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## ORIGINAL ARTICLE

WILEY

# Immediate implant placement and provisionalization: Aesthetic outcome 1 year after implant placement. A prospective clinical multicenter study

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## Abstract

**Background:** Prospective aesthetic outcomes on a high number of patients after immediate implant placement and provisionalization (IIPP) are lacking.

**Purpose:** To analyze the aesthetic outcome after IIPP.

**Materials and Methods:** One hundred consecutive patients with a failing maxillary incisor were provided with an immediately placed and provisionalized nonloaded implant using a flapless procedure and palatal implant positioning. The remaining gap buccally was filled with a bone substitute. Preoperatively (T0), 2 weeks postoperatively (T1), direct after placement of the permanent crown (T2), and 1 year after IIPP (T3), standardized light photographs were made. Change in aesthetic score was the primary outcome measure. Both the white aesthetic score (WES) and pink aesthetic score (PES) were used.

**Results:** In the first year postsurgery, the mean total-WES and total-PES scores raised from 4.5 to 8.2, and from 9.9 to 12.1, respectively. The mean PES scores for mesial and distal papilla, soft tissue marginal level, contour, color, and texture, raised significantly ( $P < .05$ ), while the alveolar process contour, on average, remained stable from T0 to T3.

**Conclusions:** Within the limitations of this 1-year research, it may be concluded that, following this minimal invasive IIPP procedure, a high aesthetic outcome was achieved.

## KEYWORDS

aesthetic outcome, dental implant, immediate implant placement, immediate restoration, implant position

## 1 | INTRODUCTION

Implant position and sufficient volume of hard and soft tissue are key factors in achieving an optimal aesthetic outcome after implant therapy in the anterior maxillary region.<sup>1,2</sup> Soft-tissue loss after implant therapy is a major concern from aesthetic point of view. Immediate implant placement and provisionalization (IIPP) is

associated with a higher frequency of mid-buccal recession (>1 mm) and a greater variability in aesthetic outcome. In this perspective, the integrity of the facial bone may play an important role for long-term stability of aesthetic outcomes.<sup>3</sup> After tooth extraction, substantial loss of hard and soft tissues is inevitable, thereby compromising aesthetics.<sup>4,5</sup> In order to restore the shortage of bone volume, and thereby to ensure an optimal support of the soft tissues,

in the past most authors suggested bone augmentation procedures in advance of, or simultaneous with, implant installation. Obviously, to bypass such extra surgical interventions, priority should be given to those procedures which are simple, less invasive, involve less risk of complications, and reach their goals within the shortest time frame.<sup>6</sup> In order to diminish the effect of postextraction dimensional changes, ridge preservation procedures appear to be effective in limiting both horizontal and vertical ridge alterations.<sup>7-11</sup> In dentate situations, it is recommended that such ridge preservation procedures should always be performed immediately after tooth extraction.<sup>12,13</sup> An important role has been assigned to bovine bone substitutes, as an ideal barrier material to preserve the ridge volume and thereby giving the soft tissue immediate support, preventing it from collapsing.<sup>14-18</sup> IIPP in the aesthetic maxillary region showed good treatment outcomes at the short term, however, because of underreporting in the literature, aesthetic results and patient outcome did not allow for reliable analysis.<sup>19-21</sup> As IIPP allows immediate restoration, thereby instantly supporting the papillae and mid-buccal soft tissue, its aesthetic outcome improves.<sup>22-24</sup>

Since the buccal crest mainly consists of bundle bone, no regenerative ability is expected from the buccal plate.<sup>25</sup> It also holds, that the more an implant is placed to the buccal, the greater the risk of mid-buccal recession.<sup>26</sup> When an implant is placed in a more palatal position, a space is created between the implant and the buccal plate, allowing bone ingrowth from the surrounding interdental septa and from cranial more easily.<sup>27,28</sup> To achieve optimal ridge preservation simultaneously with implant placement, research corroborated that a minimum thickness of at least 2 mm buccal hard tissue should be present.<sup>29,30</sup> Retrospective results of our IIPP procedure revealed that, in case of application of a bovine substitute, the buccal crest thickness increased from 0.9 to 2.4 mm.<sup>31</sup> After 2 years, this buccal crest thickness compacted to 1.8 mm. In the same period, the mean height of the buccal crest increased by 1.6 mm, which was in confirmation with the results found in ridge preservation studies using bovine bone substitute.<sup>32,33</sup> Based on above-mentioned biological phenomena, this prospective clinical longitudinal multicenter research aims to analyze the aesthetic outcome after IIPP, using both the white aesthetic score (WES)<sup>34</sup> and pink aesthetic score (PES).<sup>35</sup>

## 2 | METHODS

In this prospective multicenter consecutive case series, in 100 patients having one failing maxillary incisor, an implant was placed and subsequently restored with a temporary crown. After written informed consent, patients were included in the research in the period 2014 to 2017. Data collection and analysis took place in 2017 and 2018. Ethical approval was obtained from the Ethics Committee of the Radboud University Medical Center Nijmegen (2014/157). This research was registered in the Dutch Trial Register (NTR) on October 20, 2015 (NTR5583/NL4170) and conformed to the STROBE guidelines.

### 2.1 | Study population

Inclusion criteria were: (a) the presence of one failing single maxillary incisor in between two neighboring healthy teeth, (b) sufficient occlusal support, (c) the absence of periodontal disease, (d) the absence of bruxism, (e) the presence of an adequate bone height at the apical area of the socket (at least 5 mm) to allow primary implant stability, as measured on the cone beam computed tomogram (CBCT), and (f) both intact sockets, as sockets with a periapical bone defect or a bone defect defined as EDS-2 or EDS-3.<sup>36</sup> IIPP was contraindicated in case of smoking habits exceeding more than 10 units a day, in case of pregnancy; drug or alcohol abuse, or when negative bone reactions could be expected, such as in case of osteoporosis, Paget's disease, renal osteodystrophy, immunosuppression, recent corticosteroid treatment, chemotherapy, or radiotherapy.

### 2.2 | Multicenter

In total six referral centers for oral implant therapy participated in this research. In two centers, where an oral maxillofacial surgeon placed the implants, the restorative procedure was performed by a separate restorative dentist, while in the remaining four centers the complete IIPP procedure was performed by one oral implantologist.

### 2.3 | Treatment protocol

The surgical and restorative procedure was performed following a standardized protocol.<sup>31</sup> To summarize; in cases of a failing maxillary incisor, an implant was placed immediately following atraumatic tooth extraction. As no flap was raised, the keratinized gingiva remained untouched. Patients were instructed to take 2 g Amoxicillin 1 hour preoperative followed by 500 mg Amoxicillin every 8 hours during 5 days postoperatively. Patients were instructed to rinse with 0.12% chlorhexidine solution twice a day during 14 days postsurgery. Palatal positioning created a gap of at least 2 mm between the implant and the buccal bone plate. If this was not feasible, an implant with a smaller diameter was chosen to guarantee the 2 mm gap. Subsequently, this gap was filled with a bone substitute (Bio-Oss, Geistlich Pharma AG, Wolhusen, Swiss) before implant installation (NobelActive Internal implants (Nobel Biocare, Washington, DC). The implant seat was positioned 3 mm subgingivally, taking the buccal gingival margin of the contralateral tooth as reference. Immediately afterwards, a temporary crown was fabricated, by use of a custom made titanium temporary abutment (Procera; Nobel Biocare). The non-loaded screw retained temporary crown was made either chair side, or by a dental laboratory. Also in the latter situation, the temporary crown was placed at the same day as the implant was installed. A check-up consult, in order to examine the wound healing, occlusion and articulation, and to give additional oral hygiene instructions after IIPP, took place in between 7 and 14 days postsurgery. After a period of 3 to 9 months, the permanent crown was fabricated and placed. All

abutments were individualized in an optimal slender emerging profile (Procera; Nobel Biocare).

## 2.4 | Implant survival and complications

Patients were evaluated for implant survival and complications during the first year postsurgery.

## 2.5 | Periodontal and radiographic measurements

The periodontal status of the natural dentition was measured by use of the Dutch Periodontal Screening Index (DPSI)<sup>37</sup> preoperatively (T0), and 1 year postoperatively (T3). Immediately after extraction, the clinician checked with a probe (CP 15 UNC, Hu-Friedy, Chicago, Illinois), if the socket met the criteria of at least an EDS-3. The hard tissue dimensions around the implants were evaluated by means of a low dose small field of view CBCT, direct postoperatively (T1) and at 1 year postoperative (T3). Probing around the implants to evaluate the peri-implant tissue health was not an option, since the implants were positioned maximal to the palatal and deep below bone level. The regenerating peri-implant region, consisting of Bio-Oss granules, should be preserved.

## 2.6 | Aesthetic measurements

In order to measure the aesthetic outcomes, both the implant site and contralateral site were photographed in a standardized way<sup>38</sup> at different time points; preoperatively (T0), 2 weeks postoperatively (T1), immediate after placement of the permanent crown (T2) and 1 year after IIPP (T3). On each time point, two light photographs were taken: one perpendicular to the mid-buccal of the tooth arch, and one perpendicular to the implant site. Before examination, the light photographs were placed in a digital format. Evaluation was executed by two blinded examiners, who were not involved in the patient treatments, using the WES<sup>34</sup> and the PES.<sup>35</sup>

The WES was scored on five topics, with as reference the contralateral natural tooth: "tooth shape" (WES-1), "tooth volume/outline" (WES-2), "tooth color/hue value" (WES-3), "surface texture" (WES-4), and "translucency" (WES-5). By scoring each subject with: "major discrepancy" (=0), "minor discrepancy" (=1), or "no discrepancy" (=2), a total-WES score ranging between 0 and 10 could be achieved.

The PES was scored on seven topics: PES-1 "mesial papilla" (absent = 0; incomplete = 1; complete = 2), PES-2 "distal papilla" (absent = 0; incomplete = 1; complete = 2), PES-3 "level of soft tissue margin" (major discrepancy > 2 mm = 0; minor discrepancy 1-2 mm = 1; no discrepancy < 1 mm = 2 in relation to the reference tooth), PES-4 "soft tissue contour" (unnatural = 0 fairly natural = 1 natural = 2), PES-5 "alveolar process" (obvious deficiency = 0; slight deficiency = 1; no deficiency = 2), PES-6 "soft tissue color" (obvious difference = 0; moderate difference = 1; no difference = 2 in relation

to the reference tooth), and PES-7 "soft tissue texture" (obvious difference = 0; moderate difference = 1; no difference = 2 in relation to the reference tooth). In this manner, the total-PES score of the soft tissues varied between 0 and 14.

To combine the WES and PES values, Cosyn et al<sup>39</sup> defined the "optimal score" (PES  $\geq$ 12 and WES  $\geq$ 9) and the "inadequate" score (PES <8 and/or WES <6). In order to achieve better balancing, we added two extra scores: "good" (PES  $\geq$ 10 and WES  $\geq$ 8), and "acceptable" (PES  $\geq$ 8 and WES  $\geq$ 6).

## 2.7 | Statistical methods

For all measurements, the range, mean, and SD were calculated. Aesthetic changes for component scores were tested used Chi square tests. The overall changes in aesthetics scores between various points in time were tested with a mixed model with a random intercept for treatment center. For interobserver reliability, the two-way mixed intraclass correlation coefficient (ICC) (single measurement) was used for both overall aesthetics scores. All statistics were calculated using SPSS version 24 (SPSS Inc., Chicago, Illinois), except for the mixed models which were analyses using the lmer library (v 1.1-21) of R (v3.6.0). Statistical significance was defined as  $P = .05$ .

## 3 | RESULTS

On average, IIPP took place 37 days (range 0-210 days) after the first intake visit. Of the 100 included patients, one patient was excluded for the reason that a new trauma at the implant site occurred, the implant was replaced by a new implant. Another patient withdrew because of relocation; the remaining 98 patients consisted of 57 females and 41 males with a mean age of 45.8 years (range 17-80 years). The distribution of the implants by diameter, length, and location is shown in Table 1. In all cases, primary implant stability was achieved. Reasons for extraction were root fracture

**TABLE 1** Distribution of implants by diameter, length, and location

Ø in mm	Length in mm	Location 12/22	Location 11/21	Total
3.0	15	2	0	2
3.0	13	4	0	4
3.5	18	3	5	8
3.5	15	9	20	29
3.5	13	4	4	8
3.5	11.5	1	1	2
4.3	18	0	9	9
4.3	15	0	24	24
4.3	13	0	10	10
4.3	11.5	0	2	2
Total		23	75	98

	T0		T1		T2		T3	
	SD	Mean	SD	Mean	SD	Mean	SD	Mean
WES-1: tooth shape	0.745	0.794	0.511	1	0.591	1.396	0.602	1.398*
WES-2: volume/outline	0.782	0.866	0.695	1.196	0.554	1.593	0.589	1.571*
WES-3: color/hue	0.806	0.773	0.665	0.761	0.54	1.451	0.558	1.5*
WES-4: surface texture	0.801	1.093	0.643	1	0.358	1.879	0.303	1.898*
WES-5: translucency	0.797	0.938	0.623	0.88	0.398	1.802	0.387	1.816*
Total WES score	2.3	4.464	2.002	4.837	1.454	8.132	1.38	8.184

Note. \*Significant difference T3 to T0 ( $P < .05$ ).

Abbreviations: IIPP, immediate implant placement and provisionalization; PES, pink aesthetic score; WES, white aesthetic score.

**TABLE 2** Mean WES scores and SD for each item (1-5) at different time points: preoperatively (T0), 7 to 14 days postoperatively (T1), directly after placement of the permanent crown (T2), and 1 year after IIPP (T3). All five subscores were evaluated as 0, 1, and 2. The total score is cumulative within a range of 0 to 10

(41 patients) or root resorption (10 patients). Other reasons comprised failed endodontic treatment (28 patients), trauma (16 cases) or the impossibility of further restoration (three patients). The patient group consisted of 91.8% Caucasians and 12.2% light smokers.

### 3.1 | Implant survival and complications

In the first year, no implants were lost. In one patient both a surgical complication, the soft tissue was buccally ruptured and both papillae were cut, and a biological complication occurred, a fistula at the buccal was observed after placement of the permanent crown. This led to a poor aesthetic outcome with a WES=7 and PES=7. In another patient,

a restorative complication was reported; 1 month postsurgery, the screw retained temporary crown came loose, and was tightened again after rinsing the implant with saline. The implant healed uneventfully, but the aesthetic outcome probably was affected by this adverse event (WES = 6 and PES = 8).

### 3.2 | Periodontal and radiographic measurements

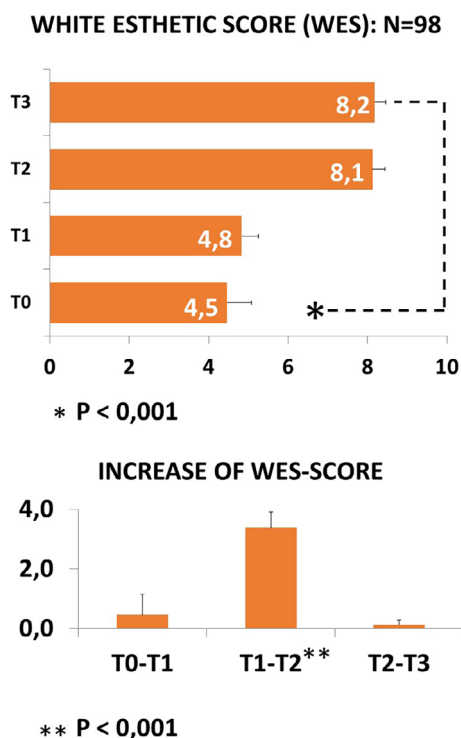
All patients scored DPSI A (healthy periodontium) at T0. At the 1 year evaluation (T3), six patients scored a DPSI B instead of DPSI A. The implants of the patients which scored DPSI B, did not show bone defects at level of the seat of the implant evaluating the CBCT scans at T3.

### 3.3 | Aesthetic measurements

Unfortunately, the light photos were not complete during all phases of the study; at T0 of one patient the light photos were missing, at T1 (on average 13 days postoperatively) of eight patients the photos were absent and at T2 (on average 199 days postoperatively) of seven patients photos were absent. At T3, on average 392 days postoperatively, light photos of all 98 patients were available. The interexaminer reliability showed an ICC of 0.982 for the WES and 0.979 for the PES.

The mean WES scores (1-5) at different time points (T0, T1, T2, T3), are shown in Table 2. The mean total-WES score increased significantly ( $P < .001$ ) from 4.5 at T0 to 8.2 1 year after IIPP at T3 (Figure 1). At T3, the optimal total-WES score of 10 was reached in 18 patients, WES = 9 in 25 patients and WES = 8 in 26 patients. WES = 7 was achieved in 16 patients, and WES = 6 in eight patients. In five cases, a total-WES score of 5 was achieved.

The mean PES scores (1-7) and frequency distribution for each item at different time points (T0, T1, T2, T3), are shown in Tables 3 and 4. The mean total-PES score raised significantly, from 9.9 at T0 to 12.1 1 year postsurgery at T3 (Figure 2). The distribution of the total-PES scores at T3 was as follows; in 18 cases, an optimal PES score of 14 was reached, in 28 patients PES = 13 was achieved and in 22 patients PES = 12. A score of PES = 11 was achieved in



**FIGURE 1** The total white aesthetic score (WES) scores with the SD at different time points (T0-T3)

**TABLE 3** Mean PES scores and SD for each item (1-7) at different time points: preoperatively (T0), 7 to 14 days postoperatively (T1), directly after placement of the permanent crown (T2), and 1 year after IIPP (T3). All seven subscores were evaluated as 0, 1, and 2. The total score is cumulative within a range of 0 to 14

	T0		T1		T2		T3	
	SD	Mean	SD	Mean	SD	Mean	SD	Mean
PES-1: mesial papilla	0.574	1.443	0.533	1.6	0.519	1.549	0.474	1.714*
PES-2: distal papilla	0.553	1.577	0.526	1.633	0.457	1.703	0.428	1.796*
PES-3: soft tissue level	0.75	1.258	0.712	1.4	0.536	1.67	0.617	1.612*
PES-4: soft tissue contour	0.703	1.443	0.578	1.567	0.421	1.769	0.405	1.827*
PES-5: alveolar process contour	0.513	1.722	0.491	1.678	0.432	1.791	0.486	1.735
PES-6: soft tissue color	0.677	1.124	0.642	1.144	0.542	1.352	0.5	1.551*
PES-7: soft tissue texture	0.669	1.33	0.611	1.4	0.452	1.752	0.37	1.837*
Total PES score	2.4	<b>9.876</b>	2.19	<b>10.411</b>	1.549	<b>11.571</b>	1.633	<b>12.081</b>

Note. \*Significant difference T3 to T0 ( $P < .001$ ).

Abbreviations: IIPP, immediate implant placement and provisionalization; PES, pink aesthetic score; WES, white aesthetic score.

**TABLE 4** Frequency distribution of the seven different PES scores at different time points: preoperatively (T0), 7 to 14 days postoperatively (T1), immediately after placement of the permanent crown (T2), and 1 year after IIPP (T3)

Score	T0			T1			T2			T3		
	0	1	2	0	1	2	0	1	2	0	1	2
PES-1: mesial papilla	4	46	50	2	32	56	1	38	52	1	26	71
PES-2: distal papilla	3	35	59	2	29	59	0	27	64	1	18	79
PES-3: soft tissue level	18	36	43	12	30	48	3	24	64	6	22	70
PES-4: soft tissue contour	12	30	55	4	31	55	0	21	70	1	15	82
PES-5: alveolar process contour	3	21	73	1	26	63	1	17	73	2	22	74
PES-6: soft tissue color	17	51	29	13	51	26	3	53	37	0	44	54
PES-7: soft tissue texture	11	43	43	6	42	42	0	25	66	0	16	82
Total		97			90			91			98	

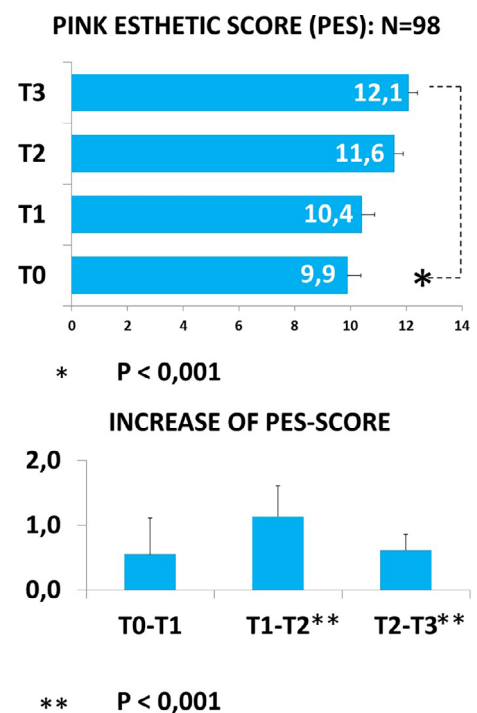
Abbreviations: IIPP, immediate implant placement and provisionalization; PES, pink aesthetic score.

19 patients and PES = 10 in 4 patients. PES = 9 was scored in two patients, and PES = 8 in three patients. In 2% of the patients an unsatisfying PES score was present, one patient scored PES = 6 and another PES = 7).

In 37% (36/98) of the patients, an "optimal" aesthetic outcome (PES  $\geq 12$  and WES  $\geq 9$ ) was scored, of which 11% (9/98) reached the maximum aesthetic score (PES=14 and WES=10). In 35% (34/98), a "good" aesthetic outcome (PES  $\geq 10$  and WES  $\geq 8$ ) was observed; in 21% (21/98), an "acceptable" aesthetic outcome (PES  $\geq 8$  and WES  $\geq 6$ ), and in 7% (7/98), an "inadequate" aesthetic outcome (PES  $< 8$  and/or WES  $< 6$ ) was accomplished. Five of the "inadequate" outcomes, scored a WES of less than 6 (all intact sockets), two scored a PES less than 8 (one intact socket and one EDS-3 defect). Examples of cases with an optimal, good, acceptable, and inadequate aesthetic outcome at T3 are shown in Figure 3. The changes in WES and PES scores over the various intervals with a random intercept for center are shown in Table 5.

#### 4 | DISCUSSION

Today, it is still unclear which treatment protocol and materials are the best to replace a natural tooth direct after extraction. Aesthetic



**FIGURE 2** The total pink aesthetic score (PES) scores with the SD at different time points (T0-T3)



## 4 CATEGORIES OF OVERALL AESTHETIC OUTCOME:



**FIGURE 3** Examples of cases with an “optimal” (pink aesthetic score [PES]  $\geq 12$  and white aesthetic score [WES]  $\geq 9$ ), “good” (pink aesthetic score [PES]  $\geq 10$  and white aesthetic score [WES]  $\geq 8$ ), “acceptable” (pink aesthetic score [PES]  $\geq 8$  and WES  $\geq 6$ ), and “inadequate” (PES  $< 8$  and/or WES  $< 6$ ) aesthetic outcome at T3

treatment outcome studies concerning IIPP should always be interpreted and compared with care, due to crucial differences in the materials and treatment modalities used. As such, implant position, surgical approach (raising a flap or flapless surgery), additional surgery (for instance applying a connective tissue graft), implant type, brand of bone substitutes, abutment configuration, and crown design are examples of factors that may influence the treatment outcome.

There is limited evidence that mid-buccal soft tissue levels could not be preserved by performance of IIPP.<sup>40</sup> In this prospective study, a flapless approach without additional connective tissue graft was used. The results are in contradiction with a previous study,<sup>41</sup> in which an additional connective tissue graft is recommended to prevent mid-buccal recession after IIPP. Concerning the mid-buccal soft tissue level, this study showed an improvement of the soft tissue level scores from T0 to T3, while the alveolar process contour remained stable in the same period.

A slight decrease in “alveolar process contour” may be expected performing IIPP without connective tissue graft, because resorption of the thin cortical bone crest is inevitable, despite of a ridge

preservation procedure.<sup>13</sup> As in this research, the PES-5 remained stable in time; we assume that also the mean alveolar process contour remained stable at the different time points. It could be argued that occlusal photos must be taken. However, the question remains to what extent the measured changes are clinically relevant, because in our study PES-5 remained unchanged over time. Furthermore, the mid-buccal soft-tissue level aesthetic score increased in the first year after IIPP. Therefore, the indication of a connective tissue graft simultaneous with IIPP, which means extra morbidity, costs, and risks, is questionable. In the few cases with a poor aesthetic outcome after IIPP (of which five poor WES scores and two poor PES scores), only one patient was dissatisfied by the buccal contour.

A main cause of the poor WES ratings was a too bulky emerging profile; too much pressure on the hard and soft tissues caused papilla retraction and/or buccal soft tissue retraction. With respect to the two poor PES-scores; in one case, the soft tissues were damaged during implant installation, in the other the tip of the implant was too much tilted towards the buccal crest, thereby creating a gap lesser than 2 mm. The high total WES and PES scores at T3 are in

**TABLE 5** Analyses of change in WES and PES scores over various intervals. Results of multilevel analyses with a random intercept for center

WES				
Interval	Increment	95%ci of incr	P	ICC
T0- > T1	0.63	[-1.05...2.36]	.451	0.236
T0- > T2	3.55	[2.32...4.74]	<.001	0.121
T0- > T3	3.58	[2.33...4.85]	<.001	0.135
T1- > T2	2.83	[1.05...4.58]	.002	0.477
T2- > T3	0.14	[-0.04...0.29]	.145	0.021
PES				
Interval	Increment	95%ci of incr	P	ICC
T0- > T1	0.21	[-0.85...1.18]	.751	0.114
T0- > T2	1.81	[1.06...2.43]	<.001	0.013
T0- > T3	2.16	[1.31...2.99]	<.001	0.049
T1- > T2	1.14	[0.67...1.74]	<.001	0
T2- > T3	0.62	[0.37...0.86]	<.001	0

Abbreviations: ICC, intraclass correlation coefficient; PES, pink aesthetic score; WES, white aesthetic score.

confirmation with earlier reported results,<sup>31</sup> in which on average a total WES score of 8.4 and a total PES-score of 11.8 was achieved after 103 weeks. Also the prospective study of Cosyn et al<sup>42</sup> reported a high mean PES of 12.15 1 year after IIPP ( $n = 20$ ). However, an earlier study from 2011 presenting the aesthetic outcome after 3 years showed less favorable results,<sup>39</sup> in 21% of the patients ( $n = 25$ ), an optimal score (PES  $\geq 12$  and WES  $\geq 9$ ) was achieved and in 21% of the cases ( $n = 25$ ) inadequate aesthetic results (PES  $< 8$  and/or WES  $< 6$ ) were observed. Raes et al<sup>43</sup> also presented treatment outcomes 1 year after performing IIPP. In this study ( $n = 16$ ), the implants were placed conform the protocol described by Buser et al,<sup>44</sup> which implicates an implant position more buccally, as compared to our IIPP protocol. Different from this study, besides incisors, also canines and premolars were included. Subsequently, cement retained temporary crowns were placed. Before mentioned factors may explain why Raes et al reported a lower mean WES (7.2) and PES (10.3) score.<sup>43</sup> Overall, 8% of their cases showed an optimal score (PES  $\geq 12$  and WES  $\geq 9$ ). In total, 24% of the cases were aesthetically inadequate (PES  $< 8$  and/or WES  $< 6$ ). Recently the 8-year aesthetic outcome of the same patient population was published with a mean PES-score of 10.4,<sup>45</sup> indicating that the PES value, as scored after 1 year, remained stable after 8 to 10 years. Comparable studies, with long-term results on such a high number of patients treated with IIPP, are lacking. Limitations of this study are that no control group was present, and the fact that the strict inclusion criteria implicated that about 25% of the referred patients fell outside the IIPP protocol. Within the limitations of this study, it may be concluded that 1 year after following the presented IIPP protocol, the mean aesthetic outcome is high. Which specific factors influenced the aesthetic outcome is topic for further research. Future comparative studies are needed to be able to evaluate different IIPP designs in a prospective way.

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## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

## AUTHOR CONTRIBUTIONS

E.G. conceived the ideas, did acquisition, collected, analyzed and interpreted the data, and drafted the paper as first author; T.A.S. conceived the ideas, did acquisition, and collected the data; E.B. statistical analyzed the data; G.M.R. critically revised; and G.J.M. guided the scientific writing.

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