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EVALUATION OF IMMEDIATE LOADED IMPLANTS PLACED USING THE SOCKET SHIELD TECHNIQUE IN THE ESTHETIC ZONE (A RANDOMIZED CONTROLLED CLINICAL TRIAL)

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ABSTRACT

INTRODUCTION: Once teeth are extracted, the alveolar bone with the labial bone plate reduction occurs as a consequence of the absence of blood flow. The socket-shield technique (SST) was introduced to end these consequences.
OBJECTIVES: Our goal was to compare between the conventional approach and the SST perspectives; clinical and radiographical.
MATERIALS AND METHODS: 20 individuals were parted into 2 groups; the study group: The (SST) with immediate loading was applied 10 implants in the anterior maxilla. The control group: 10 implants were instantly placed using immediate implant placement (IIP) along with the immediate loading. For both groups, CBCT-scans were pre-operatively evaluated and 6 months period for evaluating the dimensional changes within the labial bone plates including both the vertical and horizontal bone loss (VBL, HBL), measuring of clinical attachment loss (CAL), the dental implant stability quotients (DISQs) and the pink esthetic scores (PES),
RESULTS: The mean Dental Implant Stability (DISQ) was 77.92+2.44 and 75.14+2.34 in control and study groups respectively 6 months postoperatively, the average HBL bone level 6 months postoperative in Group 1 was 6.88+0.97mm, and in Group 2 was 6.74+0.93mm. While mean VBL level after 6 months of follow up in Groups 1 and 2 was 0.93+0.57mm, and 1.55+0.85mm respectively. The mean PES in Group 1 was 12.10+0.57 after 6 months, while in Group 2 was 7.80+1.14. The mean CAL 6 months Post-operatively in Group 1 and Group 2 was 0.90+0.57mm and 1.50+0.85mm respectively. There was high statistically significant difference between the study and control group.
CONCLUSIONS: The technique of socket-shield was conserved the labial root part
KEYWORDS: Immediate implants, Extraction socket, immediate loading, socket shield technique.
RUNNING TITLE: Socket shield versus immediate implant

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INTRODUCTION

Many physicians have struggled to maintain or enhance tissues; both soft and hard before and after intervention. After extraction, the regression of soft tissue is believed to have significant part in this aspect. The immediate implant placement (IIP) has been related to a higher degree of resorption within surrounding tissue (1). Several approaches have been applied to keep the extraction sockets looking their best and enhance the rate of success of the loaded implants. Some of the treatments used in this respect included guided-bone regeneration, the use of membranes, papilla preservation techniques, and rapid implant implantation (2, 3).

The additional bone resorption that often occurs in the first six months after implantation is reduced by guided bone regeneration treatments combined with immediate implant insertion. Additionally, GBR can shorten the time-period needed for recovery. However, the unpredictability of the bone remodeling process is caused by the blood flow loss that is supplied through the peri-odontal ligament next to tooth extraction process (4).

The SST's principal idea was to disconnect the remaining root parts of tooth whilst still maintaining

the integrity of the labial area and its connection to the buccal bone. After the palatal sections of the root was extracted, the IIP procedure was carried out (5). With this shielding technique, the buccal section of the root's crucial peri-odontal attachment mechanism must remain undisturbed to avoid the predicted post-extraction bundle bone remodeling if buccal bone preservation is to be achieved (6).

Hurzeler and colleagues **(2010)** (7) were among the earliest researchers to present the SST. According to their findings, the SST could slow the resorption process after tooth extraction. Also, their results confirmed that after extraction, the SST would aid in the labial bone's protection.

MATERIALS & METHODS

In the current research, a sample size of twenty adult individuals (both sexes) were admitted into the outpatient clinic of the faculty of dentistry at oral and maxillo-facial surgery department, Alexandria University. The study design was a randomized-controlled clinical trial, the institute where it was conducted had the necessary ethical approval, and all of the participants gave their informed consent. Based on a prior study, the sample size was estimated. Patients were distributed into 2 groups:

The study group: Ten maxillary anterior teeth were extracted, immediate functional implants were placed via the SST, and immediately non-functional implants were loaded.

The control group: Ten maxillary anterior teeth were extracted followed by IIP using the traditional technique, and then the implants were immediately loaded.

Criteria Inclusion: Subjected patients of both sexes, between the age (20-45) years must have good oral hygiene. Also, patients should have non-restorable maxillary anterior single rooted teeth within the esthetic zone. Individuals must have buccal peri-odontal tissues which are properly intact and labial bone plates with the thickness of less than 1.5 mm. Patients should have intact root with no tooth mobility and no sub-gingival caries and labial root curvatures.

Exclusion criteria: Individuals with systemic disorders that would interfere with the normal healing process for example, unrestrained diabetes mellitus (DM), having a history of head and/or neck radio-therapy. Individuals with peri-odontal disorders, teeth vertical or horizontal root fracture at or below the bone level. Individuals with no history of bruxism/ para-functional habits. Patients that had incidents of teeth with local pathologic that may influence the root's labial part as external or internal root resorption, maxillary 1st and 2nd premolars in both lactating and/or pregnant women.

Implant System

KIS plant super-line system implants have a platform-switched implant neck, Tapered-Straight Design for stable placement, and a unique macro-thread that promotes gradual bone condensing, gentle ridge development, and minimal shear force generation. The Implant dimension was standardized in this study (4mmx13mm).

Pre-operative Phase

Pre-operative clinical exams were performed on all patients. Patient information, including name, gender, age, and past dental and medical data, was gathered. The entire tissues; oral and para-oral, were examined visually and physically on the spot. Also, Cone-beam computed tomography (CBCT) was performed on all patients in order to determine the implants' proper size for insertion.

Operative phase

Immediately before surgery, all patients were guided to mouth cleansing with mouthwashes next to the extra oral disinfection of the surgical sites and the oral hygiene instructions. All procedures used local infiltration anesthesia.

In the study group: We separated the facial root segment from the rest of the root by means of a Lindemann bur C162 (Jota, Switzerland) (length =11 mm, diameter=016 mm) and the bur' full length in a mesio-distal direction for detaching both the root's palatal and labial parts. De-coronation of the tooth was reduced by means of a diamond bur (diameter= 2.3 mm) above the gingival level by 1mm, via utilizing a high-speed hand piece under copious irrigation. Additionally, the root's palatal portion was painlessly removed by means of a peri-otome and forceps. After reducing the buccal shield to bone level, the palatal root section is removed atraumatically. Then the socket was thoroughly curetted. The implant was inserted palatally leaving 2mm gap from the buccal shield and 2-3mm apical to the socket base. With a pilot drill of 2.2mm diameter, the implant site was first marked or prepared in order to determine the depth and placement of the implant. The Lindemann first intermediate drill was then used to expand the osteotomy. The implant's diameter will determine the final drill. The next step was to create immediate provisional restorations with an S-shaped emergence profile on stock straight titanium abutments (Figure 1).

In the control group: To preserve the alveolar bone, an atraumatic extraction using peri-otomes and forceps was carried out. The socket was then gently cleaned after the tooth was removed using curettes, and irrigated with physiological saline solution. The implant location drilling was then carried out with 1000 rpm, high torque, and internal irrigation with normal saline. A pilot drill with a 2.2mm diameter was used to prepare the implant site in order to determine the depth and position the implant. Following that, the osteotomy was enlarged using Lindemann's first intermediate drill and then final drill in accordance with the implant's diameter. A ratchet and its connector were then used to thread the implant into the bone. The final phase entailed producing immediate provisional restorations using

a standard straight titanium abutment and an S-shaped emergence profile (Figure 2).

For both groups: The Osstell ISQ (Ostell Goteborg, Sweden, Jota, Switzerland) resonant frequency analysis (RFA) equipment was used to test primary stability while the smartpeg was screwed to the implant fixture. All of the temporary crowns were cleared around 1mm from occlusion, and patients were instructed to stay away from functional overloads.

Postoperative phase

Following surgery, patients were prescribed an oral antibiotic a dose of 1 g twice daily for 5 days (Amoxicillin/Clavulanic acid) among others and an oral analgesic (Ibuprofen) in doses of 400 mg 3 times a day for 5 days. The patients were instructed to consume extra-oral cold packs intermittently every 10 minutes for 2 hours on the 1st day and were advised not to brush the area for 2 weeks. The patients also adhered to strict oral hygiene procedures and routinely cleaned with mouthwash. For the 1st week, patients were examined every day then for the 1st month weekly and then 6 months period post-operatively.

Follow up phase

Clinical evaluation

Measurement of implant stability: Using a RFA instrument, the implant stability was evaluated as one of the 2ry outcomes both immediately after implant insertion and six months afterwards.

Pink esthetic score: The PES evaluation of dental implants using the PES rating system, immediately post-operatively and six months afterwards. The PES is based on seven variables: mesial papilla, distal papilla, soft-tissue level, soft tissue contour, alveolar process deficiency, soft-tissue color and texture.

Each variable was assessed with a 2-1-0 score, with 2 being the best and 0 being the poorest score. The mesial and distal papillae were evaluated for completeness, incompleteness or absence.

Clinical attachment loss measurements (8): Clinical attachment loss measurements is the amount of peri-odontal support around an implant that has been damaged, measured in mm. By employing a peri-odontal probe for measuring the distance between both the pocket's base and the implant neck margin, measurements were taken around implants.

Radiographic evaluation

Cone beam computed tomography (CBCT): CBCT scans obtained before surgery and six months afterwards helped to assess both the horizontal and vertical bone loss for all patients. For estimating the bone dimensional alterations, the sagittal images were plotted as follows:

The horizontal bone level: On the horizontal level of the bone, a line was drawn that intersected the apex of the implant and was perpendicular to the shoulder of the implant. A second line was drawn to the outer margin of the labial plate of bone to record each implant in both groups. A line was then drawn that intersected the other line on the labial plate of bone and the implant's apex.

The vertical bone level: perpendicular lines were drawn from the shoulder of the implant till the bone crest both labially and palatally. For each implant, the mean average was noticed in both groups.

The difference between preoperative and six-month postoperative horizontal bone levels served to measure horizontal bone loss.

Prosthesis phase

The pro-sthodontist completed the final prosthetic treatment (porcelain bonded to metal crown) after six months.

Statistical Analysis (9)

Data were collected, revised, coded and introduced to the Statistical Package for Social Science (IBM SPSS) version 20. The qualitative data were presented as number and percentages while quantitative data were presented as mean, standard deviations and ranges when their distribution found parametric.

RESULTS

Twenty individuals who needed to have their maxillary single-rooted teeth out had twenty implants implanted; none of these patients had any systemic diseases. The patients were between the ages of 20 and 45, with a mean age of 37 for both genders (12 females and 8 males).

Both groups used implants that were the same size: diameter of 4 mm and length of 13 mm. Four maxillary incisors, two lateral incisors, and four maxillary canines were extracted from the study group, while five maxillary incisors, two lateral incisors, and three maxillary canines were removed from the control group.

No difficulties were noted during or after the procedure on any of the patients, who all experienced surgery while under local anesthesia.

1. Measurment of implant stability by Ostell ™

The immediate mean Implant Stability in Group 1 was 67.58±2.61, while in Group 2 was 64.53±2.16. 6 months postoperatively the mean Implant Stability was 77.92±2.44 and 75.14±2.34 in Group 1 and Group 2 respectively. (Table1) (Figures 3.A, 4.A)

2. Vertical and horizontal bone level

The average HBL bone level 6 months after implant placement in Group 1 was 6.88±0.97mm, and in Group 2 was 6.74±0. 93mm.While mean VBL bone level after 6 months of follow up in Groups 1 and 2 was 0.93±0.57mm, and 1.55±0.85mm respectively. (Table1) (Figure 5)

At 6 months post-operatively, there was a considerable statistically significant improvement of the variables when the means for Implant Stability, HBL, and VBL bone level were compared at baseline and 6 months after surgery in both groups. At 6 months after surgery, there wasn't any statistically noteworthy difference between the 2

groups in terms of the acquired Implant Stability. P-value >0.05: Non significant(NS); P-value <0.05: Significant(S); P-value< 0.01: highly significant(HS) *: Paired t- test

On the other hand, there were highly statistically significant differences between group 1 and group 2 in terms of HBL and VBL from baseline to 6 months, the socket-shield group showed the least amount of bone loss. (Figure 6.A)

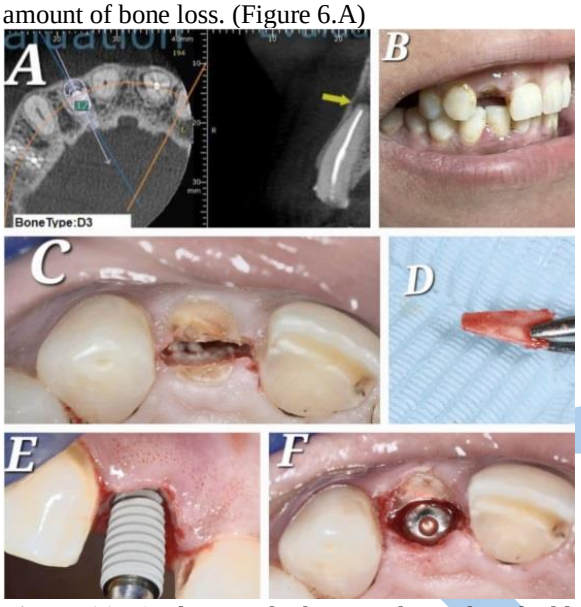

Figure (1): A photograph showing the socket shield technique procedure. **A)** CBCT showing badly destructed right maxillary lateral incisor. **B)** A photograph showing badly destructed right maxillary lateral incisor. **C)** A photograph showing hemisection of the root using Lindemann cutter C162. **D)** A photograph showing atraumatic removal of the palatal part of the root using forceps. **E)** A Photograph showing implant insertion. **F)** A photograph showing the labial root shell in contact with the implant.

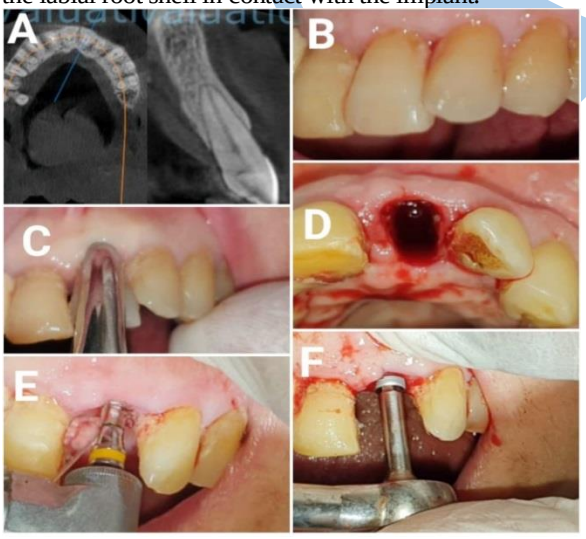

Figure (2): A photograph showing the surgical procedures of the implant placement in the control group. **A)** CBCT showing left maxillary left central incisor. **B)** A photograph showing left maxillary upper central incisor. **C)** A photograph showing atraumatic extraction of the upper left central incisor using forceps.

D) A photograph showing the socket was debrided and irrigated by physiologic saline solution. **E)** A Photograph showing drilling of the implant site with copious irrigation. **F)** A photograph showing implant insertion.

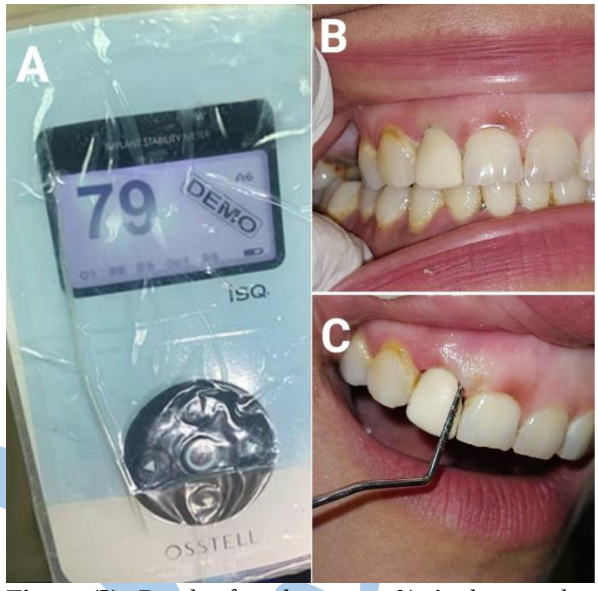

Figure (3): Result of study group. **A)** A photograph showing secondary stability measurement after six months from implant placement displayed on the portable instrument screen. **B)** A photograph showing PES six months postoperatively. **C)** A photograph showing CAL six months postoperatively.

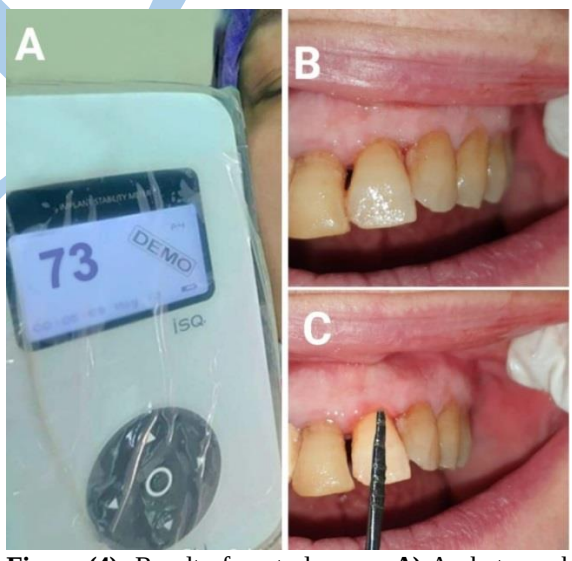

Figure (4): Result of control group. **A)** A photograph showing secondary stability measurement after six months from implant placement displayed on the portable instrument screen. **B)** A photograph showing PES six months postoperatively. **C)** A photograph showing CAL six months postoperatively.

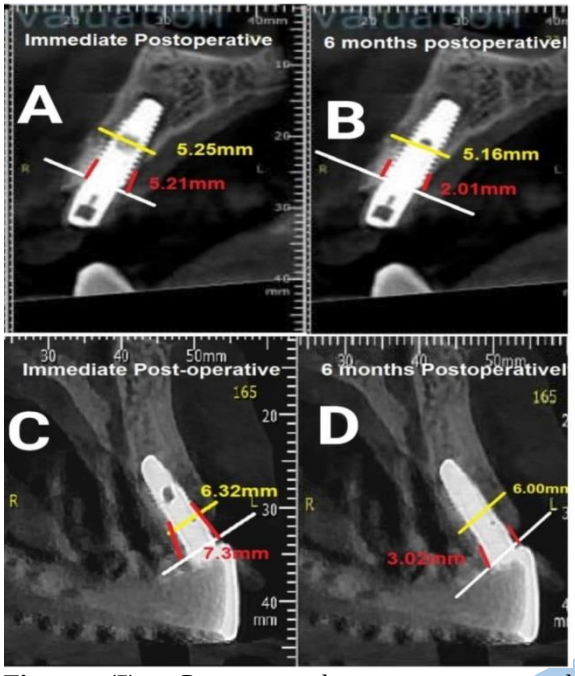

Figure (5): Cone beam computed tomographyshowing horizontal (H) and vertical (V) bone level in study and control group throughout the follow up period. **A)** H&V bone level in study group immediate postoperative. **B)** H&V bone level in study group after six months. **C)** H&V bone level in control group immediate postoperative. **D)** H&V bone level in control group after six months.

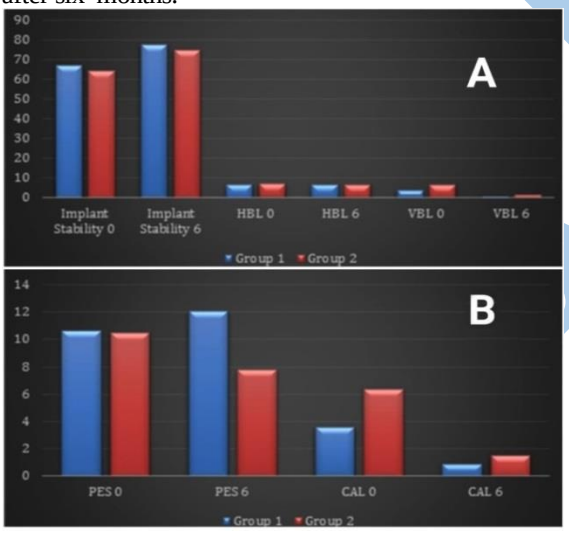

Figure (6): A) Shows the difference between (Group 1 and Group2) regarding Implant Stability immediate, Implant Stability Post 6 month, HBL bone level Immediate, HBL bone level Post 6 month, VBL bone level immediate and VBL bone level Post 6 month. **B)** Shows the difference between (Group 1 and Group2) regarding PES Pre-Operative, PES Post 6 month, CAL Pre-Operative and CAL Post 6 month.

3. Pink esthetic score

The mean PES in Group 1 was 10.70±0.95 and 12.10±0.57 pre-operatively and after 6 months respectively, while in Group 2 was 10.50±1.51 and 7.80±1.14 respectively. (Table 2) (Figures 3.B, 4.B)

4. Clinical Attachment loss

The mean CAL 6 months Post-operatively in group 1 and group 2 was (0.90±0.57 mm) and (1.50±0.85mm) respectively (Table 2) (Figure 3.C, 4.C)

Table 1: Comparison between immediate and Post 6months Regarding Implant Stability, HBL bone level and VBL bone level in Group 1 and Group 2.

Parameter	Group 1 Mean ± SD	*P**	Group 2 Mean ± SD	*P**
Implant Stability 0 6 months	67.58±2.61 77.92±2.44	<0.001 (HS)	64.53±2.16 75.14±2.34	<0.001 (HS)
HBL bone level 0 6 months	6.99±0.96 6.88±0.97	<0.001 (HS)	7.06±0.92 6.74±0.93	<0.001 (HS)
VBL bone level 0 6 months	3.75±0.94 0.93±0.57	<0.001 (HS)	6.55±1.25 1.55±0.85	<0.001 (HS)

P-value >0.05: Non significant (NS); P-value <0.05: Significant(S); P-value< 0.01: highly significant(HS)
*: Paired t- test

Table 2: Comparison between Pre-Operative and Post 6months Regarding PES and CAL in Group 1 and Group 2.

Parameter	Group 1 Mean ± SD	*P**	Group 2 Mean ± SD	*P**
PES 0 6 months	 10.70±0.95 12.10±0.57	 <0.001 (HS)	 10.50±1.51 7.80±1.14	0.11 (NS)
CAL 0 6 months	 3.60±0.97 0.90±0.57	 <0.001 (HS)	 6.40±1.17 1.50±0.85	0.18 (NS)

P-value >0.05: Non significant (NS); P-value <0.05: Significant(S); P-value< 0.01: highly significant(HS)
*: Paired t- test

Table 3: Comparison between Group 1 and Group 2 Regarding Implant PES 0-6 and CAL 0-6.

Parameter	Group 1 Mean Rank	Group 2 Mean Rank	*P•*
PES 0-6	15.50	5.50	<0.001
CAL 0-6	14.95	6.05	D

P-value >0.05: Non significant(NS); P-value <0.05: Significant(S); P-value< 0.01: highly significant(HS)
•: Independent t-test

In group 1, comparing the mean values of PES and CAL at baseline and 6 months Post-operatively showed highly statistically significant difference, while in group 2 demonstrated non-statistically

noteworthy differences between pre-operative and 6 months post-operative outcomes of PES and CAL. P-value >0.05: Non significant(NS); P-value <0.05: Significant(S); P-value< 0.01: highly significant(HS) *: Paired t- test. (Table 3) (Figure 6.B)

DISCUSSION

Typically, the alveolar ridge resorption; both horizontal and vertical, occurs after tooth extraction, particularly on the buccal side. The peri-odontal ligament is anticipated to be lost during tooth extraction because it is one of the primary routes of vascular supplying to the face plate. Furthermore, it has been shown that the face plate thickness in the front maxilla is 1-mm or less, making it more vulnerable to resorption and surgical damage in approximately 90% of patients. Additionally, the 1-mm face plate is principally consist of cortical bone and is lacking an endosseous marrow-derived vascular supply (10).

The implant restoration's emergence profile and the implant site are impacted by the facial bone resorption, which can lead to both biological and esthetically challenging issues, particularly within the maxillary-anterior region. As a consequence, all efforts were done to avoid or decrease the remodeling of physiological ridge that occur after the tooth extraction. These efforts include socket preservation methods and bone augmentation utilizing various bone materials and membranes (11).

Frequent recommendations and procedures were presented synchronously with the immediate implant placement (IIP) for preserving bony structures and soft tissues around implants.

These procedures include: extraction with minimal trauma, proper patient selection, flapless surgery, ideal three-Dimensional implant osteotomy drilling, grafting of dual-zone including the jumping space and the gap till the gingival margin, simultaneous connective tissue graft, immediate temporization, and utilizing platform-switched implants. The fundamental reasons for lacking the major vascular supplying and the light facial bone are yet vague. Hence, neither of the aforementioned procedures was able to stop the remodeling of physiological bone that took place after the extraction (12). Yet, the midfacial mucosal recession with IIP is still possible.

Within the esthetic region, Once used along with Immediate Implant placement (IIP), the technique of socket-shield (SST) is a believed to be a reliable technique which offers superior esthetic results, a higher rates of survivorship, and improved radiographic parameters for IIP alone (13).

In this present report, our recorded values of the dental implant stability quotient (DISQ) were around 64 and 75 respectively at baseline and 6 months postoperative for the control group. While for the study group, it was about 67 at baseline and after 6 months, increased to ≃ 77. Those outcomes were close to of Abd-Elrahman-study`s findings who compared the SST with immediate provisionalization versus IIP with immediate provisionalization (7).

In addition, our ISQ outcomes were agreed with the findings of Degidi et al., (2010) (14) Alterations occurred in the mean vertical bone height and horizontal ridge in buccal and oral/lingual characteristics were analyzed for each and every measurement level by means of CBCT-scan.

Radiographic analysis revealed that both groups had acceptable marginal bone stability after 6 months of provisionalization. The HBL for SST and IIP was 6.99 and 7.06mm at baseline sequentially. After 6 months the HBL was decreased to 6.88 and 6.74mm respectively. Current study outcomes were very close to those of Abd-Elrahman and colleagues upon using immediate implantation versus socket-shield approaches (15).

Regarding the VBL scores at base line and 6 months post-operatively, were around 3 and 0.9mm for our study group. While for the control, they were ≃ 6mm and 1.5mm.

Both the bone levels' outcomes; horizontal and vertical, were close to those of Chen and Pan (16), who recorded a facial bone loss of 0.72 mm. also, Abadzhiev and his team (17) have scored a bone loss of 0.8 mm. The work of Baumer and co-workers (18), have shown that the bone loss of around 1 mm width followed the final restoration.

In the current research, there were minor volumetric changes of the soft tissues. Hence, the socket-shield approach alongside with the preserved marginal bone crest around the immediate dental implants (IDIs) might have contributed to the increased PESs within the research group.

PES increased from 10.70 to 12.10 for our SST group, while the IIP group decreased from 10.50 to 7.8. Additionally, Baümer et al. have shown negligible changes in the gingival contour, limited marginal bone loss, and a low incidence of recessions at the IDIs and the neighboring teeth, all of which are compatible with peri-implant health (19).

Also, Hinze and colleagues have noticed minimal volumetric modifications over the course of a three-month follow-up period, with a maximum of 0.5 mm, in all patients (6).

Current socket shield technique regarding CAL values at 6 months were reduced from 3.60mm to 0.90mm, In our current research, in the study group, the CAL value`s reduction was attributed to the significant healing process with SST in compare to IIP. This was presented by improved density and organization of collagen fibers surrounding dental implants which prevents peri-implantitis and enhances Osseo-integration (7).

To our knowledge, no data or clinical studies have been published concerning the evaluation and recording the clinical attachment level around immediately placed dental implants using socket shield technique.

CONCLUSION

Within the limitations of this clinical trial investigation, it could be established that applying the technique of socket-shield along with conserving the labial root part might be a minimally invasive and dependable choice for conditions requiring the IIP.

According to the current study findings, it is revealed that retaining the root's buccal shell along with the immediate placing of the implant is considered a feasible procedure for achieving Osseo-integration without inducing inflammatory responses.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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