

Original Article

Papilla Index & Pink Esthetic Score Around Customized vs Standard Healing Abutment in Immediate Implant Cases: A Randomized Controlled Trial

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Abstract

Aim: The aim of study was the comparison between customized and standard healing abutments in immediate implants with regarding the healing of the soft tissue (gingiva).

Methodology: Sixty-four immediate implant placement with patients who require tooth or remaining root extraction, patients were randomly assigned to standard healing abutment (group 1) or customized healing abutment group (group 2). Clinical examinations were taken at baseline record preoperative, two weeks postoperative, one month postoperative, three months postoperative, one week after crown delivery) using Papilla index score and Pink esthetic score systems.

Group 1: Standard Healing Abutment: the adequate height was selected after measuring the soft tissue depth using a plastic periodontal probe.

Group 2: Customized Healing Abutment: First, a standard healing abutment was roughened using a carbide dental stone, a layer of flowable composite was applied and cured circumferentially on the base of the abutment forming a finish line-like composite ring, to prevent composite leakage during intraoral application. The abutment was then inserted in the socket to check for seating and any possible interference.

Results: Revealed lack of statistical significance between the two groups regarding the mesial papilla, but a significant difference was noticed regarding the distal score

Regarding the total PES index it has also been found that there was no significant difference through the 5 phases (no difference in the results between the two groups in the 5 phases).

Conclusions: 1- Both standard and customized healing abutments have improved the peri-implant soft tissue of immediate implants. 2-Customized healing abutments had offered slightly better esthetic results than standard ones.

Keywords: Customized healing abutment, standard healing abutment, papilla index, pink esthetic score, soft tissue

I. INTRODUCTION:

Dental caries is the most common infectious disease worldwide. Globally, 60%–90% of humans have dental caries (World Health Organization (WHO) 2016), in addition to some systemic diseases which can affect the oral health and lead to tooth loss, the importance of this tooth lies in its major role in maintaining normal masticatory function and esthetic harmony.

The simplest treatment plan to an edentulous area was either complete or partial removable dentures. However, those prostheses have shown some well-documented problems such as lack of stability and retention which are affected by the height and shape of the edentulous ridge.

Fixed treatment modality have been always the first treatment choice for most of the patients, however it is not applicable for all cases in addition to sacrificing part of the adjacent tooth structure to gain retention for the fixed restoration.

Implant placement had offered a treatment modality that saved the patient from either tooth reduction to obtain a fixed prosthetic option or receiving a removable restoration. In the last decades, dental implants have been the treatment of choice to replace missing teeth, with good long-term prognosis.

Immediate implant placement refers to the placement of implant immediately into fresh extraction sockets. Such protocol allowed to decrease the number of surgical procedures and shorten the overall treatment course which intern increases the demand of the patient. However, clinicians have discovered some esthetic complications during practicing

Apart from facial bone dimensions, the gingival biotype seems to play a role in the extent of soft tissue collapse and the risk for mid-facial

recession around immediately installed implants (Bittner et al. 2019) (Kan et al. 2011). To achieve an optimal esthetic outcome, implants must be placed in an optimal position and inclination.

Based on the round circular shape of a standard healing abutment, the result is a round, unnatural-looking soft tissue profile (Janakievski, 2007). Additional appointments might be required for further tissue conditioning. Therefore, some clinicians have suggested the utilization of customized healing abutments to provide a better emergence profile of the peri-implant tissues. A customized healing abutment was done by modifying the size and trans-mucosal shape of the healing abutment to mimic the natural profile of an emerging tooth.

II. SUBJECTS AND METHODS:

1- Anesthesia:

- Local anaesthetics were used to achieve local analgesia, as they provide a safe and effective method of pain control.
- Anesthetic Gel, with 20% Benzocaine and Xylitol Gluten Free (Topicare, Egypt) was applied on the injection site for patient comfort.
- Participants received 4% Articaine Hydrochloride with Epinephrine vasoconstrictor 1:100,000 via infiltration technique, both buccally (labially) and palatally.

2- Extraction:

- Tooth extractions were carried out with a flapless approach starting with fine periosteal elevator (Kohler, Germany) in order to minimize surgical trauma to the residual bone walls by cutting the attached

periodontal ligament. Straight elevator and remaining root forceps (SedraDent, Pakistan) were later used to accomplish extraction. Once the tooth was removed, the socket was debrided with bone curette (Kohler, Germany) and rinsed with saline solution (Sodium chloride infusion BP, Egypt), after which a periodontal probe (Kohler, Germany) was inserted inside the socket to check the integrity of buccal wall and mesial and distal bony peaks.

3- Implant Placement:

a- Entry points and use of the pilot drill:

-At the marked implant site in the socket apex, a pilot drill of 1.6mm diameter was lightly pumped up and down into the extraction socket according to the bone anatomy and dimensions until the pilot drill mark was 1.5 apical to the crestal bone margin.

b- Drilling:

-The implant osteotomy site was prepared with sequential drilling till the planned implant diameter and length was achieved.

-Both internal and external irrigation with saline was done.

-A parallel pin was inserted in the osteotomy site between drilling to ensure implant angulation in relation to the adjacent teeth.

-The osteotomy was again rinsed with saline solution, and the clinician verified with a periodontal probe the integrity of buccal wall and mesial and distal bony peaks prior to implant placement.

c- Implant placement:

-Dual implant (Egypt) was installed in the osteotomy site using implant mount, it was first

inserted manually until opposed with mild resistance, insertion was then completed using a torque wrench.

-The implant platform (Dual, Egypt) was placed 1mm deep to the buccal bone margin, this would imply that the implant platform was 2mm sub-crestal at mesial and distal sites and an adequate primary stability was obtained with insertion torque of 45 Ncm.

-In the clinical situation where an immediate implant could not be placed a spontaneous healing and a delayed implant placement was scheduled; these patients were excluded from the study and received an implant 2-3 months later.

-Implant position was confirmed with intraoperative periapical radiograph to ensure 2mm subcrestal insertion.

4-Healing Abutment Application:

-Before healing abutment placement the operator received a sealed envelope to reveal the type of abutment to be used.

-For group 1: A standard healing abutment was received, the adequate height was selected after measuring the soft tissue depth using a plastic periodontal probe.

-For group 2: A customized healing abutment was received. First, a standard healing abutment was roughened using a carbide dental stone (Mani, Japan).

A layer of flowable composite was applied and cured circumferentially on the base of the abutment forming a finish line-like composite ring, to prevent composite leakage during intraoral application.

The abutment was then inserted in the socket to check for seating and any possible interference.

After seating, flowable composite was applied and cured following the available anatomy at this stage the exact anatomical shape wasn't fulfilled, the abutment was removed, inspected for irregularities carefully finished and then screwed over the implant.

A final composite layer was then applied to preserve the socket shape, cured and the abutment was left untouched until the end of the healing phase. The resulted abutment possessed a narrow and concave transmucosal morphology and emerged with a larger diameter at the most coronal level of soft tissues.

The height and the diameter (at the transmucosal level as well as at the emergence) of the customized healing abutment was adapted to each single clinical case. The customized healing abutment was inserted in the same visit after implant insertion.

5-Radiographic Evaluation:

A final periapical xray was taken after abutment placement to check proper abutment seating.

6-Post-Operative instructions:

- All the patients were instructed to take the following medications:
Analgesic and anti-inflammatory drug (Diclofenac Sodium 50mg)(cataflam, Egypt) every 8 hours after the surgery and continued for five days.

7- Follow up :

- Standardized intraoral photographs of 64 patients with 64 implant-supported crowns sites and adjacent peri-implant soft tissue in the esthetic zone (central and lateral incisors, canine, first premolar) served as basis for this evaluation at a time interval (preoperative, 2 weeks after surger, one month after surgery, three months after surgery, after one week of crown delivery.

- standardization of photos was guaranteed through utilization of the same camera (Canon 80D, Japan) set at the same specs, photos were taken at the same light conditions from a fixed distance.

8- Crown fabrication:

- After 3 months of implant insertion the 64 patients were recalled for follow up evaluation, pictures and prosthesis insertion.
- -All ceramic screw-retained restorations(zirconium)were used for all patients as they offer esthetic advantages over metal based restorations.
- Healing the abutment removal: The standard healing abutment was unscrewed by anti-clock-wise rotation using a manual screw-driver (controlled group).
- Composite removal with abrasive stone was partially done for the customized abutment to facilitate its rotational removal,then the healing abutment was unscrewed by anti-clock-wise rotation using a manual screw-driver (intervention group).
- Closed tray transfer copings (Dual, Egypt) were placed on implants.
- Impression material application: A light-bodied addition silicone impression material (Elite zhermck, Italy) was injected around the transfer coping. Meanwhile, the impression stock metal tray(Misr Dental, Egypt) was loaded with heavy-bodied addition silicone impression material (Elite Zhermack, Italy) and seated directly in the mouth exactly in its place.
- After material setting, tray was removed from patient mouth and the transfers remain attached to the implants. The transfer was then unscrewed from the implants, screwed on analogues (Dual, Egypt) and repositioned guided with the transfer imprints on the impression.

- Jaw relation was recorded using bite registration material (Elite Zhermack, Italy).
- Alginate (Cavex, Netherlands) impression for the opposing arch was taken.
- Shade was selected using Ivoclar shade guide under room light.
- Abutments were again seated in place and a light layer of composite was reapplied to maintain the emergence profile of the customized group.
- After 3 days screw retained crown was inserted on implants.
- access hole closure using flowable composite (Anycom, Korea) was obtained.

9-Measuring Outcomes

9-A papilla index:

Interdental papilla is the gingival portion, that occupies the space between two adjacent teeth, morphologically it was first described by Cohen in 1959, loss of which can lead to cosmetic deformities, phonetic problems, and lateral food impaction.

The Papilla Index (Jemt, 1997) assesses the size of the interproximal gingival papilla height adjacent to implant-supported single-tooth restorations using a score from 0 to 4: 0 = no papilla present, 1 = less than half of the papilla height is present, and a convex nature of the adjacent tissue is noted, 2 = more than half of the papilla height is present but not to the full extent of the contact point (papilla is not in complete harmony), 3 = the papilla fills the entire proximal space and is in good harmony, 4 = the papilla is hyperplastic. Thus, a complete papilla formation will achieve 3 points. (Fürhauser et al. 2005).

The papillary fill was measured by joining the zeniths of the adjacent teeth and then drawing a

line perpendicular to it till the contact point in Adobe Photoshop software version 8.

9-B Pink esthetic score (PES):

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.

III. RESULTS:

Revealed lack of statistical significance between the two groups regarding the mesial papilla, but a significant difference was noticed regarding the distal score

Regarding the total PES index it has also been found that there was no significant difference through the 5 phases (no difference in the results between the two groups in the 5 phases).

IV. DISCUSSION:

Discussion of methodology:

Sixty four patients were recruited in the out patient clinic of Implantology seeking for single immediate implant placement in the esthetic region.

Both genders were included in the study 39 females and 25 males. Females were more in the study as the esthetic demand was higher with females, without any prejudice to any of both genders.

Patients were selected with age ranged from 18 to 50 years old, above 18 years old to assure complete dental skeletal maturity and below 50 years old to avoid bone changes resulting from hormonal imbalance, and to guarantee patient commitment to the study (DiGangi and Moore 2013).

Only cooperative patients were included in the study to ensure high standard of oral hygiene and long term clinical service (**Misch 2005**). Patients were educated with regard to oral hygiene, the hygiene measures including brushing after each meal, and were motivated about the importance of oral hygiene in the long term success of the restoration. This learning process and encouragement were continued throughout the treatment and post treatment phase.

Participants came one visit before the surgery day to assess visually the gingival condition and oral hygiene and exclude patients with periodontal disease or any signs of gingival inflammation and gingival bleeding when probing, to ensure immediate implant success and good esthetic outcome. Also patients exceeding 10 cigarettes per day were excluded as it may increase risk of periodontitis.

The gingival morphology plays an important role in determining the final esthetic outcome. Therefore, selecting patients with thick gingival biotype increase success rate of immediate implant.

In the direct method, the tissue thickness was measured using a periodontal probe. When the thickness is >1.5 mm, it was categorized as thick biotype and if less than 1.5 mm, it was considered as thin and excluded from the study (**Greenberg et al. 1976**).

Radiographic evaluation to all patients using cone beam computed tomography (CBCT) to measure buccal and lingual bone plates and should possess 2mm or more for each plate to avoid bone loss and esthetic failure. Also to determine the position and the desired angulations of the implant. Adequate apical bone was needed for implant placement to ensure implant primary stability that can resist forces on the healing abutments avoiding implant failure.

To eliminate any possible local factors that might affect the results of this study, patients with active infections (abscess, fistula) around the failing tooth or the remaining root, patients with deep overbite and heavy smoker patients were not included in this study.

Periodontal therapy including subgingival and supragingival scaling was performed to all patients participating in this study to establish good experimental base line and to avoid periodontal affection to the adjacent teeth. To assure healthy periodontal condition during the course of this study, patients were intensively instructed in proper oral and prosthetic hygiene (**Lambert et al. 2000**).

Both internal and external irrigation with saline solution was used during drilling in the extraction socket. This minimizes postoperative edema and reduces the high temperature to satisfactory levels that can be generated during drilling the implant osteotomies (**Benington et al. 2002**).

After tooth extraction and implant placement some cases had jumping gap exceeded 2mm, cerabone xenograft was used to fill the gap and these cases were excluded from the study.

Healing abutment placement with no contact in centric occlusion or eccentric occlusion to reduce stresses on implant in the healing period. With the controlled group selecting a standard healing abutment approximated to the socket depth and diameter and with the intervention group a standard healing abutment approximated to the socket depth and diameter was selected and a flowable composite application was done by layering to fill the socket depth and diameter around the healing abutment and then polished with rubber cups to ensure highly polished composite surface in contact with the gingival tissue to avoid gingival inflammation and post-operative discomfort. Flowable composite filler content (57–78% by volume) is lower than that of

conventional composites (81–92% by volume), which prevents the reduction of undesirable polymerization shrinkage in the material. Polymerization shrinkage impairs the adaptation of the composite (**Langalia et al. 2015**).

Pre-operative and post-operative medications were given to all patients to control the risk of implant failure, post-operative infection, edema and to decrease patient apprehension. Broad spectrum antibiotics and anti-inflammatory drugs were administered to all patients (**Grondahi et al. 1996**).

In order to reduce the risk of infection the patients were instructed to use chlorhexidine mouth wash one week prior to surgery and antibiotic coverage was prescribed 24 hours before surgery and continued for one week after (**Schwartz and Larson 2007**).

Patients were recalled two weeks and one month after the surgery and one week after the delivery to inspect the gingival tissue during the healing period. Crown delivery after three months of immediate implant placement to ensure complete osseointegration, with no signs of gingival inflammation or bleeding on probing. Closed tray impression technique was taken with all the cases, based on a research enrolled by Heather et al.; accuracies of two impression techniques, namely open tray and closed tray, were not significantly different (**Conrad 2007**). Humphries et al. reported that the closed tray technique yielded a higher correlation to coordinate values on the definitive cast than open tray technique (**Humphries 1990**).

Balouch et al. compare the dimensional accuracy between open and closed tray impression techniques and found that dimensional changes of closed tray technique was lesser than open tray and can be attributed to its simplicity, accuracy of operator in implementing the technique (**Rismanchian and Monirifard 2008**).

(**Prithviraj et al. 2011**) and application of custom tray instead of prefabricated tray (**Sazgara and Nahidi 2009**).

Screw retained restoration was the choice in all the cases, as the cementation were done on the cast outside the patient mouth reducing the risk of leaving excess cement subgingival which might affect the results. Screw implantation allows easy oral hygiene maintenance, dental repairs as well as surgical intervention along with its efficacy when the interocclusal space is limited (**Cosola et al. 2018**).

Discussion of results:

The sample of sixty four patients (39 Females, 25 Males), with a mean age of 40 years were included in this study. A total of 64 immediate implants were inserted (32 each group). All patients attended the 3 months follow-up.

Immediate implant placement had been widely used among prosthodontics aiming to preserve or improve the peri-implant soft tissue condition, healing abutments was considered the simplest form of preservation to the papillary status conforming with the esthetic demands when restoring single tooth in the anterior region.

Pink esthetic score and papillary index are common tools in assessment of soft tissue changes around immediate implants from esthetic perspective (**Gunjan Srivastava et al. 2020**).

In this study both papillary index and pink esthetic score were utilized to report the differences that lied when using a customized healing abutment (group 2) or a standard healing one (group 1) in single immediate implants in the anterior region.

1- Papilla index scores

The papillary index score was reported for both the mesial (M) and the distal(D) papilla, scores

were given ranging from zero (no papilla),1(less than half of the papillary height present),2 (more than half of the papilla height was full but not including the contact point,3 (full papillary height),4 (hyperplastic papilla).

The scores were recorded through 5 phases 1- (preoperative), 2- (2 weeks post-operative), 3-(one-month post-operative, 4- (three-months postoperative i.e. after osseo-integration), 5- (one week after crown delivery)

Records taken for both groups prior to implant placement (phase 1) had revealed that the majority of participants possessed more than half of the papilla full (score 2) i.e., (group 1 (50%(M),25%(D)), group 2(75%(M),50%(D))).

After implant placement, no records were taken before 10 days healing period to alleviate the impact of post-operative inflammation or edema (if present) on the reported results.

In phase 2, slight drop in the reported scores were observed in the standard group (M: 0% received score (3),D:25% had received score (0)) when compared to the preoperative results (M:25% received score (3),D: 0% had score (0)), while in the customized group no changes in the scores status was recorded, this might be attributed to the round cross section of the standard abutment unlike the oval cervical tooth morphology thus resulted in losing part of the proximal support given to both mesial and distal papilla.

On the other hand, customization had followed the cervical tooth contour, offering proper cervical fullness to the extracted socket with subsequent support to the adjacent papilla.

During the follow up recalls (phase 3,4) improvement in the peri implant soft tissue was observed in both groups compared to phase 2, better results were reported in the customized group over that of the standard one.

In group 1: 25% of the population had reached full papillary height (score 3) in mesial papilla, in distal papilla, despite being improved from phase 2 (zero% had scored a (0) score) yet mild recession was observed in distal papilla (75% had score 1) when compared to phase 1 (50% (1)) (these results conform with **Tarnow et al. 2000**).

Those results continued 1 week after crown delivery before the fullness of crown contour has affected the score results

In group 2: phase 3 (M;25% has score (3), D:75% had score (3)) this might result from the highly finished concave surface which encourages the adaptation of the gingiva over the abutment surface and the papillary growth in both sides .by the end of phase 4 improvement has continued in the distal papillary scores and was maintained in phase 5 (1week after crown delivery) where all population had full height papillary contact.

This could be explained by the anatomy of the delivered crown where the nature of the contact of the mesial papilla is usually at a higher incisal level from the distal one which facilitate the distal papillary height reaching contact (score 3).

Regarding the association tests, positive association between the group and the total papilla index score in phase 2, 3, 4 and 5 had revealed that customized technique would result in better results whenever compared to standard one as regard the papilla index score.

Furthermore, it revealed lack of statistical significance between the two groups regarding the mesial papilla, but a significant difference was noticed regarding the distal score.

These findings were conformed with **Alexandre et al 2019** who appraised the papilla index and alleged an improvement from base line to 12 m follow up at both M & D papillae in customized

group even though only the distal site had registered a significant improvement.

2- Pink esthetic score:

The pink esthetic score was to assess mesial papilla(M), distal papilla (D), level of soft tissue margin, soft tissue contour, alveolar process, soft tissue color and texture.

Scores were given ranging from **zero** (Absent of (M) and (D)) (Major discrepancy>2mm of level of soft tissue margin) (unnatural of soft tissue contour) (obvious changes of alveolar process, soft tissue color and texture).

one (Incomplete of (M) and (D)) (Minor discrepancy 1-2mm of level of soft tissue margin) (fairly natural of soft tissue contour) (slight changes of alveolar process, soft tissue color and texture)

Two (Complete of (M) and (D)) (No discrepancy<1mm of level of soft tissue margin) (Natural of soft tissue contour) (No difference of alveolar process, soft tissue color and texture).

The scores were recorded through 5 phases 1- (pre-operative), 2- (2 weeks post-operative), 3- (one month post-operative), 4- (three months post-operative), 5- (one week after crown delivery).

Table (11) has shown lack of statistical significance in the total PES score between the standard and customized abutment.

Regarding (M) and (D) papillae results were conforming with the results of papilla index throughout the five follow-up phases.

Regarding level of soft tissue margin in group 1 (phase 1 50% score1, 50% score2), in phase 2 (2 weeks' post-operative) slight drop was observed (75% score1) and got improved again in phase 3,4 and 5 as phase 1 (50% score1, 50% score 2).

In group 2 (phase 1 100% score2), in phase 2 (2weeks post-operative) slight drop was also observed (50% score 2) and got improved again in phase 3,4 and 5 as phase 1 (100% score2).

No significant difference regarding the level of soft tissue and this agreed with (**Parvini et al. 2022**).

Regarding soft tissue contour in group 1 (phase 1 25% score0, 25% score1, 50% score2), slight improvement was observed in phase 2 (50% score 1, 50% score 2) and slight loss was observed in phase 3 (25% score0, 25% score1, 50% score2) that lasts the same in phases 4 and 5 as preoperative (phase 1).

In group 2 (phase1 50% score1 and 50% score2), slight improvement in score2 was observed in phase 2 (75%) and slight loss was observed in phase 3 (50% score1, 50% score2) that kept the same in phase 4 and 5.

No significant difference regarding the soft tissue contour, slight loss of contour was observed in both groups.

No significant difference was found in the alveolar process, group 1 and 2 showed (100% score2) ending in phase 5 with (100% score2).

Moderate difference in the soft tissue color was found in both standard and customized groups, in group 1 (phase 1 50% score1, 50% score2), in phase 2 (2 weeks' post-operative) a drop was observed (25% score0, 75% score1) and slightly raised in phases 3, 4 and 5 (100% score1).

In group 2 (phase 1 50% score1, 50% score2), in phase 2 (2weeks post-operative) a slight drop was observed (100% score1) and slightly raised in phases 3, 4 and 5 (75% score1, 25% score2).

Change in color was due-to horizontal and vertical soft tissue deficiency (**Stefanini et al. 2023**).

Regarding the soft tissue texture in group 1 (phase 1 75% score2, 25% score1), in phase 2 (2 weeks' post-operative) an obvious drop was noticed (50% score0, 25% score1 and 25% score2), in phase 3, 4 and 5 a slight rise was observed in comparison to phase 2 (75% score1 and 25% score2).

In group 2 (phase 1 75% score1, 25% score2), a slight drop was observed in phases 2, 3, 4 and 5 (100% of population score1), indicating moderate difference in soft tissue texture with customized healing abutments and standard one.

Soft tissue color and texture showed slight decrease during the 5 phases, group 2 was slightly better than group 1 regarding soft tissue color and texture, this may be due-to the customization.

V. CONCLUSION:

From the previous study it was concluded that:

1. Both standard and customized healing abutments have improved the periimplant soft tissue of immediate implants.
2. Customized healing abutments had offered slightly better esthetic results than standard ones.

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Ethics: This study protocol was approved by the ethical committee of the faculty of dentistry – Cairo university.

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