Esthetic Index for Anterior Maxillary Implant-Supported Restorations

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Background: The aim of this study is to develop and validate a complex esthetic index (CEI) designed for rating the esthetics of anterior maxillary implant-supported restorations with respect to the surrounding soft and hard tissues.

Methods: Fifty patients (31 males and 19 females; age: 18 to 50 years; mean age ± SD: 32.4 ± 9.1 years) previously treated with dental implants were evaluated regarding the esthetic results of their restorations using the proposed CEI. Two calibrated oral surgeons did the evaluation and recording. The evaluation was carried out twice by each of the examiners 2 weeks apart. The weighted Cohen's κ was used to calculate the intra- and interobserver agreement.

Results: An analysis of CEI for 50 anterior maxillary implant-supported restorations showed good intra- and interobserver agreement for the soft tissue index (S) and implant-supported restoration index (R). Only the interobserver agreement for the overall R was rated as moderate (0.54 and 0.52). The single-parameter analysis showed that the lowest (moderate) intra- and interobserver agreement was with the subjective parameters of S (soft tissue color and texture variations) and R (crown surface roughness and ridges and color and translucency). An adequate CEI of S100, P100, and R100 was scored by both examiners in 10% and 12% of cases for evaluations I and II, respectively.

Conclusions: This study presents evidence that this newly developed CEI, which incorporates the implant restoration and adjacent soft and hard tissue parameters, is a reproducible tool for scoring anterior implant esthetic predictably. However, prospective clinical trials involving examiners with different training backgrounds are needed to further validate the long-term stability of this index. *J Periodontol 2010;81:34-42.*

KEY WORDS

Dental implants, single-tooth; dental prosthesis, implant-supported.

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The use of implants has evolved into an accepted, predictable treatment for replacing missing teeth. Implant rehabilitation is no longer just a vehicle to restore lost masticatory and phonetic function; it has become an integral part of modern implant dentistry for achieving structural and esthetically pleasing outcomes.[1] Implant-supported restorations should imitate the appearance of natural teeth.[1-4] Furthermore, the implant-supported restoration should be in symmetry with the adjacent dentition.[5] To ensure that optimal esthetics can be achieved during implant rehabilitation, the following prerequisites are considered essential: adequate bone volume (horizontal, vertical, and, contour), optimal implant position (mesio-distal, apico-coronal, bucco-lingual, and angulation), stable and healthy peri-implant soft tissues, and an esthetic soft tissue contour.[1,6-9]

Quantitatively evaluating esthetic results is quite new and has not been fully developed in implant dentistry. Most authors evaluated factors that encompass only a portion of our proposed complex esthetic index (CEI) for anterior maxillary implant-supported restorations. For example, Furhauser et al.[5] proposed the pink esthetic score (PES) to evaluate seven soft tissue parameters (mesial and distal papilla, alveolar process, soft-tissue texture, contour, and color, and level of the soft tissue margin) around single-tooth implant crowns. Meijer et al.[10] proposed a new index for rating esthetics of implant-supported

single crowns and adjacent soft tissues. The index consists of nine parameters that are based on the anatomic form, color, and surface characteristics of the crown and peri-implant soft tissues. Recently, Belser et al.[11] modified the PES classification system (assessed mesial papilla, distal papilla, curvature of the facial mucosa, level of the facial mucosa, and root convexity/soft tissue color and texture at the facial aspect of the implant site) and proposed a white esthetic score that included the general tooth form, outline and volume of the clinical crown, color (which includes the assessment of the dimension's hue and value and surface texture), and translucency to assess an implant-supported restoration. To our knowledge, there is no clear and statistically proven reproducible esthetic index that considers all potential influencing factors. One of the main issues surrounding these published classifications is that factors involving hard tissue (alveolar bone) are lacking. It is well established that the soft tissue appearance is largely dependent upon the underlying bone topography.[12] Hence, it is important to include a hard tissue assessment, such as horizontal bone deficiency and interproximal bone height, into any newly proposed esthetic index. Chen et al.[6] showed that implants with a buccally oriented shoulder position had three times more recession than implants with a lingual shoulder position. Furthermore, more tissue recession was noted in thin tissue biotype sites than in thick tissue biotype sites. Hence, an implant-supported restoration esthetic index should have a prognostic value that includes both soft and hard tissues. The aim of this study is not only to develop but also to validate a CEI for rating the esthetics of anterior maxillary implant-supported restorations and their surrounding soft and hard tissues.

MATERIALS AND METHODS

Subject Sample
Between January and April 2009, 50 patients (31 males and 19 females; age: 18 to 50 years; mean age ± SD: 32.4 ± 9.1 years) previously treated with dental implants were investigated in the Department of Maxillofacial Surgery, University of Kaunas, for implant esthetic outcomes using the proposed CEI. All implants[‡] were restored with abutments[§] and cement-retained restorations. The locations of the dental implants are shown in Figure 1. All participants read and signed an informed consent form. The use of human subjects in this study was reviewed and approved by the Health Science Institutional Review Board of the University of Kaunas. Subjects had to fulfill the following criteria to be included in the study: 1) single dental implants placed and restored between 1 and 2 years prior to the evaluation; 2) all evaluated implants in the esthetic zone of the maxilla, including first premolars; 3) adjacent teeth not restored with im-
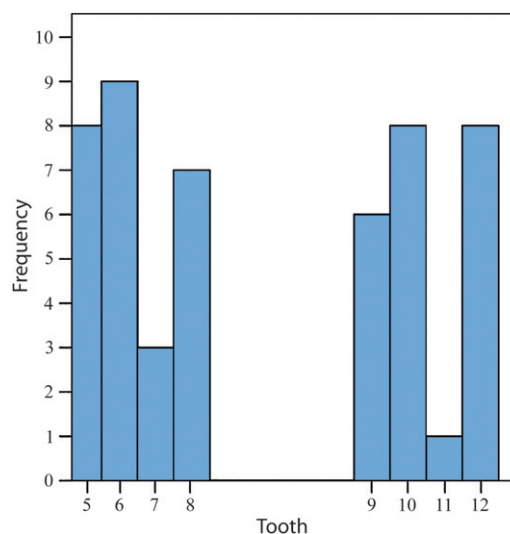

Figure 1.
Distribution of anterior maxillary dental implants.

plants or prosthetic restorations; and 4) available clinical records.

CEI for Anterior Maxillary Implant-Supported Restorations
Table 1 is an overview of the proposed CEI. This esthetic index is composed of three components: the soft tissue index (S), predictive index (P), and implant-supported restoration index (R). Within each category, specific parameters were evaluated and graded as adequate (rating 20%), compromised (rating 10%), or deficient (rating 0%).

Soft tissue characteristics of the S that were previously published[8] include soft tissue contour variations, soft tissue vertical deficiency, soft tissue color and texture variations, and mesial and distal papillae appearance.

The P primary assessed the following components: mesial and distal interproximal bone height, gingival tissue biotype, apico-coronal position of the implants, and horizontal contour deficiency. For the measurement of the interproximal marginal bone level, standardized periapical radiographs were taken using a customized film holder.[‖] The long-cone paralleling technique was used to determine the mesial and distal interproximal bone height. The evaluation was performed in a linear fashion from the cemento-enamel junction (CEJ) of the adjacent teeth to the mesial and distal alveolar bone crest using standardized computerized dental-imaging software.[¶] The implant apico-coronal position was recorded in the same way

Table 1.

CEI for an Anterior Maxillary Implant-Supported Restoration: S, P, and R Assessment Ratings and Evaluation Grades

Index and Parameters	Rating and Evaluation Grades of Parameter Variations		
	Adequate (20%)	Compromised (10%)	Deficient (0%)
S			
1: soft tissue contour variations	No	<2 mm	≥2 mm
2: soft tissue vertical deficiency	No	1 to 2 mm	>2 mm
3: soft tissue color and texture variations	No	Moderate	Obvious
4: mesial papillae appearance	Complete fill	Partial fill	None
5: distal papillae appearance	Complete fill	Partial fill	None
General rating and evaluation grade	100%	60% to 90%	<50%
P			
1: mesial interproximal bone height	<5 mm	5 to 7 mm	>7 mm
2: distal interproximal bone height	<5 mm	5 to 7 mm	>7 mm
3: gingival tissue biotype	>2 mm	1 to 2 mm	<1 mm
4: implant apico-coronal position	1.5 to 3 mm	>3 to 5 mm	>5 mm
5: horizontal contour deficiency	No	1 to 3 mm	>3 mm
General rating and evaluation grade	100%	60% to 90%	<50%
R			
1: color and translucency	No	Moderate	Obvious
2: labial convexity in the abutment/implant junction	No	<1 mm	<2 mm
3: implant/crown incisal edge position	No	±1 mm	±2 mm
4: crown width/length ratio	<0.85	0.85 to 1.0	>1.0
5: surface roughness and ridges	No	Moderate	Obvious
General rating and evaluation grade	100%	60% to 90%	<50%

to measure the dental-implant shoulder position. The gingival tissue biotype was evaluated as previously published.[8] The horizontal contour deficiency was assessed using a periodontal probe measuring from the middle part of the dental implant to an imaginary line drawn to the buccal bone flange of the adjacent teeth. Distances of 0, 1 to 3, and >3 mm were defined as adequate, compromised, and deficient grades, respectively.

The R evaluated the color and translucency of the implant-supported restoration, labial convexity in the abutment/implant junction, implant/crown incisal edge position, crown width/length ratio, and surface roughness and ridges of the implant-supported restoration in relationship to adjacent and contralateral teeth. All mentioned R parameters, with the exception of crown width/length ratio, must be in harmony with the adjacent and contralateral teeth. The variation in parameter ratings for each grade is shown in Table 1. Crown width/length ratios of <0.85, 0.85 to 1.0, and >1.0 were defined as adequate, compromised, or deficient.

To make the CEI more informative, each component of the indices (S, P, and R) is described independently. As mentioned above, each component consisted of five separate parameters defined as adequate (20%), compromised (10%) and deficient (0%). Consequently, when the S, P, and R general ratings were adequate, the CEI rating was 100%. When one of the indices registered between 60% and 90%, this was a compromised and clinically acceptable result. When the CEI was <50%, this was a deficient and clinically unacceptable esthetic outcome. For example, when the CEI was adequate, it was expressed as S100, P100, and R100.

For the measurement of the interproximal marginal bone level, standardized periapical radiographs were obtained using a customized film holder[#] with a rigid film-object x-ray source coupled to a beam-aiming device to achieve a reproducible exposure geometry. The long-cone paralleling technique was used with the aim of viewing the implant threads clearly. When deviation from optimal x-ray geometry was observed, the radiograph was retaken during the same visit. To assess the mesial and distal interproximal bone height, linear radiographic measurements were made using standardized computerized system

Rinn film holder, XCP Instruments, Rinn.

dental-imaging software.** Linear measurements were defined as the mesial and distal distance from the CEJ of the adjacent teeth to the highest point of the alveolar crest. The measurements were obtained by drawing a line through the mesial and distal aspect of the CEJ and measuring the distance perpendicularly to this line at the highest alveolar crest height on adjacent teeth. The implant apico-coronal position was obtained by measuring the distance from drawing a perpendicular line through the mesial and distal aspect of the CEJ at the dental implant shoulder.

Two calibrated oral surgeons (examiners 1 [GJ] and 2 [Dr. Dalius Sakavicius, Associate Professor, Department of Oral and Maxillofacial Surgery, Kaunas University of Medicine, Lithuania]) did the evaluation and recording. All linear measurements were recorded to the nearest 1 mm with the use of a periodontal probe.[††] Triple recordings were performed, and the mean value was calculated. The evaluation was carried out twice by each of the examiners. There was a 2-week time period between the evaluations to prevent recollection of the first evaluation.

Statistical Analyses
Statistical analyses were performed using a statistical program.[‡‡] The weighted Cohen's κ was calculated to express the intra- and interobserver agreement. κ represents the observed proportion of non-chance agreement. Means and standard deviations were also calculated.

RESULTS
S Evaluation
The intra- and interobserver agreement and weighted Cohen's κ for S parameters are listed in Table 2. Overall, good and very good agreements were noted. The lowest intraobserver agreement of 0.8 and 0.55 was for the soft tissue color and texture variations. Similarly, the lowest agreement of 0.74 was observed for the soft tissue color and texture variations in evaluation I and 0.43 in evaluation II.

Table 3 shows good or very good intra- and interobserver S agreement. Examiner 1 recorded the S as compromised in 29 (58%) cases, adequate in 13 (26%) cases, and deficient in eight (16%) cases. The mean S was 77.4% in both periods of evaluation as evaluated by examiner 1. A similar recording was noted by examiner 2, who scored 28 (56%) cases as compromised, 14 (28%) cases as adequate, and eight (16%) cases as deficient. The mean S was 78.0% and 78.4% as evaluated by examiner 2 in evaluation periods I and II, respectively. Figure 2A shows the almost even distribution of the S cumulative percentage depending on S grade, evaluation period, and examiner.

P Evaluation
The intra- and interobserver agreement and weighted Cohen's κ for the P parameters are listed in Table 2. There were good and very good agreements for all P items. The intraobserver agreement was 0.91 and 0.84 for examiners 1 and 2, respectively. The lowest agreement for examiner 1 was 0.9 for mesial interproximal bone height and, for examiner 2, was 0.92 for distal interproximal bone height and horizontal contour deficiency.

For the interobserver P agreement, 0.79 and 0.61 were found for evaluations I and II, respectively. The lowest agreement was found for the gingival tissue biotype variations in evaluation I and 0.77 for mesial interproximal bone height in the evaluation II.

Analysis of the distribution of P grades revealed that examiner 1 had the same number 28 (56%) of compromised P in both periods of evaluation (Table 3). A slight difference was noted in the other two grades. Similar observations were noted for examiner 2 in the index rating. The mean P was 67.4% and 66.6% evaluated by examiner 1 and 67.6% and 67.4% recorded by examiner 2 for evaluations I and II, respectively. Figure 2B shows an almost even distribution of the P cumulative percentage depending on the P grade, evaluation period, and examiner.

Implant-Supported R Evaluation
Table 2 lists the intra- and interobserver agreement and weighted Cohen's κ for the R parameters. A very good agreement of 0.92 and 0.84 was noted for both examiners (1 and 2). Examiner 1 had the lowest agreement of 0.93 for crown width/length ratio and examiner 2 had and agreement of 0.76 for crown color and translucency recording.

A moderate interobserver agreement (0.54 and 0.52) was identified in evaluations I and II. The lowest agreement in evaluation I was for crown surface roughness and ridges (0.63) and, for evaluation II, was for color and translucency (0.49).

Examiner 1 scored 35 (70%) and 36 (72%) of a compromised R in both periods of evaluation (Table 3). This was almost identical for examiner 2, who recorded 40 (80%) and 34 (68%) for evaluations I and II. The mean R was almost identical for both examiners (82.8% to 83.6%). Figure 2C shows that the cumulative percentage of the R depending on grade, evaluation period, and examiner was distributed evenly.

CEI Evaluation
Table 3 illustrates the results of the CEI. An adequate CEI of S100, P100, and R100 was observed by both

Table 2.

S, P, and R Parameter Evaluation: Intra- and Interobserver Agreement and Weighted Cohen's κ

| | Intraobserver Agreement | | | | Interobserver Agreement | | | |
| | Examiner 1 | | Examiner 2 | | Examiner 1 Versus Examiner 2: Evaluation I | | Examiner 1 Versus Examiner 2: Evaluation II | |
Assessment	Observed Agreement (%)	Cohen's κ	Observed Agreement (%)	Cohen's κ	Observed Agreement (%)	Cohen's κ	Observed Agreement (%)	Cohen's κ
S								
Soft tissue contour variations	100	1.0	98.0	0.96	98.0	0.96	96.0	0.92
Soft tissue vertical deficiency	100	1.0	98.0	0.96	98.0	0.96	100	1.0
Soft tissue color and texture variations	92.0	0.8	86.0	0.55	90.0	0.74	80.0	0.43
Mesial papillae appearance	100	1.0	98.0	0.96	100	1.0	98.0	0.96
Distal papillae appearance	100	1.0	100	1.0	100	1.0	100	1.0
General overall items	92.0	0.9	88.0	0.86	86.0	0.83	78.0	0.73
P								
Mesial interproximal bone height	94.0	0.9	96.0	0.93	96.0	0.93	86.0	0.77
Distal interproximal bone height	96.0	0.93	94.0	0.92	96.0	0.96	90.0	0.82
Gingival tissue biotype	98.0	0.97	100	1.0	90.0	0.84	92.0	0.87
Implant apico-coronal position	98.0	0.96	98.0	0.96	98.0	0.96	98.0	0.96
Horizontal contour deficiency	100	1.0	96.0	0.92	94.0	0.88	94.0	0.88
General overall items	92.0	0.91	86.0	0.84	82.0	0.79	66.0	0.61
R								
Color and translucency	98.0	0.94	92.0	0.76	78.0	0.65	80.0	0.49
Labial convexity in the abutment/implant junction	100	1.0	98.0	0.96	92.0	0.85	90.0	0.81
Implant/crown incisal edge position	98.0	0.94	98.0	0.94	98.0	0.94	98.0	0.94
Crown width/length ratio	96.0	0.93	100	1.0	96.0	0.93	100	1.0
Surface roughness and ridges	98.0	0.94	96.0	0.85	88.0	0.63	90.0	0.65
General overall items	94.0	0.92	84.0	0.84	64.0	0.54	62.0	0.52

examiners in 10% and 12% of cases in evaluations I and II, respectively (Fig. 3A). Further analysis revealed the importance of each CEI component. It was found that in situations where the CEI was S100, P100, and R <100%, the number of cases was the same as it was using the adequate CEI (Fig. 3B). When the P was <100%, the number of cases with adequate S and R was reduced more than twice. When the S was <100%, the number of cases with adequate P and R was significantly reduced.

DISCUSSION

Esthetic-outcome assessment has become an emerging area of focus in implant dentistry. This is particu-
larly true for anterior maxillary implant-supported restorations. To sustain the esthetic appearance, it is essential to consider surrounding soft and hard tissue characteristics and how they relate to adjacent structures. Studies[5,10,11] published in this field tended to focus only on a few of these factors. It is quite evident that, when esthetics are considered, authors should examine and evaluate all soft and hard tissue parameters and implant-supported restoration because all these factors are important for long-term esthetic stability. For instance, horizontal bone level and interproximal bone height are tightly correlated to the stability and appearance of the peri-implant tissue.[12] Interestingly, Chen et al.[6] showed that the thin tissue biotype had more implant soft tissue recession
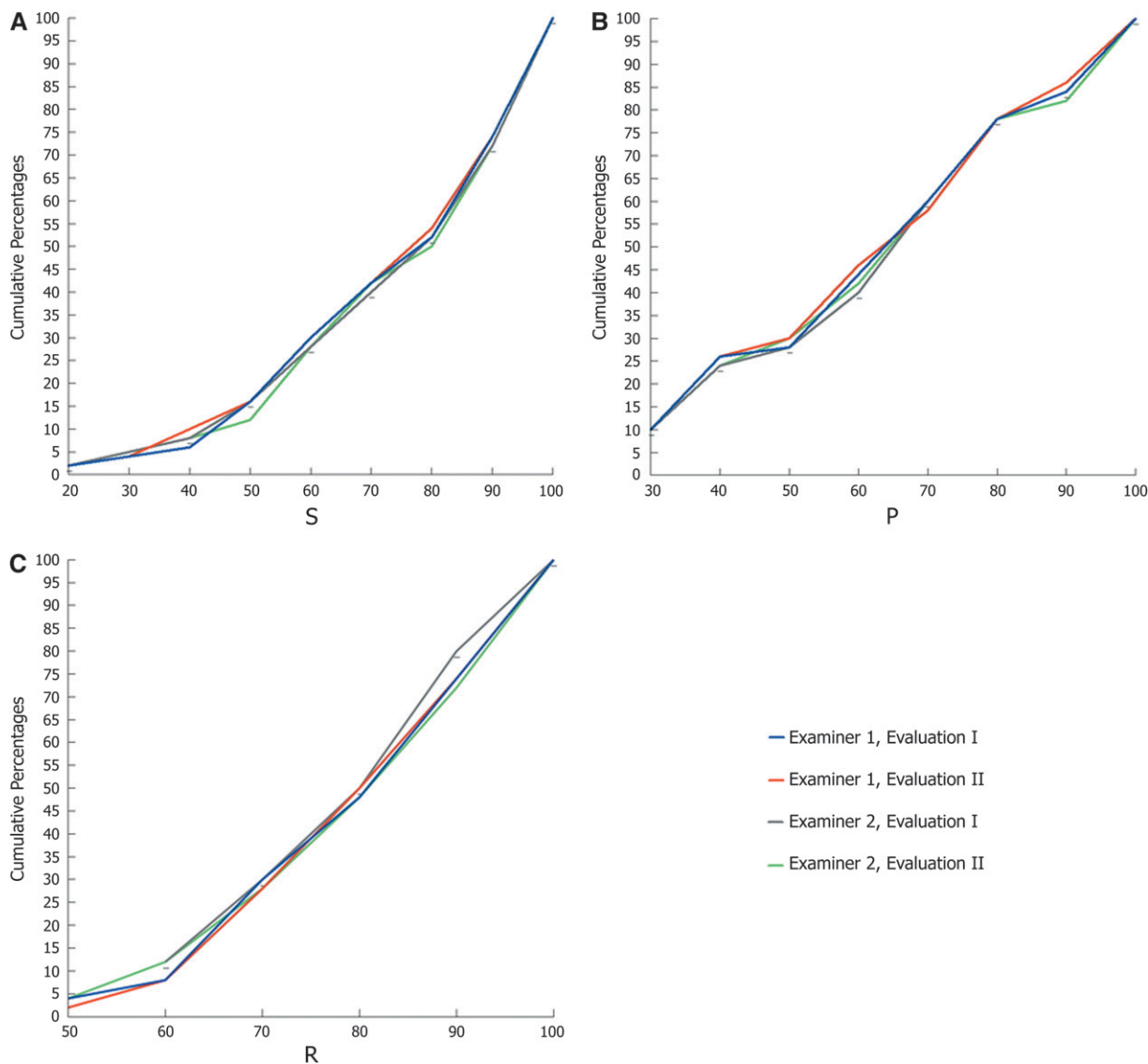
Figure 2.
*Distribution of cumulative percentages depending on S **(A)**, P **(B)**, and R **(C)** grade, evaluation period, and examiner.*

than the thick tissue biotype. Similarly, implants with a buccal shoulder position had three times more recession than implants with a lingual/palatal shoulder position. Using the CEI, which includes both soft and hard tissue assessments, the results from the present study show that CEI can be a good index to adequately predict future implant esthetics. As previously stated, the CEI analyzes soft tissue, hard tissue, and restoration because all of these influence the esthetic outcomes of implants. Different variations of these three parameters were evaluated and graded as adequate (rating 20%), compromised (rating 10%), and deficient (rating 0%). A simple rating by three grades, adequate, compromised, and deficient, was chosen because if more detailed ratings were applied then the results would become difficult to interpret, especially in the in-

termediate category. This concern was reported by Trisi and Rao[13] in bone scoring and by Furhauser et al.[5] in soft tissue assessment.

An analysis of CEI for 50 anterior maxillary implant-supported restorations showed good intra- and interobserver agreement for the S and R. Only interobserver agreement for the overall R was rated as moderate (0.54 and 0.52). This can be attributed to the lack of prosthetic restorative experience of the examiners. Both examiners were specialized in oral surgery. This was further supported by the study published by Meijer et al.[10] in which the prosthodontists had better intraobserver implant-crown esthetic-index agreement than the oral-maxillofacial surgeons. The appreciation of the esthetic outcome of the single implant-supported crowns was rated

Table 3.

S, P, and R Evaluation Grades (%) Assessed by Examiners 1 and 2 in Evaluations I and II

Parameter Evaluation Grade	Examiner 1/ Evaluation I			Examiner 1/ Evaluation II			Examiner 2/ Evaluation I			Examiner 2/ Evaluation II		
	n	Index Within Evaluation Grades	Cumulative Index Grade	n	Index Within Evaluation Grades	Cumulative Index Grade	n	Index Within Evaluation Grades	Cumulative Index Grade	n	Index Within Evaluation Grades	Cumulative Index Grade
S												
Deficient												
20	1	2	2	1	2	2	1	2	2	1	2	2
30	1	2	4	1	2	4	0	0	0	0	0	0
40	1	2	6	0	0	0	3	6	8	3	6	8
50	5	10	16	6	12	16	4	8	16	2	4	12
Compromised												
60	7	14	30	7	14	30	6	12	28	8	16	28
70	6	12	42	6	12	42	6	12	40	7	14	42
80	5	10	52	6	12	54	6	12	52	4	8	50
90	11	22	74	10	20	74	10	20	72	11	22	72
Adequate												
100	13	26	100	13	26	100	14	28	100	14	28	100
Mean (SD)		77.4 (20.98)			77.4 (20.58)			78.0 (20.9)			78.4 (20.54)	
P												
Deficient												
30	30	30	30	30	30	30	30	30	30	30	30	30
40	40	40	40	40	40	40	40	40	40	40	40	40
50	50	50	50	50	50	50	50	50	50	50	50	50
Compromised												
60	8	16	44	8	16	46	6	12	40	6	12	42
70	8	16	60	6	12	58	10	20	60	9	18	60
80	9	18	78	10	20	78	9	18	78	9	18	78
90	3	6	84	4	8	86	3	6	84	2	4	82
Adequate												
100	8	16	100	7	14	100	8	16	100	9	18	100
Mean (SD)		67.4 (22.7)			66.6 (22.64)			67.6 (22.46)			67.4 (22.84)	
R												
Deficient												
50	2	4	4	1	2	2	0	0	0	2	4	4
Compromised												
60	2	4	8	3	6	8	6	12	12	4	8	12
70	11	22	30	10	20	28	9	18	30	8	16	28
80	9	18	48	11	22	50	10	20	50	10	20	48
90	13	26	74	12	24	74	15	30	80	12	24	72
Adequate												
100	13	26	100	13	26	100	10	20	100	14	28	100
Mean (SD)		83.6 (13.96)			83.8 (13.38)			82.8 (13.1)			83.6 (14.54)	

higher by patients than by prosthodontists.[14] It is evident that dental professionals are less satisfied with respect to the result than their patients.[14-16] Meijndert et al.[16] reported that the peri-implant mucosa was rated as less satisfactory than the implant-supported crown by dental professionals and patients.

Single-parameter analyses showed that the lowest (moderate) intra- and interobserver agreement was for the subjective parameters of S (soft tissue color and texture variations) and R (crown surface roughness and ridges and color and translucency). Subjective parameters were reduced to a minimum for S
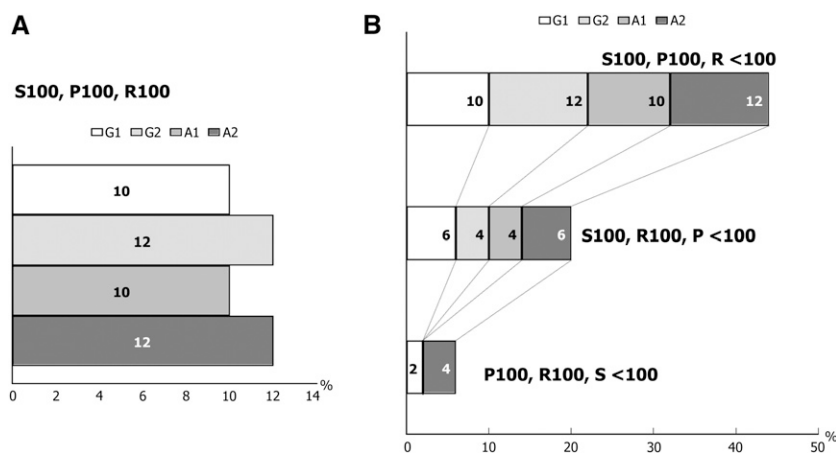
Figure 3.
A) *Adequate (S100, P100, and R100) CEI distribution evaluated by surgeons 1 and 2 in both evaluation periods.* **B)** *CEI distribution when one of the indexes was <100 as evaluated by surgeons 1 and 2 in both evaluation periods. G1 = examiner 1, evaluation I; G2 = examiner 1, evaluation II; A1 = examiner 2, evaluation I; A2 = examiner 2, evaluation II.*

evaluation. This is in agreement with Belser et al.,[11] who developed the PES that combines both soft tissue color and texture into one score in an attempt to minimize the subjectivity of the index evaluation. Nonetheless, registered differences among ratings of single parameters have no significant influence on the overall S, P, and R CEI grade (Table 3). In addition, CEI is a reliable esthetic index for grading implant esthetic outcomes. This is supported by the fact that both examiners independently scored an adequate CEI of S100, P100, and R100 in 10% and 12% of cases for evaluations I and II, respectively (Fig. 3A).

The analysis of the importance of each component of the CEI showed that, in situations where the CEI was S100, P100, and R <100%, the number of cases was the same as those reported with an adequate CEI (Fig. 3B). This suggests that implant-supported restoration quality can be compromised or deficient even if the S and P are adequate.

CONCLUSIONS

The CEI presented in this article consists of an assessment of adjacent soft and hard tissues and implant restorations and was found to be a reproducible tool for scoring the predictability of anterior implant esthetics. However, prospective clinical trials involving examiners with a prosthetic background are needed to further validate the long-term stability of this index.

ACKNOWLEDGMENTS

REFERENCES

1. Kazor CE, Al-Shammari K, Sarmment DP, Misch CE, Wang HL. Implant plastic surgery: A review and rationale. *J Oral Implantol* 2004;30:240-254.
2. Phillips K, Kois JC. Aesthetic peri-implant site development. The restorative connection. *Dent Clin North Am* 1998;42:57-70.
3. Belser U, Buser D, Higginbottom F. Consensus statements and recommended clinical procedures regarding esthetics in implant dentistry. *Int J Oral Maxillofac Implants* 2004; 19(Suppl.):73-74.
4. Juodzbalys G, Wang HL. Soft and hard tissue assessment of immediate implant placement: A case series. *Clin Oral Implants Res* 2007;18: 237-243.
5. Furhauser R, Florescu D, Benesch T, Haas R, Mailath G, Watzek G. Evaluation of soft tissue around single-tooth implant crowns: The pink esthetic score. *Clin Oral Implants Res* 2005;16:639-644.
6. Chen ST, Darby IB, Reynolds EC. A prospective clinical study of non-submerged immediate implants: Clinical outcomes and esthetic results. *Clin Oral Implants Res* 2007;18:552-562.
7. Evans CDJ, Chen ST. Esthetic outcomes of immediate implant placements. *Clin Oral Implants Res* 2008; 19:73-80.
8. Juodzbalys G, Sakavicius D, Wang H-L. Classification of extraction sockets based upon soft and hard tissue components. *J Periodontol* 2008;79:413-424.
9. De Rouck T, Collys K, Cosyn J. Single-tooth replacement in the anterior maxilla by means of immediate implantation and provisionalization: A review. *Int J Oral Maxillofac Implants* 2008;23:897-904.
10. Meijer HJ, Stellingsma K, Meijndert L, Raghoebar GM. A new index for rating aesthetics of implant-supported single crowns and adjacent soft tissues – The Implant Crown Aesthetic Index. *Clin Oral Implants Res* 2005; 16:645-649.
11. Belser UC, Grütter L, Vailati F, Bornstein MM, Weber HP, Buser D. 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; 80:140-151.
12. Bianchi AE, Sanfilippo F. Single-tooth replacement by immediate implant and connective tissue graft: A 1-9-year clinical evaluation. *Clin Oral Implants Res* 2004;15:269-277.
13. Trisi P, Rao W. Bone classification: Clinical-histomorphometric comparison. *Clin Oral Implants Res* 1999;10:1-7.
14. Chang M, Odman PA, Wennström JL, Andersson B. Esthetic outcome of implant-supported single-tooth replacements assessed by the patient and by prosthodontists. *Int J Prosthodont* 1999;12:335-341.

15. De Rouck T, Collys K, Cosyn J. Immediate single-tooth implants in the anterior maxilla: A 1-year case cohort study on hard and soft tissue response. *J Clin Periodontol* 2008;35:649-657.
16. Meijndert L, Meijer HJ, Stellingsma K, Stegenga B, Raghoebar GM. Evaluation of aesthetics of implant-supported single-tooth replacements using different bone augmentation procedures: A prospective ran-domized clinical study. *Clin Oral Implants Res* 2007; 18:715-719.

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