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EVALUATION OF IMMEDIATE IMPLANT INSERTION IN THE ESTHETIC ZONE USING SOCKET SHIELD TECHNIQUE. A CLINICAL COMPARATIVE STUDY

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Abstract

Aim: The objective of the present study was to evaluate the efficacy of the socket shield technique for immediate implantation at the esthetic zone, through comparison to the traditional conventional immediate implant technique. **Patients and Methods:** The study was conducted on 20 immediate implant placement sites in the anterior maxillary region. In the study group, 10 implants were inserted using socket shield technique, while in the control group, 10 implants were inserted using the conventional immediate placement technique. Immediate postoperative and six months postoperative CBCT were obtained for all the cases, to assess bone density around the inserted implants as well as horizontal and vertical bone loss, Implant stability quotients (ISQs) was measured immediately and six months post-operatively with one and three-month intervals. **Results:** Implant stability recorded a higher mean value in the study group in comparison to the control group, with a statistically significant difference between both groups (p=0.001). Assessment of bone density around the implants after six months of insertion showed a higher mean value in the study group compared to in the control group with statistically significant difference (p=0.003). Regarding horizontal bone gap, a higher mean value (0.64±0.14 mm) was recorded in the control group in comparison to 0.52±0.18 in the study group, with no statistically significant difference between both groups (p=0.199). Vertical bone loss immediately postoperatively, there was no significant difference between the two groups (P=0.783). At 6 months, a higher mean value (13.54±1.36 mm) was recorded in the study group compared to (13.08±0.54) the control group, with no statistically significant difference between both groups (p=0.424) **Conclusion:** It has been concluded that the Socket shield technique, eliminates the negative consequences of bone resorption of the buccal plate of bone; leading to maintaining hard and soft tissue contours providing perfect esthetic results and good function.

Keywords: Esthetic Zone, Immediate Implants, Socket Shield.

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INTRODUCTION

One of the most effective ways to replace a missing tooth is to insert a single-tooth implant in the esthetic zone. The implant crown, as well as healthy and stable peri-implant tissues greatly influence the aesthetic outcome. [1],[2],[3] As a matter of fact, it is essential to conserve intact bone anatomy and the overlying soft tissue architecture.[4] Immediately after extraction, bone remodeling starts and may last up to 2 years. In the anterior maxillary region, resorption occurs more readily in the buccal plate of bone rather than the palatal one, due to its thickness. [5] The size of the alveolar ridge changes as a result of socket remodeling following tooth loss. Loss of ridge volume and shape might occur depending on the degree of alteration. [6],[7]

Several approaches have been described in order to preserve thin buccal cortical plate and socket alterations caused by tooth extraction. These include immediate implant placement after extraction protocol, palatal approach technique, preserving the buccal wall contact, performing the surgery using the flapless technique to maintain vascularization, and socket augmentation utilizing soft tissue or bone grafts to preserve the dimension of the ridge.[7],[8],[9]

While some of these methods may aid in overcoming the problems caused by the resorption of the buccal wall and the contraction of the soft tissues above it, enabling successful aesthetic rehabilitation in the anterior areas, none of them can totally solve the issue, which is directly linked to and caused by the tooth extraction.[10],[11]

Socket shield technique (SST) has been developed to minimize the adverse effects of buccal bone plate resorption following tooth extraction and provide ideal aesthetic results when post-extraction implants are placed in aesthetic zone. The aim of the present study was to evaluate the efficacy of the socket shield technique for immediate implantation at the esthetic zone through comparison to the conventional immediate implant technique.[12]

PATIENTS AND METHODS

After approval of the ethical committee and obtaining an informed consent, the study was conducted on 20 implant sites presented in patients presented with remaining roots related to maxillary anterior teeth. They were seeking extraction of the root and immediate implant placement to restore esthetics and function. The implants were divided randomly using a research randomizer software (http://www.randomizer.org/) into two equal groups; Group I (study group)-Composed of 10 implants inserted using the socket shield technique and Group II (control group)-Composed of 10 implants inserted using conventional immediate technique.

In the study group, a full-thickness pyramidal flap composed of a gingival incision and one oblique incision was done followed by decoronation of the tooth to the gingival level. Finally, cutting through the root with the canal as a reference point was done in mesiodistal direction to the full working length till the root was entirely separated into two

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parts. Initial preparation of the implant bed was done with a pilot drill of 2 mm. and a tapered self-threading implant was inserted immediately to the bone palatal to the root.

In the control group, atraumatic extraction was performed to the un-restorable tooth or remaining root using microperiotome, and upper anterior forceps. All remnants of infection within the socket apex were to be thoroughly curetted out, followed by copious saline irrigation. Implant bed preparation was conducted using conventional sequential osteotomy and manual implant insertion.

A smart peg was inserted to the implant to measure the primary stability using osstell. Finally, the smart pig was removed, and the implant was covered by a healing collar to facilitate readings at one, three- and six-month post-operative follow-up periods.

Cone beam computed tomography (CBCT) was obtained, for all the cases, immediately post-operative and after six months for measurement of horizontal and vertical bone loss, and for assessment of bone density. After six months, the abutment was screwed with the implant, and the final crown was constructed and cemented.

RESULTS

Horizontal Gap: Immediately postoperatively, there was no significant difference between groups (P=0.399). At 6 months, a higher mean value (0.64±0.14 mm) was recorded in Group II (control group) in comparison to 0.52±0.18 in Group I (study group), however with no statistically significant difference between both groups (p=0.199).

In the interval from immediately post-operatively to 6 months, group I (study group) recorded a greater percent decrease [median= -13.04%, range -30% to -5.13%], while Group II (control group) recorded a median percent decrease= -5.55%, ranging from (-10 % to – 3.7%), this difference between groups was statistically significant (p=0.013), (Table1)

Table 1: Descriptive Statistics of CBCT -Horizontal Gap and Comparison between groups regarding Horizontal Gap (independent t-test) and % Change in the Horizontal gap (Mann Whitney U test)

Time	Groups	Mean	Std. Dev	95% Confidence Interval for Mean		Min	Max	t	P
				Lower Bound	Upper Bound				
Immediate	Group I (Study group)	.61	.17	.46	.77	.46	.91	-.88	.399 ns
	Group II (control group)	.69	.15	.55	.82	.49	.90		
6 month	Group I (Study group)	.52	.18	.36	.69	.35	.82	-1.36	.199 ns
	Group II (control group)	.64	.14	.51	.77	.47	.85		

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Percent change		Median	Min	Max	P-value
	Group I	-13.04	-30.00	-5.13	0.013*
	Group II	-5.55	-10.00	-3.70	

Vertical bone loss

Immediately postoperatively, there was no significant difference between groups (P=0.783). At 6 months, a higher mean value (13.54±1.36 mm) was recorded in Group I (study group) in comparison to (13.08±0.54) in Group II (control group), with no statistically significant difference between both groups (p=0.424).

In the interval from immediately post-operatively to 6 months, group I (study group) recorded a percent increase [median= 0.704%, range -1.23% to 4.24%], while Group II (control group) recorded a median percent decrease= -8.61%, ranging from (-8.61 % to – 1.37%). The difference between groups was statistically significant (p=0.002), (Table 2).

Table 2: Descriptive Statistics of CBCT - Vertical bone loss and comparison between groups regarding Vertical bone loss (independent t-test) and % Change in Vertical bone loss (Mann Whitney U test). Significance level p≤ 0.05

Time	Groups	Mean	Std. Dev	95% Confidence Interval for Mean		Min	Max	t	P
				Lower Bound	Upper Bound				
Immediate	Group I (Study group)	13.44	1.52	12.04	14.85	11.80	16.30	-.29	.783 ns
	Group II (control group)	13.61	.38	13.26	13.97	13.10	14.31		
6 month	Group I (Study group)	13.54	1.36	12.29	14.80	12.30	16.10	.84	.424 ns
	Group II (control group)	13.08	.54	12.58	13.58	12.42	13.91		
Percent change		Median				Min	Max	P-value	
	Group I	0.704				-1.23	4.24	0.002*	
	Group II	-3.63				-8.61	-1.37		

Bone density

Assessment of bone density around the implants after six months of insertion showed a higher mean value in the study group (2823±603.31) compared to in the control group (2120±377.91), the difference between the two groups was statistically significant (p=0.003). Table (3)

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Table 3: Descriptive statistics of CBCT - Bone density and comparison between groups regarding Bone density (independent t-test) and % Change in Bone density (Mann Whitney U test)

Time	Groups	Mean	Std. Dev	95% Confidence Interval for Mean		Min	Max	t	P
				Lower Bound	Upper Bound				
Immediate	Group I (Study group)	2116.14	548.07	1609.26	2623.03	1396.00	2862.00	1.44	.175 ns
	Group II (control group)	1708.29	509.69	1236.90	2179.67	1323.00	2780.00		
6 M	Group I (Study group)	2823.00	603.31	2265.03	3380.97	1980.00	3582.00	2.61	.026 *
	Group II (control group)	2120.00	377.91	1770.49	2469.51	1733.00	2831.00		
Percent change		Median				Min	Max	P-value	
	Group I	36.1				25.16	41.83	0.482^{ns}	
	Group II	30.02				1.83	49.29		

Implant Stability

Immediately postoperatively, there was no significant difference between groups (P=0.477). At one month, a higher mean value (62.57±4.79 ISQ) was recorded in Group I (study group), in comparison to 59.57±3.82 in Group II (control group), with no statistically significant difference between both groups (p=0.221).

At 3 months, a higher mean value (68±3.16 ISQ) was recorded in Group I (study group) in comparison to 61±3.79 in Group II (control group), with a statistically significant difference between both groups (p=0.003).

At 6 months, a higher mean value (71.14±2.97 ISQ) was recorded in Group I (study group) in comparison to 63.71±3.5 in Group II (control group), with a statistically significant difference between both groups (p=0.001), (Table 4).

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Table 4: Descriptive Statistics of Ostell Stability (ISQ) and Comparison between Groups Regarding Ostell Stability (Independent T-Test)

Time	Groups	Mean	Std. Dev	95% Confidence Interval for Mean		Min	Max	t	P
				Lower Bound	Upper Bound				
Immediate	Group I (Study group)	57.29	8.48	49.44	65.13	46.00	67.00	.75	.477 ns
	Group II (control group)	54.71	3.35	51.61	57.81	51.00	60.00		
1 month	Group I (Study group)	62.57	4.79	58.14	67.00	55.00	69.00	1.29	.221 ns
	Group II (control group)	59.57	3.82	56.04	63.11	54.00	64.00		
3 months	Group I (Study group)	68.00	3.16	65.08	70.92	62.00	72.00	3.75	.003*
	Group II (control group)	61.00	3.79	57.50	64.50	54.00	65.00		
6 months	Group I (Study group)	71.14	2.97	68.40	73.89	67.00	75.00	4.28	.001*
	Group II (control group)	63.71	3.50	60.48	66.95	60.00	70.00		

DISCUSSION

In the present study, the horizontal bone loss in the study group recorded a median percent decrease = -13.04%, ranging from (-30% to -5.13%), while the control group recorded a median percent decrease = -5.55%, ranging from (-10 % to – 3.7%), this difference between groups was statistically significant (p=0.013). Also, the vertical bone loss recorded an insignificant increase (p= 0.267) in mean value from (13.44±1.52) immediately post-operatively; to (13.54±1.36) at 6 months in the study group. While the control group reported a statistically significant (p=0.005) decrease in mean vertical bone loss from (13.61±0.38) immediately post-operatively, to (13.08±0.54) at 6 months. These results can be explained due to the presence of the labial shield at the level of the bone crest that preserves it and prevent resorption in the study group, while in the control group the implant is placed at the crestal bone level that undergoes physiological bone resorption. These results were go along with the study by Barakat et al.[13], who reported in his study group the mean horizontal bone loss after 7 months was 0.10**±**0.03mm**,** while in the control group the mean horizontal bone loss after 7 months was 0.34**±**0.11mm. The difference in horizontal bone loss between both groups after seven months of implant placement was statistically significant. Also, It was in agreement with the study by Abd-Elrahman et al.[14] The vertical bone loss; ranged from 0.11 to 0.55 (0.31) mm and 0.25 to 1.51 (0.7) mm for the study and control groups, respectively. Also, in agreement with Barakat et al.[13], who reported the mean vertical bone loss after 7 months was 0.44 ±

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0.24 mm, while in the control group the mean vertical bone loss after 7 months was 1.61±0.78mm. The difference in vertical bone loss between both groups after seven months of implant placement was statistically significant.

The socket shield group results for both horizontal and vertical bone loss are similar to those of Chen and Pan et al.[15], in 2013, who showed 0.72 mm of buccal bone resorption. Abadzhiev et al.[16] reported 0.8 mm of bone loss in 2014. After the final restoration, Baumer et al.[17], in 2015 found a mean horizontal loss of 1 mm. According to Baumer's 2017 report, the mesial and distal portions had minimal decreases in bone loss of 0.33 and 0.17 mm, respectively. The mean horizontal and vertical bone loss using the socket shield approach was found to be 1 mm following the final restoration, which is in line with Baumer's et al.[9] 2015 findings.

The ridge contour was preserved in this study by leaving a root shell next to the buccal crestal bone and immediately inserting an implant into the palatal socket wall. Because of the physiological processes that occur right after tooth extraction and continue until the end of the first week, there is an increase in osteoclasts both inside and outside the buccal and lingual bone walls. Given the intimate relationship between the bundle bone and the periodontal tissue, the presence of osteoclasts on the inner surface of the socket walls suggested that the bundle bone was undergoing resorption. Anatomically, the buccal bone plate is thinner than the lingual or palatal bone plate. Since the bundle bone is a tissue that is dependent on teeth, it will gradually diminish following extraction. As a result, the buccal wall experienced the greatest degree of hard tissue loss since there was more bundle bone in the buccal crest than in the lingual wall. Due to the lack of osteoclastic remodeling of the coronal part of the buccal plate, these scientific data along with the empirical experience of placing implants immediately in newly extracted sockets have led to the theory that we could potentially prevent bone resorption in this crucial area by protecting the periodontal tissues on the buccal part of the socket.[17],[18]

In the present study, the study group reported a gradual statistically significant (p= 0.00) increases in mean implant stability (ISQ) from (57.29±8.48) immediately post-operatively; to (71.14±2.97) at 6 months. Also, the control group showed a statistically significant (p=0.001) gradual increase in mean implant stability from (54.71±3.35) immediately post-operatively, to (63.71±3.35) at 6 months. A higher mean value was recorded in the study group in comparison to the control group immediately, after one month, three months, and six months post-operatively. These results matched the results of Barakat et al.[13], where the primary implant stability in the study group was 60.30 ± 6.43 ISQ, which increased to be 69.80 ± 3.77 ISQ after seven months from implant placement. Also, agreed with a study made by Abd-Elrahman et al.[14], where the mean ISQ for the control group was 66.4 ± 5.64 and increased to 75.5 ± 4.4 after 6 months, while it was 68.6 ± 3.81 for the study group and increased to 76.7 ± 3.49 after 6 months.

The results of bone density in the current study revealed no significant difference immediately post-operatively, between the two groups. But, after 6 months, a higher bone density mean value (2823±603.31) was recorded in the study group compared to

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(2120±377.91) in the control group, with a statistically significant difference between both groups (p=0.026). The higher significant difference and higher bone density in the study group may be due to the presence of the root. The measurements of bone density were taken three times then the average was detected in both groups. In addition, the measurements were taken away from the shield. So further investigation is recommended for a new technique in measuring the bone density like micro CT to determine exactly does there is a difference in the bone density between the two techniques or not. A more accurate technique is needed for accurate measurement of the bone density in the small area on CBCT. There was a positive correlation between ISQ units and bone density in the current study. That was in agreement with many researches that documented a positive correlation between the height of the crestal cortical bone and ISQ values. Over time, the resonance frequency rises due to increased stiffness from bone remodeling and new bone production.[19],[20],[21]

CONCLUSION

Socket shield technique eliminates detrimental effects of buccal bone plate resorption after tooth extraction. Preservation of a part of the root leads to maintaining both the hard and soft tissue contours and producing an excellent functional aesthetic result.

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