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Original Research Article

Comparative outcome of socket shield method and conventional immediate implant implantation with immediate temporization- a 10 years follow-up

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ABSTRACT

Background: Dental implants are now regarded as an effective treatment option for replacing missing teeth. The objective was to evaluate the socket shield approach with immediate temporization to the conventional instantaneous implant with immediate temporization utilizing the parameters of horizontal and vertical dimensional bone loss, crestal bone thickness (CBT) and pink esthetic score (PES).
Methods: This prospective study was carried out at Banasree Dental and German Dental implant surgery centers from December 2010 to December 2020 where 74 patients who had non-restorable maxillary teeth in the esthetic region were conducted and evaluated for implant settlement. The allocated individuals were divided into two groups immediate implant with socket shield group (study group, n=22) and the conventional immediate implant placement group (control group, n=52). SPSS version 21.0 was used to analyze all of the data.
Results: Mean value of crestal bone thickness (CBT) at the pre-operative time was 1.31±0.2 in both groups but at the 6 months follow-up time it was 1.2±0.22 and 1.07±0.21, at the 24 months follow-up time it was 1.13±0.24 and 0.99±0.20 and at the 60 months follow-up time in was 1.05±0.27 and 0.79±0.15 and at the 120 months follow-up time it was 1.03±0.29 and 0.69±0.17 in the study and control group respectively. In the study group, the mean value of pink esthetic score was 11.45±1.6 at 6 months follow-up time, 12±0.89 at 24 months, 12.5±0.87 at the 60 months and 12.5±0.86 at the 120 months follow-up time whereas in the control group, it was 11±1.32, 10±1.52, 8.9±1.63 and 7.5±1.55, respectively.
Conclusions: The SST group revealed minimal reduction in CBT, horizontal and vertical bone loss and a superior PES compared to conventional immediate implant.

Keywords: Bone loss, Conventional Implant, Crestal bone thickness, Pink esthetic score, Socket shield technique

INTRODUCTION

Alveolar ridge remodeling and numerous dimensional alterations are brought on by tooth extractions and the subsequent trauma to the hard tissue.[1-3] The face side of the maxilla often experiences the most vertical and horizontal erosion of the alveolar ridge afterward tooth extraction.[4] This is because of the loss of the periodontal ligament following tooth extraction, which is primary source of blood flow to the face plate.[5] To prevent bone resorptions, many writers concentrated their efforts on developing guided bone regeneration (GBR) techniques.[6] Numerous procedures have been documented in the literature to address the issue of resorption, along with immediate implant insertion, guided bone regeneration, flapless implant placement, palatially positioned implants, and platform-switched implants.[7-10] Therefore, no surgical procedure or material used today can completely stop the preimplant hard and soft tissues from experiencing dimensional changes over time.[11] To solve

this kind of issue and improve the predictability of gingival margin position, Hurzeler et al tested a novel surgical procedure first on an animal model and subsequently on people.[12] During the quick insertion of the fixture, it was intended to leave some of the root section on the buccal side. The goal is to keep the crestal bone at its natural position and a healthy periodontium. This technique is defined "socket shield technique". In a 5-year retrospective assessment of 128 socket shield instances in the esthetic region and posterior sites, Gluckman et al reported an overall survival percentage of 96.1% in 2018. The interior and external exposures of the shields were the most frequent problems.[13] Gluckman et al modified the previous socket shield technique in 2019, emphasizing the importance of dropping the height of the socket shield to the level of the bone crest in order to prevent internal shield exposure and fabricating temporary refurbishments with an "S-shaped" emergence profile to maximize soft tissue infill.[14]

Therefore, the current study's objective was to evaluate the socket shield approach with immediate temporization to the conservative instantaneous implant with immediate temporization utilizing the parameters of horizontal and vertical dimensional bone loss, crestal bone thickness (CBT) and pink esthetic score (PES).

METHODS

This prospective study was carried out at Banasree Dental and German Dental implant surgery centers from December 2010 to December 2020 where 74 patients with non-restorable maxillary teeth in the esthetic zone were conducted and evaluated for implant placement. The goal, the nature of the study, the type of intervention, the specific surgical method, and any potential problems were all explained to the patients before they signed a written consent form. This study comprised patients with non-restorable maxillary teeth in the esthetic zone who were between the ages of 21 and 60, and who had relatively intact buccal periodontal tissues as far as could be diagnosed.

Inclusion and exclusion criteria

Patients with facial bone thickness of less than 2 mm, without soft tissue anomalies, and patients who exhibit good dental hygiene were also included in this study. The study excluded patients with systemic conditions such as uncontrolled diabetes mellitus, a history of head and neck radiation therapy, heavy smokers, patients taking drugs that influence periodontal repair, and patients receiving anticoagulant therapy. Patients who had radiation therapy within the two years before the trial or who were presently receiving radiation therapy were not allowed to participate. Patients with a history of anaesthesia or drug allergies, psychiatric disorders, uncooperative patients, hepatitis B and C positivity, autoimmune diseases like rheumatoid arthritis, periodontal disease, vertical root fracture, horizontal fracture at or below the bone level, and teeth with local pathologic incidents that affect the labial part of the root as external or internal root resorption were also excluded from the study.

The allocated patients were divided into two groups Immediate Implant with socket shield group (study group, n=22) and conventional immediate implant placement group (control group, n=52). All patients had cone beam computed tomography (CBCT) scans performed in order to determine the labial bone thickness and height as well as to plot the results and choose the appropriate implant size. All procedures are carried out using socket-shielding technology and conventional immediate implantation of titanium screwed implants in post-extraction sockets.

Surgical procedure

In the study group, the gingival margin was carefully resembled, and a tiny flap was produced by light periosteal scoring. In order to prevent the bundle bone's blood supply from being cut off, the periosteum was stripped away as little as possible. To carefully dislocate and remove the crown fragment, the tooth was split horizontally supra-gingivally. Elevators and forceps were used for this procedure. Using diamond burs with a no. 14 long tapered fissure, the tooth was vertically sectioned. With elevators and forceps, the palatal side of the root piece was cautiously removed. The tooth's labial fragment was sub gingivally clipped. Osteotomy drills operating at 800-1000 RPM and 30-40 Ncm were used to prepare the osteotomy location palatal to the retained facial root fragment and used cold irrigating solution. When the osteotomy site was ready, the appropriate-sized implant was inserted in direct interaction with the labial root fragment. The little flap that had been lifted previously to coronally relocate it on the facial side was then used to stitch the labial and palatal gingival edges, ensuring that the labial sleeve of the tooth was entirely protected before a periodontal pack was applied.

In the control group, to preserve the remaining alveolar bone, an atraumatic extraction was carried out using periotome and forceps. The socket was then carefully cleaned after the tooth was removed using curettes and irrigated with physiological saline solution. The implant and labial plate were separated by about 2 mm as a result of the osteotomy's palatal direction. The implant was positioned above the crest of the bone and in some cases, bone graft also done as per requirements. The coronal tissues were then supported by an interim crown that was built chairside on a straight/angular titanium abutment.

Follow-up

To determine whether the implant was properly positioned, the amount of horizontal and vertical bone loss, and the thickness of the crestal bone, all patients underwent CBCT evaluations at the time of implant insertion as well as 6, 24, 60 and 120 months after

prosthetic loading in both immediate and late loading protocol. The PES scoring system for dental implants was used to examine the PES evaluation which Fur Hauser introduced in 2005.[15]

SPSS version 21.0, developed by SPSS Inc. in Chicago, Illinois, was used to analyze all of the data. The normality of the numerical data was examined using the Shapiro-Wilk test and the Kolmogorov-Smirnov test. To express parametric data, mean±SD was utilized. The analysis of parametric data for group comparisons was conducted using a one-way ANOVA and non-parametric data using a chi-squire (χ^2) test. P value <0.05 was set as the threshold of statistical significance.

RESULTS

This table shows the baseline characteristics of the study patients where most of the patients were aged between 31-40 years and followed by 21-30 in both groups. The mean age was 32.73±5.68 and 31.54±3.88 in the study group and control group, respectively. There was no significant difference between the groups (p value=0.997). The preoperatively mean value of crestal bone thickness (CBT) was 1.31 mm and the pink esthetic score (PES) was 13.0 in both groups and there was no significant difference. Most (63.6%) of the patients were implanted with a 4.0 mm diameter and trauma was the most (72.7%) common reason for extraction.

Table 1: Baseline characteristics of the study patients.

Age	Study group (n=22)	Control group (n=54)	P value
21-30	9	24	
31-40	10	25	
41-50	2	3	
51-60	1	1	
Mean (SD)	32.73±5.68	31.54±3.88	0.997
CBT (mean ±SD) mm	1.31±0.2	1.31±0.2	1.00
PES score (mean±SD)	13.0±1.0	13.0±1.0	1.00
Implant diameter (mm)			
3.5 n (%)	8 (36.4)	19 (36.5)	1.00
4.0 n (%)	14 (63.6)	33 (63.5)	
Reasons for extraction			
Trauma, n (%)	16 (72.7)	38 (73.1)	1.00
Decay/pulp lesions, n (%)	6 (27.3)	14 (26.9)	

In the sex distribution of the study patients, 12 (55%) patients were female and 10 (45%) were male in the study group whereas, in the control group, 28 (54%) were female and 24 (46%) were male, and there was no significant difference between the group.

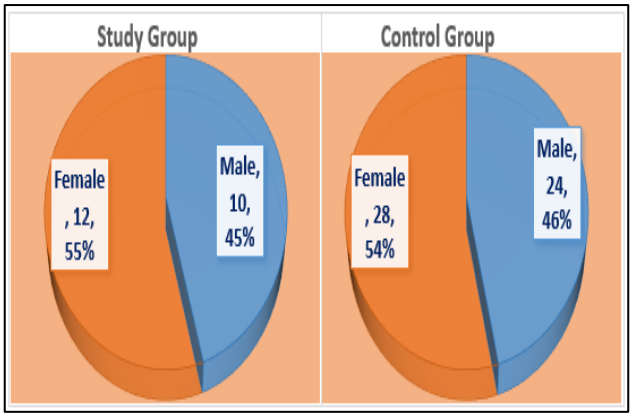

Figure 1: Sex distribution of the study patients.

Table 2: Comparison of crestal bone thickness between the two groups at different time points.

Crestal bone thickness (CBT)	Study group (n=22)	Control group (n=54)	P value
Pre-operative	1.31±0.2	1.31±0.2	1.00
6 months (mean±SD)	1.2±0.22	1.07±0.21	0.019
24 months (mean±SD)	1.13±0.24	0.99±0.20	0.016
60 months (mean±SD)	1.05±0.27	0.79±0.15	<0.0001
120 months (mean±SD)	1.03±0.29	0.69±0.17	<0.0001

The mean value of crestal bone thickness (CBT) at the pre-operative time was 1.31±0.2 in both groups but at the 6 months follow-up time, it was 1.2±0.22 and 1.07±0.21, at the 24 months follow-up time it was 1.13±0.24 and 0.99±0.20, at the 60 months follow-up time it was 1.05±0.27 and 0.79±0.15 and at the 120 months follow-up time it was 1.03±0.29 and 0.69±0.17 in the study and control group respectively. At the 60- and 120-months follow-up time, there was a highly significant difference (p value <0.0001) between the two groups.

Table 2 revealed the difference in crestal bone thickness between the two groups at the various period of follow-up time whereas the difference was increasing along with the increasing follow-up time. Crestal bone thickness was reduced more rapidly in the control group than in the study group.

Table 3 explained the bone loss between the two groups where at the 6 months follow-up time the mean value of the horizontal bone loss was 0.11±0.06 and 0.24±0.14 and the mean value of the vertical bone loss was 0.3±0.13 and 0.69±0.29 in the study group and control group, respectively. At the 24-month follow-up period the horizontal and vertical bone loss was 0.18±0.07 and 0.48±0.14 in the study group and 0.32±0.24 and 1.01±0.17 in the control group, At the 60 months follow-up time it was 0.26±0.09 and 0.62±0.15 in the study

group and 0.52±0.32 and 1.12±0.18 in the control group, and at the 120 months follow-up time it was 0.28±0.11 and 0.66±0.17 in the study group and 0.62±0.31 and 1.18±0.19 in the control group, respectively. The difference in the mean value of the bone loss was significant between the two groups during the follow-up period but the vertical bone loss difference was highly significant (p value <0.0001).

Table 3: Evaluation of the vertical and horizontal bone loss in the two groups at different time points.

Bone loss	Study group (n=22)	Control group (n=54)	P value
6 months			
Horizontal bone loss (mean±SD)	0.11±0.06	0.24±0.14	0.0001
Vertical bone loss (mean±SD)	0.3±0.13	0.69±0.29	<0.0001
24 months			
Horizontal bone loss (mean±SD)	0.18±0.07	0.32±0.24	0.03
Vertical bone loss (mean±SD)	0.48±0.14	1.01±0.17	<0.0001
60 months			
Horizontal bone loss (mean±SD)	0.26±0.09	0.52±0.32	0.00011
Vertical bone loss (mean±SD)	0.62±0.15	1.12±0.18	<0.0001
120 months			
Horizontal bone loss (mean±SD)	0.28±0.11	0.62±0.31	0.0001
Vertical bone loss (mean±SD)	0.66±0.17	1.18±0.19	<0.0001

Table 4: Evaluation of pink esthetic score in the two groups at different time points.

Pink esthetic score	Study group (n=22)	Control group (n=54)	P value
6 months (mean±SD)	11.45±1.6	11±1.32	0.21
24 months (mean±SD)	12±0.89	10±1.52	<0.0001
60 months (mean±SD)	12.5±0.87	8.9±1.63	<0.0001
120 months (mean±SD)	12.5±0.86	7.5±1.55	<0.0001

In the study group, the mean value of pink esthetic score was 11.45±1.6 at 6 months follow-up time, 12±0.89 at 24 months, 12.5±0.87 at the 60 months and 12.5±0.86 at the 120 months follow-up time whereas in the control group, it was 11±1.32, 10±1.52, 8.9±1.63 and 7.5±1.55, respectively. There was a significant difference at 24 months 60- and 120-months follow-up time (p value <0.0001).

DISCUSSION

The socket shield approach, also known as the root retention therapy by Hurzeler et al was initially used in the field of implants.[12] This study compares the immediate implant placement with the socket shield method to the conventional immediate implant placement method. In this study, we found that the mean age was 32.73±5.68 and 31.54±3.88 in the study group and control group, respectively. The preoperatively mean value of crestal bone thickness (CBT) was 1.31 mm and the pink esthetic score (PES) was 13.0 in both groups. That result is similar to Abd-Elrahman et al where the mean age was 30.9±5.5 in both groups and also similar to Santhanakrishnan et al where the mean age was 30.6±6.3 and 29.8±9.7, CBT was 1.3±0.1 and 1.3±0.1, PES was 13.0 (2.0) and 13.0 (2.0) in SST group and IIP group, respectively.[16,17] According to Sun et al study, 66.7% of patients were implanted with a 4.00 diameter in both groups and 86.7% of patients had trauma-related extraction which is similar to our study where 63.6% of patients were implanted with a 4.0 mm diameter and trauma was most (72.7%) common reason for extraction.[18] The socket shield technique (SST) creates a novel treatment by completely retaining the alveolar ridge, which aids in maintaining pink aesthetics.[19] In a randomized control clinical trial investigation, Bharakat et al compared the insertion of an instantaneous implant with SST to that of a traditional implant. In contrast to conventional implantation, the results demonstrated that there was a minimal bone loss in the horizontal and vertical directions in the SST group.[20]

Changes in crestal bone thickness (CBT) were chosen as the key factor because they have a negative impact on the health of the soft and hard tissues surrounding the implant. In this study, CBT was assessed six months, twenty-four months, and sixty months after the implant installation. The statistical differences in the CBT changes between the groups were quite significant. At the pre-operative time mean value of CBT was 1.31 (0.2) in both groups but at the 6 months follow-up time was 1.2±0.22 and 1.07±0.21, at the 24 months follow-up time it was 1.13±0.24 and 0.99±0.20 and at the 60 months follow-up time in was 1.05±0.27 and 0.79±0.15 in the study and control group, respectively. In a study by Gupta et al. the average crestal bone thickness (CBT) in the front maxilla was discovered to be 0.82 mm.[21] Before implant insertion, Cho et al discovered a thickness of 1.91±0.45 mm.[22] According to research by Abadzhiev et al, socket-shield patients saw a mean loss of 0.8 millimeters in just two years, compared to a mean loss of 5 millimeters in just two years for the immediate implant group.[23] In their investigation, Baumer et al discovered a mean loss of 0.88 mm in the labial direction, and their histologic analysis revealed no osteoclastic alterations at the crest.[24] In research conducted by Engelke et al following atraumatic internal root fragmentation in 15 patients, postoperative measurements showed that the mean crestal thickness was 1.11 mm preoperatively and

the mean labial bone thickness was 1.40 mm immediately after surgery.[25] The SST group's modest modifications could be linked to the periodontal ligament's crisscross layout, which improved root socket maintenance and prevented buccal wall collapse by maintaining vascularity and the periodontal ligament.

In this study, at the 6 months follow-up time, the mean value of the horizontal bone loss was 0.11±0.06 and 0.24±0.14 and the mean value of the vertical bone loss was 0.3±0.13 and 0.69±0.29 in the study group and control group, respectively. At the 24-month follow-up period the horizontal and vertical bone loss was 0.18±0.07 and 0.48±0.14 in the study group and 0.32±0.24 and 1.01±0.17 in the control group, At the 60 months follow-up time it was 0.26±0.09 and 0.62±0.15 in the study group and 0.52±0.32 and 1.12±0.18 in the control group, respectively. This demonstrates unmistakably how the socket shield and traditional rapid implant placement vary in terms of tissue stability. The socket shield group's results for both horizontal and vertical bone loss are comparable to those published by Chen and Pan, who noted 0.72 mm of buccal bone resorption.[26] In 2014, Abadzhiev et al reported a 0.8 mm bone loss.[23] After the final repair, Baumer et al observed a mean horizontal loss of 1 mm.[27] According to Baumer et al, the marginal increases in bone loss at the mesial and distal aspects were 0.33 and 0.17 mm, respectively.[24] Barakat et al in 2017 reported that the mean horizontal bone loss was 0.10±0.03 mm and the mean vertical bone loss was 0.44±0.24 mm after 7 months.[20]

The PES is a good tool for accurately assessing the soft tissue around single-tooth implant crowns. In the study group, the mean value of pink esthetic score was 11.45±1.6 at 6 months' follow-up time, 12±0.89 at 24 months and 12.5±0.87 at the 60 months follow-up time whereas in the control group, it was 11±1.32, 10±1.52 and 8.9±1.63, respectively. The PES outcomes from the socket shield group are consistent with the PES reported by Baumer et al, who stated a mean PES of 12.[24]

The PES difference between the study group and the control group can be related to the control group experiencing greater horizontal and vertical bone loss than the study group.

CONCLUSION

The SST group revealed a minimal reduction in CBT, horizontal and vertical bone loss and a superior PES compared to conventional immediate implant. In comparison to the traditional instantaneous implant approach, the socket shield technique is safer and yields better esthetic results. However, it is a sensitive procedure, that needs practice to be executed properly. It is necessary to do further in-depth research with larger samples to determine the effectiveness of both approaches.

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