, Benesch T, Haas R, Mailath G, Watzek G. Evaluation of soft tissue around single-tooth

- implant crowns: the pink esthetic score. *Clin Oral Impl Res* 2005; 16:639-44.
13. Buser D, Martin W, Belser U. Optimizing esthetics for implant restorations in the anterior maxilla: anatomic and surgical considerations. *Int J Oral Maxillofac Implants* 2004; 19:43-61.
  14. Chen S, Buser D. Esthetic outcomes following immediate and early implant placement in the anterior maxilla--a systematic review. *Int J Oral Maxillofac Implants* 2014; 29:186-215.
  15. Buser D, Chappuis V, Belser U, Chen S. Implant placement post extraction in esthetic single tooth sites: when immediate, when early, when late? *Periodontol* 2000 2017; 73:84-102.
  16. Barakat D, Hassan R, Eldibany M. Evaluation of the socket shield technique for immediate implantation. *Alex Dent J*. 2017; 42: 155-161.
  17. Baumer D, Zuhr O, Rebele S, Hurzeler M. Socket Shield Technique for immediate implant placement--clinical, radiographic and volumetric data after 5 years. *Clin Oral Implants Res* 2017; 28:1450-8.
  18. Degidi M, Daprile G, Piattelli A. Determination of primary stability: A comparison of the surgeon's perception and objective measurements. *Int J Oral Maxillofac Imp* 2010; 25:558-61.
  19. Abdel-raheim A, Al-fakharany A. Evaluation of immediate implant with socket shield technique in aesthetic zone. *Al-Azhar Journal of Dental Science* 2019; 22:123-9.