

A Simplified Method For Evaluating Optimized Gingival Contour For Single Implant Supported Zirconia Crown In The Aesthetic Zone - An In Vivo Study.

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DOI: 10.47750/pnr.2022.13.S02.03

Abstract

Introduction- Restoring missing teeth in the aesthetic area specially anterior maxilla with implants is particularly challenging, because this is a highly visible area that frequently presents anatomical challenges for implant placement, such as insufficient available bone volume and thin soft tissue. Achieving an optimal esthetic result when replacing a single missing tooth with an implant in the esthetic zone is a very demanding procedure, since no deficit of bone or soft tissue can be accepted.

Material and Method- A total of 10 patients were chosen for the study which requires placement of implants in the missing maxillary anterior tooth region. Dentists of two different dental specialties (one prosthodontist and one periodontist) evaluated the pink esthetic score (PES) at the baseline, after 3 months follow up and 6 months follow up.

Result-The mean PES score based on clinical evaluation and photographic evaluation after crown placement (Baseline) and at the 3 months and 6 months follow up are presented with significant differences for all the variables of pink esthetic score (PES) except for soft tissue colour.

Conclusion- The PES is a tool for reproducibly evaluating the esthetic appearance of the soft tissue around single-tooth implant crowns. The esthetic outcome of soft tissue around a single-tooth implant was improved significantly after a 6-month follow-up compared with the baseline according to PES assessment.

Keywords- Implant, Pink Esthetic Score, Zirconia, Esthetics.

INTRODUCTION

Loss of anterior maxillary tooth/teeth causes psychological and emotional trauma to an individual. In order to replace anterior maxillary missing tooth/teeth, implants has now become the most predictable & successfully established method of rehabilitation. Survival of implant and its clinical success is demonstrated in numerous studies in relationship to the quantity & quality of the bone available in the implant bed. But the standard of implant treatment in aesthetic zone is concerned with both function and in achieving aesthetic long-term results.

Restoring missing teeth in the aesthetic area specially anterior maxilla with implants is particularly challenging, because this is a highly visible area that frequently presents anatomical challenges for implant placement, such as insufficient available bone volume and thin soft tissue.⁷

The most common esthetic complication is gingival recession that exposes the implant abutment junction, with one study reporting that up to 61% of cases had at least 1 mm of gingival recession on the facial aspect⁵ Gingival recession leads to development of open gingival embrasures.⁷

Open gingival embrasures “black triangles” are defined as the embrasures cervical to the interproximal contact that is not filled by gingival tissues. Consequently, black triangles are complex aesthetic and functional problems. Among these problems is that they are noticeably unaesthetic which negatively affects the smile, facilitate retention of food debris which can negatively affect the health of the periodontium.⁸

Achieving an optimal esthetic result when replacing a single missing tooth with an implant in the esthetic zone is a very demanding procedure, since no deficit of bone or soft tissue can be accepted.⁹ Tooth form, size, and colour are

considered to be important factors influencing dental esthetics. Furthermore, factors such as favourable emergence profile of the crown, harmonious soft tissue contour, completely filled interdental spaces are frequently considered to be of significance.¹⁰

Fürhauser *et al.* introduced an excellent index termed pink esthetic score (PES) for evaluation of the soft tissue around single-implant crowns that might change over time.¹¹

Belser *et al.* have later introduced pink esthetic score (PES) to evaluate the esthetic outcome of soft tissue around implant-supported single crowns in the anterior zone.¹²

It 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 is assessed with a 2–1–0 score, with 2 being the best and 0 being the poorest score. All variables are assessed by comparison with a reference tooth.¹³

Thus, the current study was aimed to utilize the new defined PES to evaluate the soft-tissue alterations around a single-tooth implant in the anterior maxilla at the time of crown placement, 3 months and 6 months post-loading.

MATERIAL AND METHOD

A total of 10 patients were chosen for the study which requires placement of implants in the missing maxillary anterior tooth region. All patients were given adequate information about the procedure and were provided with possible alternatives. Thereafter a written consent was taken and their participation was totally voluntary.

INCLUSION CRITERIA

1. Adjacent teeth intact; restored with functionally and esthetically good restorations; restored with prostheses precluding the addition of the missing tooth.
2. Patient reluctance of preparation of adjacent teeth.
3. Site where fixed prosthesis cannot give Esthetic outcome due to bone defects.
4. Healthy patient with no risk of implant surgery.
5. Age 18 & above.
6. The patient is available for the follow up study.
7. Provision of written informed consent.\

EXCLUSION CRITERIA:

Certain exclusion criteria include

1. Presence of any local or systemic diseases which contraindicates surgery example uncontrolled diabetes, cardiac or neuromuscular diseases.
2. Use of drugs such as steroids, need to be carefully considered.
3. Pregnant or lactating females.
4. Patient unable or unwilling to return for follow up visits.
5. Poor patient compliance.

PES ASSESSMENT

Each single implant Crown was photographed with a digital camera taken such a way so that the Frankfort horizontal plane of the patient was parallel to the ground.

Photos of the implant crown and the peri-implant soft tissues, including at least one adjacent tooth on each side, were taken using a facial projection perpendicular to the facial implant crown. In addition, a photo of the reference teeth, the incisor and canine on the contralateral side, was also taken.

Then the photographs were assessed for soft tissue health by one prosthodontist and one periodontist with a PES index 1 h after seating of the restoration (Figure 1). They were given a form with six variables involved and were asked to give their scores for each parameter with the 0–1–2 scoring system, with 2 being the best and 0 being the poorest score.

The PES was based on six variables: mesial papilla, distal papilla, soft-tissue level, soft tissue contour, soft-tissue colour and texture .

The mesial and distal papilla were evaluated for completeness, incompleteness or absence. All other variables were assessed by comparison with a reference tooth, i.e. the corresponding tooth (anterior region) or a neighbouring tooth (premolar region).

The highest possible score reflecting a perfect match of the peri-implant soft tissue with that of the reference tooth was 12.

The patients were recalled for a radiographic and clinical examination 3 months(Figure 2). and 6 months (Figure 3). after crown placements (follow-up). PES assessments were given by the same one prosthodontist and one periodontist, who scored the restorations at baseline .

SPSS statistical software (SPSS Inc., Chicago, IL, USA) was used for all statistical analysis. Paired t test was used to compare the probing depth, bone loss and six variables of PES (mesial papilla, distal papilla, level of soft tissue margin, soft tissue contour, soft tissue color, soft tissue texture) at various time intervals i.e at baseline, 3 months,6 months.



FIGURE 1: AFTER CROWN PLACEMENT



FIGURE 2: AFTER 3 MONTHS



FIGURE 3: AFTER 6 MONTHS

RESULT

Pes Assessment

The mean PES score based on clinical evaluation and photographic evaluation after crown placement (Baseline) and at the the 3 months and 6 months follow up are presented in (table 1).Significant differences between baseline and follow up were found in all single variable except soft tissue color.

The mean value at baseline For mesial papilla ,distal pailla , level of soft tissue margin, soft tissue contour, soft tissue texture were .95, 1.20, 1.25, 1.250, 1.55 and 1.40 respectively.(Table 1)

The mean value at 3 Month For mesial papilla ,distal pailla , level of soft tissue margin, soft tissue contour, soft tissue texture were 1.25, 1.45, 1.35, 1.500, 1.65 and 1.80 respectively. (Table 1)

The mean value at 6 Month For mesial papilla ,distal pailla , level of soft tissue margin, soft tissue contour, soft tissue texture were 1.650, 1.65, 1.700, 1.70, 1.75 and 2.00 respectively. (Table 1)

The mean difference for each variables at baseline to 3rd month were -.300, -.250,-.100, -.2500, -.100, -.400 respectively and p value at baseline to 3 months for mesial papilla , distal papilla, soft tissue contour, soft tissue texture were .024, .01, .01, .02 which were significant and the p values for level of soft tissue margin and soft tissue color were .1 and .1 which were not significant.

The mean difference for each variables at baseline to 6th month were -.7000, -.450, -.4500, -.4500, -.200and -.600 respectively and p value at baseline to 6th months for mesial papilla, distal papilla, soft tissue contour, soft tissue texture and level of soft tissue margin were.004, .004, .004, .004, .04 which were significant and the p value for soft tissue color was .1 which was not significant.

The mean difference for each variables at 3rd month to 6th month were -.4000, -.200, -.3500, -.2000, -.100, -.200 respectively and p value at 3rd to 6th months for, distal papilla, level of soft tissue margin, soft tissue contour, were.03, .02, .03, which were significant and the p value for mesial papilla, soft tissue color , soft tissue texture were .08, .1 and .1 which were not significant.

The percentage of improvement at Baseline to 3 months for mesial papilla, distal papilla, level of soft tissue margin, soft tissue contour, soft tissue color and soft tissue texture were 31%, 20%, 8%, 20%, 6.4% and 28.57% respectively.

The percentage of improvement at 3 months to 6 months for mesial papilla, distal papilla, level of soft tissue margin, soft tissue contour, soft tissue color and soft tissue texture were 32 %, 13.79 %, 25.92 %, 13.33 %, 6.06 % and 11.11 % respectively.

The percentage of improvement at Baseline to 6 months for mesial papilla, distal papilla, level of soft tissue margin, soft tissue contour, soft tissue color and soft tissue texture were 73.68 %, 37.5%, 36%, 36%, 12.90 % and 42.85 % respectively.

Tooth surface	Mean	Standard deviation	Std. error mean
At Baseline			
Mesial papilla	.95	.685	.217
Distal papilla	1.20	.587	.186
Level of soft tissue margin	1.25	.635	.201
Soft tissue contour	1.250	.6346	.2007
Soft tissue color	1.55	.497	.157
Soft tissue texture	1.40	.810	.256
At 3 months			
Mesial papilla	1.25	.825	.261
Distal papilla	1.45	.643	.203
Level of soft tissue margin	1.35	.669	.211
Soft tissue contour	1.500	.5270	.1667
Soft tissue color	1.65	.412	.130
Soft tissue texture	1.80	.422	.133
At 06 months			
Mesial papilla	1.650	.4743	.1500
Distal papilla	1.65	.626	.198
Level of soft tissue margin	1.700	.3496	.1106
Soft tissue contour	1.70	.422	.133
Soft tissue color	1.75	.264	.083
Soft tissue texture	2.00	.000	.000

Table 1: Descriptive statistics of PES of studied individuals at different time interval

Tooth surface	Mean Diff	T value	P value
Baseline-03 months			
Mesial papilla	-.300	-2.714	.024*
Distal papilla	-.250	-3.000	.01*
Level of soft tissue margin	-.100	-1.500	.1**
Soft tissue contour	-.2500	-3.000	.01*
Soft tissue color	-.100	-1.500	.1**
Soft tissue texture	-.400	-2.753	.02*
Baseline – 06 months			
Mesial papilla	-.7000	-3.772	.004*
Distal papilla	-.450	-3.857	.004*
Level of soft tissue margin	-.4500	-3.857	.004*
Soft tissue contour	-.4500	-3.857	.004*
Soft tissue color	-.200	-1.809	.1**
Soft tissue texture	-.600	-2.343	.04*
03 month- 06 months			
Mesial papilla	-.4000	-1.922	.08**
Distal papilla	-.200	-2.449	.03*
Level of soft tissue margin	-.3500	-2.689	.02*
Soft tissue contour	-.2000	-2.449	.03*
Soft tissue color	-.100	-1.500	.1**
Soft tissue texture	-.200	-1.500	.1**

Table 2 Meanwise comparison of PES at time interval

DISCUSSION

Implants replacing anterior maxillary missing tooth/teeth, has now become the most predictable & successfully established method of rehabilitation. Survival of implant and its clinical success is demonstrated in numerous studies in relationship to the quantity & quality of the bone available in the implant bed but for esthetically sensitive cases, however, these osseointegration-oriented criteria are not adequate. With osseointegration and restoration of function, esthetics is a key factor in the success of implant therapy, especially in the anterior maxilla.¹¹ Patient satisfaction depends upon rehabilitation of soft tissue around the implant supported restoration.

The esthetic peri-implant tissues, including health, height, volume, color and contour must be in harmony with the healthy surrounding dentition. Measurement of esthetic outcomes is 'proposed for use in clinical studies' (Belser et al. 2004a, 2004b). Belser et al. (2004a, 2004b) suggested that a selective assessment of peri-implant soft tissue with an objective score would help to evaluate implantsupportedrestorations.¹³

PFI is then used in many publications evaluating peri-implant soft tissue. The PFI index involves one variable, i.e., the papilla height (Jemt 1997)¹⁶. However, the 'natural' appearance of implant-supported single tooth involves many factors, including peri-implant tissues and the prosthesis itself.¹⁶

In 2005, Furhauser et al. proposed an excellent index termed the pink esthetic score (PES), focusing essentially on the soft tissue aspects of an anterior implant restoration. This 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 is assessed with a 2-1-0 score, with 2 being the best and 0 being the poorest score, which results in a maximum possible score of 14²⁹.

Furhauser et al. suggested that the PES is a suitable instrument for reproducibly evaluating soft tissue around single-tooth implant crowns that might change over time and could be a useful tool for monitoring long-term soft-tissue alterations.¹³

An ITI Consensus Conference(2004) deemed that soft-tissue stability around implant restorations and adjacent teeth is of paramount importance within the anterior maxilla and the importance of soft tissue stability around implant restorations and adjacent teeth has been addressed in some published studies (Belser et al. 2004a, 2004b).⁶¹

Some researchers pointed out that the potential for significant changes in soft tissue levels after completion of restorative therapy needed to be considered for implant therapy in the esthetic zone. In their researches, they found that most of the variation occurred during the first 3–6 months following abutment connection surgery for a submerged implant system (Small & Tarnow 2000; Priest 2003; Schropp et al. 2005).^{62,24,63}

The aim of our present study was to evaluate pink esthetic score with six variables that is : mesial papilla, distal papilla, soft-tissue level, soft-tissue contour, soft-tissue color, and texture for the single tooth submerged implants placed in anterior maxillary esthetic zone during placement of crown and 3-6 months following crown placement.

In the present study photographic method was used to evaluate PES. As oral photographs are one of the method of collecting data on the therapeutic effects of clinical practice. This convenient and intuitive method is commonly used to document maintenance of a therapeutic effect over a long term follow up period .

Chang et al (1999) used oral photographs to compare the soft tissue around the single implant with that of the contralateral tooth.¹⁹ Priest (2003) reported that the use of oral photographs for data collection in the assessment of the single tooth peri-implant soft tissue permitted accurate and objective measurement.²⁴

In present study the PES score for single tooth implant varied from **7.6 at baseline** to **9 at 3 months** and **10.4 at 6 month** follow up. The esthetic outcome of soft tissue surround the implant has improved significantly. These findings corroborate the recently published data with the PFI index or with other measurements (Small & Tarnow 2000; Priest 2003; Schropp et al. 2005).^{62,24,63}

In present study, the mean PES score for mesial papilla at baseline was **.95**, at **3 months** was **1.25** and at **6 month** was **1.65**. It showed that there was a significant improvement in mesial papilla during follow up evaluation.

The mean PES score for distal papilla, at baseline was **1.2**, at **3 months** was **1.45** and at **6 months** was **1.65**. It showed that there was a significant improvement in distal papilla during follow up evaluation.

This result agreed with the findings in previous studies: papillae regenerated in most cases, although with different implant systems and observation periods (Priest 2003; Schropp et al. 2005).^{24,63} The reconstruction of periodontal attachment may contribute to this improvement.

Most studies demonstrated that recession of the tissue margin might occur following the insertion of the crown, with the risk of exposing the implant orally, especially for an on submerged implant system (Bengazi et al. 1996). It is considered that reshaping of the soft tissue might represent a means to achieve appropriate crown heights or biologic width. But an improvement was found in the level of soft-tissue margin in our study.

The mean PES score for level of soft tissue margin at baseline was **1.25**, at 3 month was **1.35** and at 6 month was **1.70**. It showed that there was a significant improvement in level of soft tissue margin during follow up evaluation. This indicated that the risk of exposure of the implant-to-crown interface or margin can be considered to be low with an optimal implant position. These findings corroborate a few of the present studies (Grunder 2000).²⁰

The mean PES score for soft tissue contour at baseline was **1.25**, at 3 month follow up was **1.55** and at 6 month follow up was **1.70**. Similarly the mean PES score for soft tissue texture at baseline was **1.40**, at 3 month follow up was **1.80** and at 6 month was **2.00**. It can be well appreciated from the values that there was a significant improvement in both soft tissue contour and soft tissue texture during follow up evaluation.

Among all the variables for PES evaluated in present study no significant improvement was found in soft tissue colour. The mean PES score for soft tissue colour at baseline was **1.55**, at 3 month follow up was **1.65** and at 6 month follow up

was 1.75. Researches on this aspect of implant esthetics are scarce. But the soft tissue colour around implant supported restoration in our present study was always acceptable (having good score). This may occur due to relief of the pressure on the soft tissue immediately after crown placement, which caused pallescence of the pink gingiva.

The percentage of improvement at Baseline to 3 months for mesial papilla, distal papilla, level of soft tissue margin, soft tissue contour, soft tissue color and soft tissue texture were 31%, 20%, 8%, 20%, 6.4% and 28.57% respectively.

The percentage of improvement at 3 months to 6 months for mesial papilla, distal papilla, level of soft tissue margin, soft tissue contour, soft tissue color and soft tissue texture were 32%, 13.79%, 25.92%, 13.33%, 6.06% and 11.11% respectively.

The percentage of improvement at Baseline to 6 months for mesial papilla, distal papilla, level of soft tissue margin, soft tissue contour, soft tissue color and soft tissue texture were 73.68%, 37.5%, 36%, 36%, 12.90% and 42.85% respectively.

There are several factors responsible for soft-tissue stability. **Buser et al. (2004)** suggested that sufficient horizontal and vertical bone volume is essential for long term esthetic soft-tissue stability.⁶⁵ To obtain sufficient bone volume both horizontally and vertically, correct 3D position of the planned implant restoration is the driving force in implant placement. This will allow for optimal bone support, along with optimal esthetics. To reduce the risk of the disturbing exposure of titanium and to create a favorable emergence profile of the crown, it was suggested to position the head of the fixture apical to the cemento-enamel junction (CEJ) of neighboring teeth, and to have the abutment shoulder placed 1–2mm below the mucosal margin (**Buser et al. 2004**).⁶⁵ In our study, the implant shoulder is positioned about 1mm palatal to the point of emergence at adjacent teeth and about 1mm apical to the CEJ of the contralateral tooth, and this may contribute to the improvement of PES in the study.

CONCLUSION

The PES is a tool for reproducibly evaluating the esthetic appearance of the soft tissue around single-tooth implant crowns.

The following conclusions can be underlined according to our results:

The esthetic outcome of soft tissue around a single-tooth implant was improved significantly after a 6-month follow-up compared with the baseline according to PES assessment.

The results suggested that changes in soft tissue levels after restorative therapy needs to be considered for single-implant restoration in the anterior maxilla.

Restoring the papilla in the present study, scored best in the PES assessments, while the soft tissue color around peri implant soft-tissue remained constants.

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