## ORIGINAL ARTICLE

# Esthetic evaluation of maxillary anterior single-tooth implant by dental specialists and non-dental personnel

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## Abstract

**Background:** Implant therapy in partially edentulous patients has become a well-established treatment modality, in general, and anterior single-tooth replacement has become a highly predictable solution. However, the current literature is scarce when it comes to objective outcome evaluation from an esthetic point of view.

**Aim:** The aim of this study was to assess the correlation between non-dental personnel's perception of single-tooth implant restoration (STIR) with pink esthetic score (PES)/white esthetic score (WES) grading given by different dental specialists.

**Materials and Methods:** A total of 20 photographs with one implant restoration in the esthetic zone (maxillary canine to canine) surrounded by virgin teeth were included in the study. A total of 20 specialists (4 periodontists; 4 prosthodontists; 4 oral surgeons; 4 endodontists; and 4 senior general dental practitioners) evaluated the photographs for PES and WES scores. Same photographs were presented to 25 laypeople. They were instructed to identify which tooth was STIR and also record what factor influenced their decision for selecting STIR (surrounding peri-implant soft tissue or implant restoration).

**Results:** Among the dental specialists, oral surgeons were very generous in PES/WES scores followed by endodontists, periodontists, general practitioners, and least scores were assigned by prosthodontists. The difference between all five groups was statistically significant. Furthermore, a negative correlation was observed between mean PES/WES scores assigned by specialists with positive identification of STIR by laypeople.

**Conclusion:** Achieving good consistent anterior esthetics is a challenge. The hard and soft tissues, as well as the crown portion, have to be in harmony for acceptable results. In this study, highest score was given by oral surgeons and prosthodontists were very critical. Furthermore, it was observed that laypeople identified white esthetic deficiencies more frequently than pink esthetic deficiencies.

**Clinical Significance:** Anterior maxillary single-tooth implant replacement is a successful and predictable treatment modality. PES/WES index are valuable objective assessment tools for evaluating anterior esthetics. However, the dentist's assessment may be different from that of the patient, because the latter is more subjective. Thus, a combination of subjective and objective assessment tools is essential while evaluating anterior esthetics.

## Introduction

Since the serendipitous discovery of the phenomenon of "osseointegration" by Sir Per-Ingvar Branemark in 1952, dental implants have become an integral part of dentistry. The greatest challenge a clinician faces is the replacement of anterior tooth.

Thus, dental implants mainly aim at obtaining predictable success for the rehabilitation of clinically challenging situations.[1]

Replacement of missing anterior teeth with dental implants has become a well-established treatment modality. Initially, dental implant success was defined only in terms of "osseointegration."

However, with high predictability of osseointegration, efforts are now redirected toward esthetic aspects of implants placed in the anterior zone.[2]

Esthetics have become an important consideration in contemporary clinical dentistry. It has been a dominating force in dictating the direction of development in implant dentistry for many decades. It encompasses not only natural looking implant restoration but also the unaltered state of the surrounding peri-implant tissue architecture.

The success of a single restoration in the esthetic zone depends mainly on the harmonious integration of the restoration into the patient's overall appearance, especially the peri-implant hard and soft tissue.[3] Systematically evaluating interproximal and buccal bone of the planned implant site is a necessity for adequate hard tissue volume to support an esthetic outcome. In addition, the amount and type of soft tissue available before implant placement is also essential for successful implant prosthesis.

In 2005, Fürhauser *et al.* proposed an excellent index termed the pink esthetic score (PES), focusing essentially on the peri-implant soft tissue around the implant restoration. The index comprises five variables; mesial papilla, distal papilla, curvature of the facial mucosa, level of the facial mucosa, and root convexity/soft tissue color and texture of the facial gingiva[4]

Later in 2009, Belser *et al.* modified the previously published PES and proposed an implant restoration index white esthetic score (WES) that took into consideration the visible part of the implant restoration, that is, the crown that emerges from peri-implant mucosa. Similar to PES, WES also has five parameters; general tooth form; outline and volume of the clinical crown; color, which includes the assessment of the dimension's hue and value; surface texture; and translucency and characterization.

A score of 2, 1, or 0 is assigned to all five parameters individually. Thus total PES and WES score range from 10 to 0. All five parameters are assessed by direct comparison with the natural, contralateral reference tooth, estimating the degree of match, or eventual mismatch. In case of an optimum duplication of the esthetically relevant features inherent to the control tooth, a maximum PES/WES score of 20 should be achievable.[5]

Numerous studies have reported that PES/WES scoring system can serve as a standard objective assessment tool for anterior implant restorations. However, the current literature is scarce when it comes to subjective evaluation from an esthetic point of view. There is a lack of data addressing the patient's satisfaction with single-tooth implant restoration (STIR) outcomes. A large void has been observed in clinical rating methods to patient's perceptions of implant restorations.[6]

Thus, a combination of objective and subjective evaluations of the esthetic outcome is essential for patients receiving dental implants in the esthetic zone.[7]

Most of the earlier studies, orthodontists were involved for esthetic assessment. In this study, endodontists have been enrolled as they deal with esthetic rehabilitation on a routine basis. Furthermore, to avoid bias, four specialists in each group from different geographical areas were selected.

With this background, the aims and objectives of this study were to evaluate PES and WES scores of STIR by different dental specialists. Furthermore, to assess the ability of laypeople to correctly identify the presence of STIR in a digital photograph and to correlate PES/WES scores assigned to each case by specialists with positive identification of STIR per case by the laypeople.

## Materials and Methods

A total of 20 STIR placed in the upper anterior region (canine to canine), surrounded by natural healthy teeth were included in the study. The presence of peri-implantitis or the use of any artificial gingiva around the implant prosthesis was excluded from the study. Of the 20 implants placed, 5 replaced right central incisor; 10 left central incisor; 2 right lateral; 2 left lateral incisor; and 1 left canine.

Digital colored photographs with canon 12.2 MP EOS 1100D DSLR camera (18-55 MM) were taken of all the 20 cases by the same examiner. Photographs were digitally color calibrated before printing to ensure proper standardization.

Ethics clearance for the study was obtained by the Institution's Ethics Committee.

In each of the photographs, the replaced tooth had to be clearly visible for the evaluation of the peri-implant soft tissue, implant prosthesis, and the contralateral tooth for comparison. PES and WES scores according to Belser *et al.*, 2009, were assigned for each of the 20 photographs by 4 periodontists, 4 oral surgeons, 4 prosthodontists, 4 endodontists, and 4 senior general dentists. Specialists across different geographical area were selected for the study to avoid bias. Mean PES and WES scores assigned by all five groups of specialists were calculated.

25 non-dental personnel; 14 females and 11 males; mean age of 18–45 years were recruited for the study. Only those individuals with no prior experience with dental treatment or dental hospital were incorporated for the study. After obtaining informed consent, volunteers were presented with 20 photographs. They were allotted 30 s each to view the 20 photographs. On completion, they were instructed to write down which according to them was implant restoration among the presented teeth. Every correct identification of STIR was considered as positive and every false identification as negative. For each of those 20 STIR, the percentage of positive identification (PPID) was calculated. The non-dental personnel's were also informed to record the factor that influenced their decision in identifying the STIR. For every positive identification, if the volunteer mentioned factor as soft tissue that influenced their decision, it was considered as pink positive. If it was the implant prosthesis that helped them in correct identification of STIR, the response was labeled as white positive. Overall, PPID for each case was calculated. Furthermore, PPID due to pink or white deficiency was also evaluated.

### Statistical analysis

Differences between all five groups of dental specialists for PES and WES scores were analyzed using one-way ANOVA test.

Spearman Rho correlation test was calculated to determine the strength of correlation between PPIDs for each of the 20 cases by non-dental personnel and PES/WES scores assigned by specialists. A scatter plot was generated between PPIDs citing pink deficiency with mean PES scores and PPIDs citing white deficiency with mean WES scores.

## Results

### PES/WES evaluation by dental specialists

In this study, 20 maxillary anterior single-tooth implants were esthetically evaluated by five groups of specialists (4 per group). A total of 400 PES and 400 WES scores were obtained.

The mean PES/WES scores were 6.46/6.58, 6.63/6.95, 7.41/7.75, 6.31/6.38, and 7.16/7.21 for general practitioners, periodontists, oral surgeons, prosthodontists, and endodontists, respectively. Oral surgeons assigned a higher PES and WES scores and prosthodontists were very critical regarding the same.

The intergroup difference between all five groups was statistically significant [Tables 1 and 2].

### PPID of STIR by non-dental personnel

The implant was correctly identified in 49 % of total opportunities. Of those, it was identified due to pink deficiency in 19% cases and white deficiencies accounted for remaining 20% cases [Graph 1].

### Correlation of non-dental personnel perception of STIR to mean PES/WES scores assigned by specialists

A total of 25 non-dental personnel were asked to identify STIR, either due to pink or white deficiency, in the digital photograph. Every positive identification per case due to pink component was correlated with overall mean PES score assigned by all the 20 specialists. Similarly, every correct identification due to white deficiency was correlated with mean WES scores (Scatter plot 1-3).

Spearman's Rho correlation found a strong negative correlation between mean PES and PPID due to pink deficiency and mean PES/WES scores with overall positive identification [Table 3].

Based on these correlation, it was calculated that when a STIR obtains a PES/WES score >16, 80% of the overall non-dental personnel were unable to identify it. Furthermore, when mean PES/WES scores were below 10, 64% correctly identified the presence of implant restoration.

## Discussion

Anterior esthetics in dental implants are an important aspect that cannot be ignored. Albrektsson's criteria for implant success were purely on the concept of osseointegration. However, these were later extended by Smith and Zarb in 1989 stressing on esthetic aspects also. Thus, peri-implant soft tissues along with the implant restoration are crucial.[4]

**Table 1:** Specialty wise observation of mean PES and WES scores of all 20 dental implants

| Dental Specialists | n | Mean±SD |
|---|---|---|
| PES | | |
| General practitioners | 80 | 6.46±1.896 |
| Periodontists | 80 | 6.63±2.184 |
| Oral surgeons | 80 | 7.41±2.097 |
| Prosthodontists | 80 | 6.31±2.016 |
| Endodontists | 80 | 7.16±2.137 |
| Total | 400 | 6.80±2.101 |
| WES | | |
| General practitioners | 80 | 6.58±2.110 |
| Periodontists | 80 | 6.95±2.158 |
| Oral surgeons | 80 | 7.75±1.761 |
| Prosthodontists | 80 | 6.38±2.252 |
| Endodontists | 80 | 7.21±1.826 |
| Total | 400 | 6.97±2.078 |
| PES/WES | | |
| General practitioners | 80 | 13.0375±3.26641 |
| Periodontists | 80 | 13.5750±3.88693 |
| Oral surgeons | 80 | 15.1625±3.40307 |
| Prosthodontists | 80 | 12.6875±3.54927 |
| Endodontists | 80 | 14.3750±3.63658 |
| Total | 400 | 13.7675±3.64990 |

PES: Pink esthetic score, WES: White esthetic score, SD: Standard deviation

**Table 2:** Inter- and intragroup comparison of pink and white esthetic scores using one-way ANOVA analysis

| ANOVA | | | | | |
|---|---|---|---|---|---|
| Group comparisons | Sum of squares | df | Mean square | F | Significant |
| PES | | | | | |
| Between groups | 71.090 | 4 | 17.772 | 4.154 | 0.003* |
| Within groups | 1690.100 | 395 | 4.279 | | |
| Total | 1761.190 | 399 | | | |
| WES | | | | | |
| Between groups | 94.210 | 4 | 23.553 | 5.713 | 0.001** |
| Within groups | 1628.488 | 395 | 4.123 | | |
| Total | 1722.698 | 399 | | | |
| PES/WES | | | | | |
| Between groups | 324.115 | 4 | 81.029 | 6.412 | 0.001** |
| Within groups | 4991.262 | 395 | 12.636 | | |
| Total | 5315.377 | 399 | | | |

**Intergroup analysis showed a statistically significant difference.
ANOVA: Analysis of variance, PES: Pink esthetic score, WES: White esthetic score
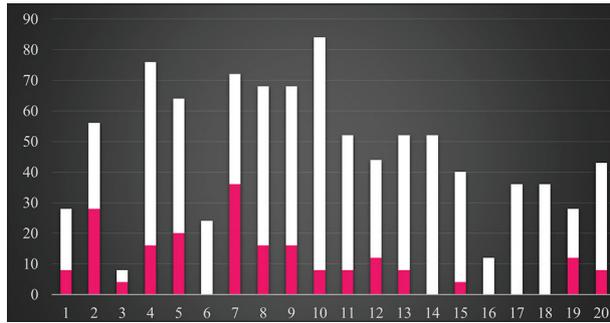
**Graph 1:** Percentage of positive identifications citing pink and white deficiency per case by non-dental personnel
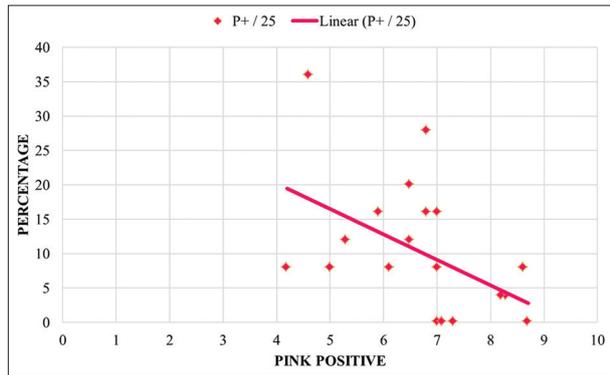


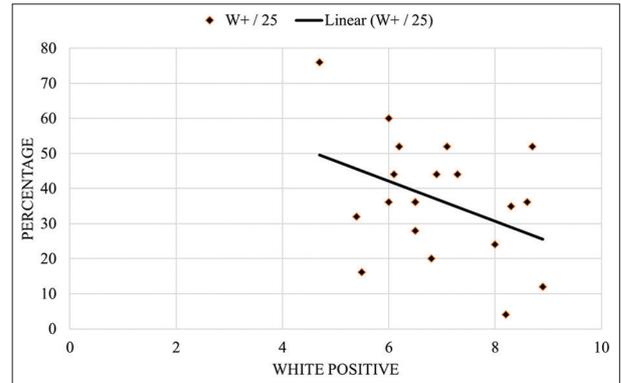**Scatter plot 1:** Case wise mean pink esthetic score assigned by specialists to percentage of positive pink identification by non-dental personnel



**Scatter plot 2:** Case wise mean white esthetic score assigned by specialists to percentage of positive white identification by non-dental personnel



**Scatter plot 3:** Case wise mean pink esthetic score/white esthetic score assigned by specialists to overall percentage of positive identification

In this study, the influence of the observer's dental specialization on their perception of esthetics was demonstrated. PES and WES grading system has become a standard objective assessment tool for esthetic evaluation on implants placed in the anterior zone.[8,9]
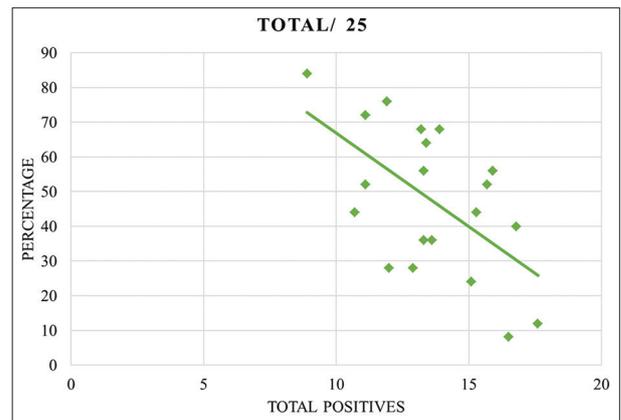
Similar to studies done by Al-Dosari *et al.*, 2016, Burgueño-Barris *et al.*, 2016, the present study also showed that prosthodontists assigned lowest scores and oral surgeons were very generous with PES/WES scores. There was a statistically significant difference among different dental specialists pertaining to PES and WES scores. Possible explanation for this could be attributed to their respective field of specialization. Patients usually stress more on esthetics after any form of prosthetic treatment. Thus, specialists tend to focus more on crown features, symmetry and golden proportion rather than on surrounding peri-implant tissues.

Furthermore, clinicians criticized white component more than soft tissue parameters. This could be due to the fact that in a day-to-day practice clinicians are more used to assess the esthetics of crown because they are able to change shape, color, or texture more easily, while peri-implant tissues are more difficult to modify and are technique sensitive.[10-12]

Most of the studies pertaining to esthetics evaluation of anterior implant were related to patient's own perception of the treatment outcome. Patient's satisfaction was analyzed using visual analog scale.[13-15]

However, in this study, non-dental personnel's perception of esthetic restoration in anterior zone was correlated to PES/WES ratings given by dental specialists. At times, patients can be biased about their own treatment outcome. Hence, volunteers unaware of the implant treatment were enrolled for the study.

In a study done by Belser et al., 2009, it was observed that if STIR reached a total PES/WES score of 12/20, 79% of non-dental personnel were unable to correctly identify it. Martin *et al.* performed a similar study in 2014. They concluded from their study that if an implant placed in upper anterior zone, achieves total PES/WES score of 12/20, it is considered to be esthetic stable.[5,16]

In the present study also results obtained were in accordance to previous studies conducted. In this study, also it was noticed that when the mean PES/WES scores given by specialists were 13/20, more than half of the non-dental personnel could not differentiate between implant and natural tooth. As value rose to 16/20, only 20% of them could correctly identify it. Spearman's

**Table 3:** Spearman Rho correlation between mean PES/pink positive, WES/white positive overall PES/WES to total positive identification

| Mean PES/WES scores | Mean PES/10 | Mean WES/10 | PES/WED/20 | P+/25 | W+/25 | Total/25 |
|---|---|---|---|---|---|---|
| MEAN PES/10 | | | | | | |
| Correlation coefficient | 1.000 | 0.674** | 0.900** | −0.616** | −0.349 | −0.576** |
| Significant (2-tailed) | 0.0 | 0.001 | 0.000 | 0.004 | 0.132 | 0.008 |
| *n* | 20 | 20 | 20 | 20 | 20 | 20 |
| MEAN WES/10 | | | | | | |
| Correlation coefficient | 0.674** | 1.000 | 0.905** | −0.406 | −0.266 | −0.382 |
| Significant (2-tailed) | 0.001 | 0.0 | 0.000 | 0.075 | 0.257 | 0.096 |
| *n* | 20 | 20 | 20 | 20 | 20 | 20 |
| PES/WES/20 | | | | | | |
| Correlation coefficient | 0.900** | 0.905** | 1.000 | −0.525* | −0.292 | −0.485* |
| Significant (2-tailed) | 0.000 | 0.000 | 0.0 | 0.018 | 0.211 | 0.030 |
| *n* | 20 | 20 | 20 | 20 | 20 | 20 |

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed). Mean PES/pink positive: −0.616**Strong negative mean WES/white positive: −0.266 weak negative mean PES/WES/total positives: −0485 *Strong negative. PES: Pink esthetic score, WES: White esthetic score

Rho analysis also showed a strong negative correlation with mean PES and percentage of positive pink identification and overall positive identification with PES/WES scores.

The results of this study indicate that white deficiencies are more easily perceived by laypeople than pink deficiencies. It is important to consider the fact that pink deficiencies can directly affect certain aspects of WES such as tooth form and volume/outline.[17,18]

## Conclusion

Dental esthetics are all about striking the right harmony between the pink and white components. Health of peri-implant hard and soft tissues and final implant restoration planned should be an integral part of overall treatment plan from the onset to ensure stable, functional and esthetically pleasing results. Dentist's assessment may be different from that of the patient because the latter is more subjective. Thus, a combination of subjective and objective assessment tool is required for esthetic evaluation of implants in anterior zone.

## References

1. Hochman MN, Chu SJ, Tarnow DP. Maxillary anterior papilla display during smiling: A clinical study of the interdental smile line. Int J Periodontics Restorative Dent 2012;32:375-83.
2. Buser D, Chappuis V, Belser UC, Chen S. Implant placement post extraction in esthetic single tooth sites: When immediate, when early, when late? Periodontol 2000 2017;73:84-102.
3. Buser D, Martin W, Belser UC. Optimizing esthetics for implant restorations in the anterior maxilla: Anatomic and surgical considerations. Int J Oral Maxillofac Implants 2004;19 Suppl:43-61.
4. Fürhauser R, Florescu D, Benesch T, Haas R, Mailath G, Watzek G, *et al.* Evaluation of soft tissue around single-tooth implant crowns: The pink esthetic score. Clin Oral Implants Res 2005;16:639-44.
5. Belser UC, Grütter L, Vailati F, Bornstein MM, Weber HP, Buser D, *et al.* Outcome evaluation of early placed maxillary anterior single-tooth implants using objective esthetic criteria: A cross-sectional, retrospective study in 45 patients with a 2- to 4-year follow-up using pink and white esthetic scores. J Periodontol 2009;80:140-51.
6. Belser UC, Buser D, Hess D, Schmid B, Bernard JP, Lang NP, *et al.* Aesthetic implant restorations in partially edentulous patients-a critical appraisal. Periodontol 2000 1998;17:132-50.
7. Baracat LF, Teixeira AM, Dos Santos MB, Da Cunha VD, Marchini L. Patient's expectations before and evaluation after dental implant therapy. Clin Implant Dent Relat Res 2011;13:141-5.
8. Furze D, Byrne A, Donos N, Mardas N. Clinical and esthetic outcomes of single-tooth implants in the anterior maxilla. Quintessence Int 2012;43:127-34.
9. Gu YX, Shi JY, Zhuang LF, Qiao SC, Xu YY, Lai HC, *et al.* Esthetic outcome and alterations of soft tissue around single implant crowns: A 2-year prospective study. Clin Oral Implants Res 2015;26:909-14.
10. Al-Dosari A, Al-Rowis R, Moslem F, Alshehri F, Ballo AM. Esthetic outcome for maxillary anterior single implants assessed by different dental specialists. J Adv Prosthodont 2016;8:345-53.
11. Burgueño-Barris G, Cortés-Acha B, Figueiredo R, Valmaseda-Castellón E. Aesthetic perception of single implants placed in the anterior zone. A cross-sectional study. Med Oral Patol Oral Cir Bucal 2016;21:e488-493.
12. Cho HL, Lee JK, Um HS, Chang BS. Esthetic evaluation of maxillary single-tooth implants in the esthetic zone. J Periodontal Implant Sci 2010;40:188-93.
13. Luo Z, Zeng R, Luo Z, Chen Z. Single implants in the esthetic zone: Analysis of recent peri-implant soft tissue alterations and patient satisfaction. A photographic study. Int J Oral Maxillofac Implants 2011;26:578-86.
14. Esposito M, Grusovin MG, Worthington HV. Agreement of quantitative subjective evaluation of esthetic changes in implant dentistry by patients and practitioners. Int J Oral Maxillofac Implants 2009;24:309-15.
15. Angkaew C, Serichetaphongse P, Krisdapong S, Dart MM,

Pimkhaokham A. Oral health-related quality of life and esthetic outcome in single anterior maxillary implants. Clin Oral Implants Res 2017;28:1089-96.

16. Jones AR, Martin W. Comparing pink and white esthetic scores to layperson perception in the single-tooth implant patient. Int J Oral Maxillofac Implants 2014;29:1348-53.

17. Vilhjálmsson VH, Klock KS, Størksen K, Bårdsen A. Aesthetics of implant-supported single anterior maxillary crowns evaluated by objective indices and participants' perceptions. Clin Oral Implants Res 2011;22:1399-403.

18. Juodzbalys G, Wang HL. Esthetic index for anterior maxillary implant-supported restorations. J Periodontol 2010;81:34-42.

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