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**Single-tooth implants with different neck designs in the aesthetic zone: A randomized clinical trial evaluating the aesthetic outcome**
Abstract
Aim: To evaluate the aesthetic outcome of single-tooth implants in the aesthetic zone with different neck designs from a professional’s and patient’s perception.

Material and Methods: 93 patients with a missing anterior tooth in the maxilla were randomly assigned to be treated with an implant with a smooth neck, a rough neck with grooves or a scalloped rough neck with grooves. Implants were installed in healed sites. One year after definitive crown placement, photographs were taken and the aesthetic outcome was assessed by professionals according to two objective aesthetic indexes (PES/WES and Implant Crown Aesthetic Index (ICAI)). A questionnaire was used to assess the aesthetic outcome and general satisfaction from a patient’s perception.

Results: One implant was lost. There were no differences in aesthetic outcome between the implant neck designs. According to the professional’s assessment using PES/WES and ICAI, respectively 79.3% and 62% of the cases showed acceptable crown aesthetics and 59.8% and 56.5% acceptable mucosa aesthetics. Overall, patients were satisfied about the aesthetics of the mucosa (>80%) and crown (>93%) and general patient satisfaction was high (9.0 ± 1.0) out of a maximum of 10). The professional's assessment revealed that a pre-implant augmentation procedure was associated with less favorable aesthetics of the mucosa.

Conclusion: This study shows that the aesthetic outcome of single-tooth implants in the maxillary aesthetic zone appears to be independent on the implant neck designs applied, but dependent on the need for pre-implant surgery.
**Introduction**

The focus of attention in contemporary implantology has shifted from implant survival towards the quality of implant survival. Particularly in the anterior region, the aesthetic outcome has been considered to be of significance for the overall treatment success (Den Hartog et al. 2008, Annibali et al. 2009, Belser et al. 2009). Both the appearance of the implant crown and the peri-implant mucosa contribute to the final aesthetic outcome (Meijer et al. 2005, Belser et al 2009).

The level of the peri-implant mucosa is an important aspect determining the aesthetic outcome (Meijer et al. 2005, Belser et al 2009). The level of the peri-implant marginal bone has been associated with the level of the peri-implant mucosa (Bengazi et al. 1996, Hermann et al. 1997, Hermann et al. 2001). After implant placement, it is accepted that some peri-implant marginal bone loss will occur (Laurell et al. 2009). Hence, loss of peri-implant marginal bone might affect the level of the peri-implant mucosa and with that the final aesthetic outcome.

The design of the implant neck is considered to be of relevance for preservation of marginal peri-implant bone (Hermann et al. 1997, Lee et al. 2007, Bratu et al. 2009). It has been reported that an implant neck with a roughened surface or with retention elements might result in less marginal peri-implant bone resorption than a traditional smooth implant neck. (Shin et al. 2006, Lee et al. 2007, Bratu et al. 2009) As a consequence, novel implant designs are often provided with a roughened surface and retention elements at the implant neck to induce maximum bone preservation, particularly when to be applied in aesthetically sensitive cases. Apart from the capacity of a rough implant neck to preserve marginal peri-implant bone, it has been suggested that an implant neck with a scalloped implant platform might preserve marginal peri-implant bone, particularly at the proximal side (Wohrle et al. 2003, Kan et al. 2007). Such a scalloped implant neck would mirror the alveolar ridge curvature, which is lower on the facial and oral aspects but rises in the proximal areas. As a consequence, a more non-violant position of the implant-abutment interface could be realised compared to common flat-platform implant designs.

To assess the aesthetic outcome of implant therapy, both the opinion of the professional and patient have to be considered. From a professional’s perception, the aesthetic outcome should be explored using an objective rating instrument. Such an instrument will facilitate a thorough analysis of the final result to improve surgical or prosthetic treatment aspects. Furthermore, it can be of value to assess treatment strategies longitudinally or to identify host factors. Recently, two instruments have been introduced to measure the aesthetics of the crown and mucoca, namely The Implant Crown Aesthetic Index (ICAI) (Meijer et al. 2005) and the Pink Esthetic Sore/White Esthetic Score (PES/WES) (Belser et al. 2009).

As the patient is the final user of implant therapy, the opinion of the patient...
is also of importance (Esposito et al., 2009). A method to assess the subjective aesthetic outcome from a patient’s perspective is the use of questionnaires (Levi et al. 2003, Schropp et al. 2004, Pjetursson et al. 2005).

Inherent to the recent shift in implantology towards the quality of implant survival, only a few studies on implant therapy in the anterior dentition inquired into the aesthetic outcome (Den Hartog et al. 2008, Annibali et al. 2009). To our best knowledge, no clinical trials have yet been published addressing the aesthetic outcome of different implant neck designs. Furthermore, little is known about predisposing factors associated with the final aesthetic outcome. Therefore, the aim of this trial was to assess from a professionals and patient’s perception, the aesthetic outcome of anterior single-tooth implants with three different neck designs.

**Material and Methods**

**Patients**

All patients with a single missing tooth in the maxillary aesthetic zone (incisor, canine or first premolar) who were referred for implant treatment to the department of Oral and Maxillofacial Surgery (University Medical Center Groningen, University of Groningen, Groningen, the Netherlands) were considered for inclusion. Patients had to be at least 18 years of age. The width of the diastema was at least 6 mm and was neighboured with natural teeth. Oral hygiene had to be adequate (modified plaque index and modified sulcus bleeding index scores ≤ 1 (Mombelli et al. 1987). Exclusion criteria were smoking, ASA score ≥ III, presence of an active periodontal disease as expressed by probing pocket depths ≥ 4 mm and bleeding on probing (index score > 1) and a history of radiotherapy to the head and neck region.

**Study design**

The study protocol of this prospective randomized clinical trial was approved by the Medical Ethical Committee of the University Medical Center Groningen and written informed consent was obtained from all eligible patients before enrolment. Patients were included between January 2005 and February 2008. By means of a specifically designed locked computer program, patients were randomly assigned to one of three study groups to be treated with an implant with

- a 1.5 mm smooth (‘machined’) implant neck (Replace Select Tapered, Nobel Biocare AB, Göteborg, Sweden) – ‘smooth’ group;
- a rough implant neck with grooves (NobelReplace Tapered Groovy, Nobel Biocare AB) – ‘rough’ group;
- a scalloped rough implant neck with grooves (NobelPerfect Groovy, Nobel Biocare AB) – ‘scalloped’ group.
Randomization by minimization (Altman 1991) was used to minimize differences between the treatment groups with regard to the following variables: age (≤ 30 years, >31 ≤ 60 years, > 60 years), location of the implant site (central or lateral incisor, canine or first premolar) and whether or not a pre-implant augmentation procedure in a separate session was indicated beforehand. The surgeon that inserted the implants was informed about the allocation on the day of surgery.

**Intervention procedure**

Implants were inserted in healed sites at least three months after tooth removal. When bone volume was insufficient for implant placement, a bone augmentation procedure was carried out in a separate session. As a grafting material, autogenous intra-oral bone was used together with anorganic bovine bone (Geistlich Bio-Oss®, Geistlich Pharma AG, Wolhusen, Switzerland). Implants were inserted three months after the augmentation procedure.

At implant surgery, a slightly palatal crest-incision with extensions through the buccal and palatal sulcus of the adjacent teeth and a divergent relieving incision at the distal tooth were made. A minimal mucoperiosteal flap was prepared to expose the alveolar ridge. The implant site was prepared by using a surgical template that was fabricated in the dental laboratory, based on the prospective implant crown in its ideal position. The shoulder of the implant was placed at a depth of 3 mm apical to the most apical aspect of the surgical template for optimal emergence profile. For the scalloped implants the mid-facial part of the implant shoulder was taken as reference. In all cases the alveolar bone was levelled to the implant neck. An implant dehiscence, fenestration or bone wall thickness <2mm facially to the implant, was augmented according to a local augmentation procedure with autogenous bone chips collected during implant bed preparation and anorganic bovine bone (Geistlich Bio-Oss®) covered with Geistlich Bio-Gide®. The wound was closed with Ethilon 5-0 nylon sutures (Johnson & Johnson Gateway, Piscatatway, USA).

During the healing phase, patients were wearing a removable partial denture that did not interfere with the wound. After three months, implants were uncovered and a screw-retained provisional crown was fabricated by means of an engaging temporary abutment and composite (Solidex, Shofu inc., Kyoto, Japan). After a provisional phase of three months (i.e., six months post-implant placement) a definitive crown was made consisting of an individually fabricated zirconia abutment for the smooth and rough groups (Procera, Nobel Biocare AB) and individualized titanium abutments (Procera, Nobel Biocare AB) for the implants in the scalloped group, since zirconia abutments were not available for these implants. A zirconica Procera coping (Nobel Biocare AB) was luted over the titanium abutments in order to create an abutment with a zirconia outside. Depending on the location of the screw access hole, crowns were cement-retained by means
of a zirconia Procera coping (Nobel Biocare AB) or screw-retained by fusing porcelain directly to the abutment. Cemented-retained crowns were cemented with glass ionomer cement (Fuji Plus, GC Europe, Leuven, Belgium). In seven patients the contralateral tooth received a new all-ceramic zirconia crown (Procera) in the same procedure (two in the smooth group and rough group, three in the scalloped group). For more details regarding product specifications, we refer to a previous clinical report (Den Hartog et al. 2009).

All surgical procedures were performed by a single experienced surgeon. The prosthetic procedure was accomplished by two experienced prosthodontists and all crowns were fabricated by one dental technician.

**Aesthetic assessment**

The aesthetic outcome was assessed on digital photographs that were taken one year after placement of the definitive crown (18 months after implant placement) (camera: Fuji-film FinePix S3 Pro). The implant and adjacent dentition were captured on one photograph which was centered at the midline. Of implants that replaced a lateral incisor, canine or first premolar, two additional photographs were taken on which the implant and contralateral tooth were centered.

The Implant Crown Aesthetic Index (ICAI) (Meijer et al. 2005) and the Pink Esthetic Sore/White Esthetic Score (PES/WES) (Belser et al. 2009) were used to determine the aesthetics of the peri-implant mucosa and implant crown. Both indexes were used, to allow for comparison with data from other studies. Both indexes are composed of aesthetically related items based on the anatomic form, colour and surface characteristics of the implant crown and peri-implant soft tissue.

The ICAI contains nine items, of which five related to the crown and four related to the peri-implant mucosa. For each item, penalty points of 0, 1 and 5 can be given representing respectively no, minor and major deviations compared to the contralateral tooth and adjacent dentition. The total score for crown and mucosa leads to the following corresponding judgement about the aesthetic outcome: 0 points, excellent; 1 or 2, satisfactory; 3 or 4, moderate; 5 or more, poor aesthetics (note: one item with a major deviation leads to poor aesthetics). In this study, the ICAI was slightly modified and has been used to analyze the aesthetics of the crown (ICAI crown) and the aesthetics of the mucosa (ICAI mucosa) separately.

The PES/WES contains ten items, five for crown and mucosa each. In contrast to the ICAI, the PES/WES reward items with points instead of utilizing penalty points. Taking the contralateral tooth as a reference, on each item 0, 1, or 2 points can be assigned representing major, minor or no discrepancies respectively. The highest possible score for the crown (WES) and for the mucosa (PES) is 10. A threshold of clinical acceptability has been defined for the PES/WES, which is set at 6 points for the WES and 6 points for the PES.
Measurements were done by two observers that were blinded to the group allocation. The intra-observer agreement of the ICAI and PES/WES has been shown to be acceptable in the studies in which these indexes were introduced (Meijer et al. 2005, Belser et al. 2009).

**Patient satisfaction**

Patient satisfaction was assessed using a self-administered questionnaire. The questionnaire comprised of four questions regarding patient’s aesthetic satisfaction with the colour and shape of the crown and mucosa. These questions could be answered on a 5-point rating scale ranging from ‘very dissatisfied’ (score 1) to ‘very satisfied’ (score 5). Furthermore, patients were asked to mark their general satisfaction on a 10 cm Visual Analogue Scale (VAS) having end phrases ‘very dissatisfied’ (0) on the left end and ‘very satisfied’ (10) on the right end.

**Data analysis**

ICAI crown scores, ICAI mucosa scores, PES scores and WES scores were analyzed separately. To assess the inter-observer agreement of both aesthetic evaluation instruments, linear weighted kappa (κ) values were calculated. Per patient, ICAI and PES/WES scores of both observers were averaged. For the ICAI, the average score was subsequently transposed to the corresponding judge (i.e. excellent, satisfactory, moderate, poor aesthetics).

For between-group comparisons Kruskal-Wallis tests were used followed by post-hoc Mann-Whitney tests in case of statistical significance. To identify factors associated with the aesthetic outcome, regression analyses were performed. The following factors were explored: implant type, age, gender and whether or not a pre-implant augmentation procedure was performed. Correlations between the aesthetic outcome and patient’s aesthetic satisfaction were determined with Spearman’s correlation tests.

In all analyses, a significant level of 0.05 was chosen. Data were analysed using the Statistical Package for Social Sciences (version 16.0, SPSS Inc, Chicago, USA).

**Results**

**Patients**

A total of 93 patients was included. Details regarding patient characteristics are depicted in Table 1. One implant in the smooth group was lost five months after implant placement. The implant survival rate at 18 months after implant placement was 96.8 % (1 implant lost) for the smooth group and 100% for the rough and scalloped study groups. All patients attended the follow-up visit at one year after definitive crown placement.
Aesthetic assessments

The PES/WES showed a satisfactory inter-observer agreement. A weighted $\kappa$-value of 0.69 was calculated for the PES and a value of 0.62 for the WES. The ICAI showed satisfactory inter-observer agreement for the soft tissue assessment ($\kappa$-value 0.64), whereas moderate agreement was found for the assessment of the crown ($\kappa$-value 0.39). Because of this moderate agreement, the ICAI crown assessment was not used in the statistical analyses.

There were no differences between study groups regarding the aesthetic outcome of the crown and peri-implant mucosa (Table 2). Furthermore, a per-item analysis of both indexes showed no differences between study groups. According to the PES/WES, in 59.8% of the cases the mucosa showed acceptable aesthetics (PES-score $\geq 6$) and in 79.3% of the cases the aesthetics of the crown were acceptable (WES-score $\geq 6$). According to the ICAI, 56.5% of the cases showed satisfactory mucosa aesthetics (satisfactory and excellent) and 62% showed satisfactory crown aesthetics. For both indexes, the crown item ‘colour of the crown’ showed the lowest score and most penalty points. According to the WES, 69% of the crowns showed a discrepancy in colour and according to the ICAI this percentage was 68% (mean values of both observers). The soft tissue item ‘level of the facial mucosa’ showed the most penalty points of the ICAI (54% on average showed deviation) and the second lowest score of the PES (61% on average showed deviation). The PES-item ‘root convexity, soft tissue colour and texture’ was assigned the lowest score (76% showed deviation).

Multivariate linear regression analysis revealed that a pre-implant augmentation procedure was significantly associated with a lower PES score and ICAI mucosa score (regression coefficient respectively 1.27 and 0.55 for PES and ICAI).

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Table 1. Baseline characteristics per study group.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Smooth group (n=31)</th>
<th>Rough group (n=31)</th>
<th>Scalloped group (n=31)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years) ± standard deviation</td>
<td>37.2 ± 12.9 (18-60)</td>
<td>40.1 ± 14.4 (18-67)</td>
<td>40.1 ± 17.2 (19-80)</td>
</tr>
<tr>
<td>Male/female ratio</td>
<td>15/16</td>
<td>17/14</td>
<td>14/17</td>
</tr>
<tr>
<td>Implant site location</td>
<td>20 / 7 / 1 / 3</td>
<td>18 / 8 / 3 / 2</td>
<td>18 / 6 / 3 / 4</td>
</tr>
<tr>
<td>Augmentation before implant surgery*</td>
<td>12</td>
<td>11</td>
<td>10</td>
</tr>
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</table>

*Implants were installed after three months.
The factor age contributed significantly to the outcome of WES (regression coefficient -0.048), whereas implant type and gender were not associated with the aesthetic outcome.

**Patient satisfaction**
Patient satisfaction was high (Table 3) and there were no between-group differences. General patient satisfaction scores using VAS ranged from 5.5 to 10.

Patient's aesthetic satisfaction with the appearance of the mucosa (colour and shape) was correlated with the outcome of PES. The outcome of all questions was correlated with general patient satisfaction.

**Discussion**
This clinical trial assessed the aesthetic outcome of single-tooth implants in the anterior dentition with three different neck designs as an independent factor,
using two established indexes for rating the objective aesthetic outcome and a questionnaire to subjectively evaluate the aesthetics from the patient's perception. No differences were observed between the aesthetic outcome of the three implant neck designs included in this trial. Patient satisfaction was high and it revealed that there was a discrepancy between the patient’s aesthetic satisfaction and the objective aesthetic outcome according to the indexes.

With regard to the aesthetic outcome of the peri-implant mucosa, no differences were notified between the three implant neck designs. Furthermore, none of the separate soft tissue items showed differences between the study groups. Beforehand, we hypothesized that the design of the implant neck might have an effect on the level of the peri-implant mucosa. However, using both indexes, such an effect could not be shown in our study. One reason for this might be that the difference in marginal bone resorption between the scalloped group and the other study groups brought about a clinical effect that was too little to be observed with the aesthetic indexes we applied (See Chapter 3 for more details regarding marginal bone loss). A second reason might be attributed to the role of the periodontium of the adjacent teeth. It is assumed that the bone level next to the adjacent teeth is highly related to at least the future level of the papillae (Choquet et al. 2001, Romeo et al. 2008). Possibly, the periodontium also acts on other aesthetically related aspects as the level of the facial mucosa.

The aesthetic assessment of the crown did not reveal differences between

<table>
<thead>
<tr>
<th>Number of patients being satisfied (%)*</th>
<th>Smooth (n=30)†</th>
<th>Rough (n=31)</th>
<th>Scalloped (n=31)</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour of the crown</td>
<td>28 (93.3%)</td>
<td>30 (96.8%)</td>
<td>28 (90.0%)</td>
<td>86 (93.3%)</td>
</tr>
<tr>
<td>Form of the crown</td>
<td>28 (93.3%)</td>
<td>31 (100%)</td>
<td>29 (93.5%)</td>
<td>88 (95.7%)</td>
</tr>
<tr>
<td>Colour of the mucosa around the implant</td>
<td>26 (86.7%)</td>
<td>27 (87.1%)</td>
<td>26 (83.9%)</td>
<td>79 (85.9%)</td>
</tr>
<tr>
<td>Form of the mucosa around the implant</td>
<td>24 (80.0%)</td>
<td>27 (87.1%)</td>
<td>24 (77.4%)</td>
<td>75 (81.5%)</td>
</tr>
<tr>
<td>General patient satisfaction</td>
<td>8.8 ± 1.1</td>
<td>8.9 ± 1.0</td>
<td>9.1 ± 0.8</td>
<td>9.0 ± 1.0</td>
</tr>
</tbody>
</table>

*Measured on 5-point scale (4 or 5 equals satisfied and very satisfied respectively)
†One implant was lost.

Abbreviations: SD=standard deviation, VAS=visual analogue scale.
study groups. We believe that the implant neck designs we investigated are of less importance for the final crown aesthetics. Implants in the study groups were restored according to the same procedure. The only difference was that for the implants in the scalloped group, titanium abutments had to be used instead of zirconia abutments in the smooth and rough group. However, the titanium abutments were modified by means of a zirconia layer. Besides, all crowns in this study were all-ceramic.

As a result from the recent introduction of the PES/WES and ICAI, published studies using these indexes for aesthetic evaluation are scarce. Only two studies could be identified that reported the aesthetic outcome of anterior single-tooth replacements using the PES/WES (Belser et al. 2009, Buser et al. 2009) and only one study using the ICAI (Meijndert et al. 2007). To our best knowledge, these are the only available instruments to rate the aesthetics of both crown and mucosa. In the first study on the PES/WES (Belser et al. 2009), the reproducibility of this index was analyzed on the basis of 45 maxillary single-tooth implants installed according to an early implant placement procedure. A mean PES-score of 7.7 ± 1.3 was reported and no implant scored lower than 6 points, the predefined level of clinical acceptability. In a second study from the same research group (Buser et al. 2009), a PES-score of 8.1 ± 1.75 was reported for 20 early placed implants and only one case showed less than 6 points. In our study, the aesthetics of the mucosa were judged with a mean score of 6.3 and 40.2% of the cases scored less than 6 points, thus were clinical unacceptable. Most likely, a less favorable preoperative situation was the underlying factor for these lower PES-scores. In our study, all implants were inserted in healed extraction sites and teeth had already been extracted at the first consultation without having opportunities to perform socket preservation techniques. It is known that after tooth removal, the walls of the alveolus undergo substantial resorption at the facial aspect, affecting the soft tissue anatomy (Schropp et al. 2003, Araujo & Lindhe 2005). Early implant placement and simultaneous guided bone regeneration according to which the implants in the abovementioned studies were inserted, might favor the facial soft tissue anatomy. For instance, it was demonstrated in these studies that the level of the contralateral reference tooth was identical in 77.8% (35 of 45) (Belser et al. 2009) and 90% (18 of 20) (Buser et al. 2009) of the cases. In our study however, this item showed the second lowest score of all items and in 36 of 92 patients (39%) the level of the mucosa was identical.

The less favorable preoperative situation in our study is also reflected in the frequency of pre-implant augmentation procedures, necessary to allow for proper implant installation three months later. In our study, a pre-implant augmentation procedure was needed in one-third of the patients and the regression analysis showed that this procedure was significantly associated with a lower PES-score. A
study to the aesthetic outcome of anterior single-tooth implants installed after a separate augmentation procedure, confirmed the negative effect of a pre-implant placement augmentation procedure on the appearance of the mucosa (Meijndert et al. 2007).

With regard to the assessments of the implant crown, in the study by Belser et al. (2009) crowns were judged with a mean WES-score of 6.9 ± 1.5 which is in line with the score of 7.3 ± 1.5 as we observed. However, in the other study from the same research group, the mean WES-score was 8.7 ± 1.0. It was argued that this higher WES-score could be explained by the fact that only one dental technician was involved having excellent expertise in the field of esthetic restorations versus multiple joining technicians in the other study. Compared to our study, this difference in white aesthetics might be explained from the fact that in our study the contralateral tooth received a new crown less frequently (in the study by Buser et al. (2009), 5 of 20 contralateral teeth received a new crown, in our study 7 of 92). Since the contralateral tooth serves as a reference tooth in assessing the white aesthetics, it is easier to reach a higher aesthetic judge when these teeth are provided with a new crown too, particularly on the variables colour, translucency and texture. Furthermore, it should be realized that the less favorable pink aesthetics we observed, could affect the outcome of the white aesthetics. Less voluminous papillae for instance or an undercontoured alveolar process might be compensated by overcontouring the anatomy of the crown. Regarding the colour of the crown, this will remain a challenging item to fulfil without any discrepancy. In our study and in the study by Buser et al. (2009), this item showed the lowest appreciation. It should be realized however that the aesthetics were assessed on photographs. It might be that in a direct assessment of the patient, the colour of the crown shows more favorable resemblance with the adjacent dentition.

As was expected from other studies, patient satisfaction was high (Schropp et al. 2004, Pjetursson et al. 2005, Den Hartog et al. 2008). Although the outcome of PES was correlated to patient satisfaction with the appearance of the mucosa, most of the patients were satisfied with the appearance of the mucosa (> 80%) and even more patients were satisfied with the appearance of the crown (> 93%). This discrepancy between the aesthetic outcome from a professional’s and patient’s perception, has been demonstrated in earlier studies (Chang et al. 1999, Meijndert et al. 2007, Esposito et al 2009). This difference might be explained by the finding that factors considered by professionals to be relevant for the esthetic outcome may not be of decisive importance for patient’s aesthetic satisfaction (Chang et al. 1999) Furthermore, it might be that for the final appreciation of the patient, the pre-operative situation plays a role of significance and gives weight to the final judgment. When the pre-operative situation is compromised and patient’s expectations are realistic, patients might be satisfied even when the aes-
The aesthetic outcome according to an objective index is poor. The aesthetic indexes do not take the preoperative situation into account.

With respect to the reproducibility of the ICAI, controversial degrees of intra- and interobserver agreement have been reported. At the introduction of the ICAI, two prosthodontists showed acceptable intra- and interobserver agreement. Gehrke et al. (Gehrke et al. 2009), however, reported poor to moderate reliability for the ICAI when applied by different professionals including prosthodontists. In our study, the ICAI was slightly modified and was used to generate a separate judgment for the crown and mucosa instead of an overall judgement. It was found that the reliability of the mucosa assessment was acceptable and of the crown assessment was moderate. Apparently, the crown is more prone to disagreement than the mucosa. We believe that this moderate reproducibility might be caused by the scoring system of the ICAI and the corresponding final judgement. Namely, when an item deviates majorly in the observer’s eyes, the aesthetics will be judged automatically as being poor. However, when this deviation is minor according to another observer, large differences in final judgment will occur. Furthermore, the ICAI is based on comparing the implant crown with the contralateral tooth and the adjacent dentition as well. This might lead to more variation in observer interpretation. Since the PES/WES applies a different scoring system and the contralateral tooth is the only reference, this index might be less sensitive for disagreement and subsequently showed higher reliability. However, this might also lead to shortcomings, since a major discrepancy on an item yet might lead to acceptable aesthetics and in some cases it would be more plausible to involve the adjacent dentition in the analyses as well (for instance when the contralateral tooth shows compromised aesthetics). More studies would be helpful to further develop a reproducible and valid aesthetic index, which should be commonly applied in implant research.

This study shows that at one year after definitive crown placement, there are no differences in aesthetic outcome between the different implant necks of single-tooth implants applied in the aesthetic zone. According to the most reproducible index (the PES/WES), the peri-implant mucosa was judged as being not acceptable in 40% of the cases whereas 20% of the implant crowns were not acceptable. However, patient’s aesthetic satisfaction regarding colour and shape of crown and mucosa was high. It should be realized that in this study all implants were installed in healed sites, at least three months after extraction and one third of the cases had to be augmented before implant placement. Since we found that a pre-implant augmentation procedure has a detrimental effect on the objective aesthetic outcome (using PES/WES), this underlines the need to prevent a separate augmentation procedures, possibly by extracting hopeless teeth in an earlier stage or by performing socket preservation techniques.
References


Implant neck designs


