

# PRESERVATION OF EXTRACTION SOCKET IN IMMEDIATE IMPLANT PLACEMENT: A CLINICAL STUDY

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## SUMMARY

**Aim.** The objective of this study was to compare different approaches temporary restoration in an immediate implant placement. To determine the respective influence of each parameter, two treatment groups were formed; a strict and standardized study protocol was applied to minimize the influence of bias and confounding factors. The Pink Esthetic Score (PES) - the esthetic out- come of soft tissue appearance was evaluated.

**Material and methods.** Sixteen patients with a single failing tooth in the maxilla and a natural contralateral site were randomly distributed into two groups. Treatment variations affected the provisional restorative in detail, group 1 with immediate implant placement and immediate temporary restoration with the simulation of the first three mm of the root and the seal of the socket, group 2 with immediate implant placement and immediate temporary restoration without the seal of the socket. All patients received the final prosthetic restoration 10-12 weeks after implant placement. Standardized photographs were taken eight months after tooth extraction. Five competent observers analyzed the esthetic outcome according to the PES.

**Results.** The overall scores of the four treatment groups revealed PES values of 8.47 (SD 2.08, group 1), 6.62 (SD 3.24, group 2). The differences between groups 1 and 2 and were statistically significant ( $P=0.015$  and  $P=0.047$ ). The single parameter analysis displayed a certain range of fluctuation and heterogeneity.

**Conclusions.** Immediate implant placement and restoration appear to be a suitable alternative to early implant placement if an experienced surgeon is entrusted with the implantation procedure.

**Key words:** esthetic outcome, immediate implant placement, immediate restoration, Pink Esthetic Score, single implant.

## Introduction

Single-tooth implant restorations in the esthetic zone have become an accepted and well-documented treatment of choice (1). A successful osseointegration may be achieved in a vast majority of cases – if appropriate established rules are followed – the focus of patients and dentists has shifted toward an optimized esthetic result (2). Clinical research in recent years has dealt with

this aspect to a great extent. Investigations have highlighted the influence of clinical treatment procedures such as the time of implant placement, the effects of additional hard and soft tissue management, and the macro and microdesign (3-9). For example, the usefulness of a temporary restoration to guide and form soft tissues in esthetically sensitive areas is widely accepted (10). But still, a large number of individual variables could make difficult to pinpoint the crucial factors for esthetic success or failure (11). In the

past, attempts have been made to shorten overall treatment time, rendering procedures more comfortable and less time consuming for patients. Numerous studies investigating different treatment plans and timing of therapeutic steps have been conducted, yet it is quite difficult to find study protocols that offer direct comparison of these and at the same time try to reduce the number of confounding cofactors. Hence, the degree of influence of a particular investigated parameter is not always explicit. Prospective studies with a randomized clinical trial design are necessary to investigate these issues. The aim of our study was to compare in term of aesthetic outcome two different approaches of temporary restoration in an immediate implant placement. To determine the respective influence of each parameter, two treatment groups were formed; a strict and standardized study protocol was applied to minimize the influence of bias and confounding factors. Using a well-established rating system – the Pink Esthetic Score (PES) – the esthetic outcome of soft tissue appearance was evaluated.

## Material and methods

### Patients

Sixteen patients (10 males, 6 females) with a mean age of 44.8 years (range 17-76), were included in the study. Inclusion criteria were the presence of a single hopeless in the maxilla, as well as, the in contralateral site of a natural tooth, that was served as reference for esthetic comparison with the implant site. Exclusion criteria were untreated periodontal disease, diabetes, or any other medical condition known to severely compromise implant treatment (such as high-dose systemic glucocorticoid treatment). All patients were advised of the treatment process and signed informed consent were obtained. For randomization, the computer program RAN-

DOM was used to create two main groups of 16 patients which were further divided into two groups of 8 patients each.

### Treatment protocol

The two investigation groups were characterized as follows:

Group 1: Immediate implant placement and immediate temporary prosthetic restoration, with the simulation of the first 3 mm of the root and the seal of the socket (Figure 1-6); permanent restoration after completion of bone and soft tissue healing (10-12 weeks afterward).

Group 2: Immediate implant placement and immediate temporary prosthetic restoration, without the seal of the socket (Figure 7-11); permanent restoration after completion of bone and soft tissue healing (10-12 weeks afterward).

### Surgical and prosthetic procedures

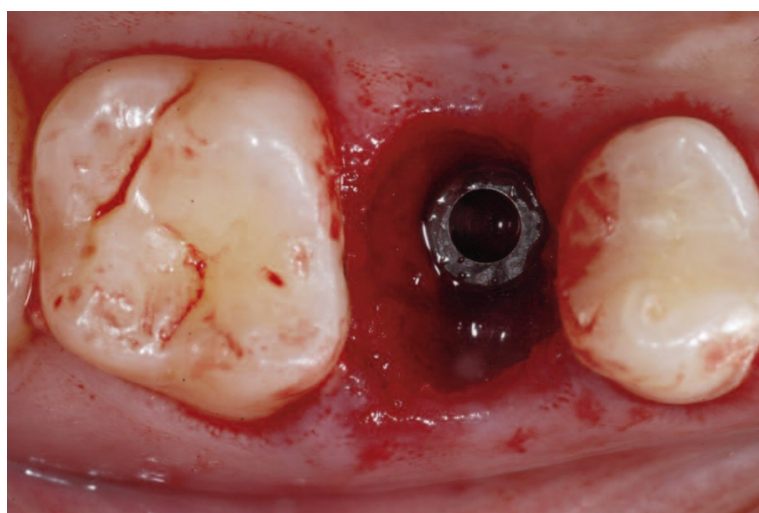
Surgical treatment for all 16 patients was performed by the same experienced maxillofacial surgeon. In all patients (Group 1 and Group 2) the tooth was carefully removed without flap elevation. After immediate implant placement a temporary prosthesis in the same time was incorporated.

A 8-mm bone level implant (Ankylos, Freiburg, Germany) was inserted in the ideal three-dimensional position. For central incisors, 3.5-mm diameter implants were used, for lateral incisors, 3.5-mm diameter implants were chosen. In all cases, an insertion torque of 45 N/cm was applied. In both groups an impression was taken right after insertion for immediate restoration and standardized abutment of adequate height (4 mm or 6 mm) was fixed.

In the Group 1, the temporary crown was shaped with an area that enters the socket for about 3 mm to reproduce the biological width of the nat-



**Figure 1**  
Group test - Initial phase.

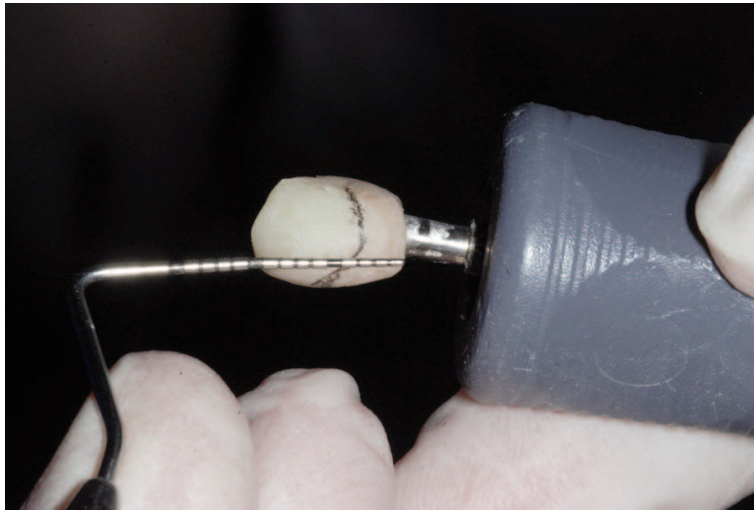


**Figure 2**  
Group 1 - Insertion of implant.



**Figure 3**  
Group 1 - Abutment.





**Figure 4**  
Group 1 - Temporary crown.



**Figure 5**  
Group 1 - Temporary crown.



**Figure 6**  
Group 1 - Final crown.



**Figure 7**  
Group 2 - Initial Phase.



**Figure 8**  
Group 2 - Extracted tooth.



**Figure 9**  
Group 2 - Temporary crown.



**Figure 10**  
Group 2 - Temporary crown.



**Figure 11**  
Group 2 - Final crown.

ural tooth, and the diameter of the provisional was manufactured in order to occlude completely the socket as in the natural tooth (Figure 2-6). In Group 2, the temporary crown was shaped without invasion of biological width (Figure 8-11). After surgery, antibiotics (twice a day for six days, 875 mg + 125 mg tablet amoxicillin and clavulanic acid) and analgesic (twice a day for two days, 600 mg ibuprofen tablet), were recommended. The patient was instructed to not brush at the surgical area for three weeks and to rinse for 1 minute with 0.2% chlorhexidine twice a day for the same time.

To achieve a harmonious appearance resembling the situation at the contralateral area in the long

term, a slight overcontouring of the buccal volume was intended which would counter any future resorption process.

For prosthetic treatment, patients were recommitted to their referring practitioner. In both groups after 10-12 weeks, complete healing of the tissues has been applied in the final monolithic zirconium.

## Follow-up examination and data analysis

Clinical examination and data collection were scheduled 8 months after tooth extraction (aver-

age 8.4 months). For esthetic evaluation, three standardized photographs (12) were taken using a digital camera one image centered on the approximal contact between the central incisors, one image centered on the implant crown, and one on the contralateral natural crown (Figure 5-9).

After the images' brightness had been adjusted (Adobe Photoshop; Adobe Systems, Rome, Italy), they were arranged and printed on DIN A4 glossy paper for evaluation.

The seven soft tissue parameters of the Pink Esthetic Score (PES) by Furhauser et al. (13) served for the assessment of (1) mesial papilla, (2) distal papilla, (3) level of soft tissue margin, (4) soft tissue contour, (5) alveolar process, (6) soft tissue color, and (7) soft tissue texture. Each of these parameters can have the values 0, 1, or 2; thus the maximum total score is 14. The mesial and distal papilla were judged by their complete presence (score 2), incomplete presence or hyperplasia (score 1) or absence (score 0). All other parameters were assessed by comparing the situation at the implant site with the corresponding contralateral natural site. Five blinded colleagues, that is, a maxillofacial surgeon, a prosthodontist, an orthodontist and two general dentists evaluated the cases. An Author of the study assisted with the procedure by handing out the photographs and models as well as taking down the ratings. For assessment of the fifth PES parameter (buccal contour), the use of the stone model was mandatory.

## Statistical analysis

Values were averaged over all five observers. Interobserver reliability was evaluated by Krippendorff's alpha coefficient for interval data. For both group, mean scores and standard deviations were calculated for single parameters and the overall PES. To facilitate a statistical conclusion, P-values were computed by applying the Kruskal-Wallis test followed by Dunn's post hoc test for multiple comparisons. The significance level was set to  $p=0.05$ .

## Results

At the time of follow-up, 16 patients (8 patients from Group 1, 8 patients from Groups 2) were available for assessment.

## Interobserver agreement

Five reviewers (A,B,C,D,E) evaluated the photographic images of the implants and contralateral sites. Krippendorff's alpha for interval data was calculated to investigate the reviewers' homogeneity with regard to the overall PES results. The value  $\alpha=0.654$  (lower 95% confidence limit 0.546) indicated an acceptable strength of agreement (14).

## PES analysis

Of a possible maximum of 14 points, overall scores in the four treatment groups were 8.47 (SD 2.08, Group 1), 6.62 (SD 3.24, Group 2) (Figure 12). As the Kruskal-Wallis test delivered a P-value of 0.005, Dunn's post hoc test was performed subsequently. The differences in overall scores between Groups 1 and 2 were statistically significant ( $P=0.015$  and  $P=0.047$ , Table 1).

## Single parameter outcome

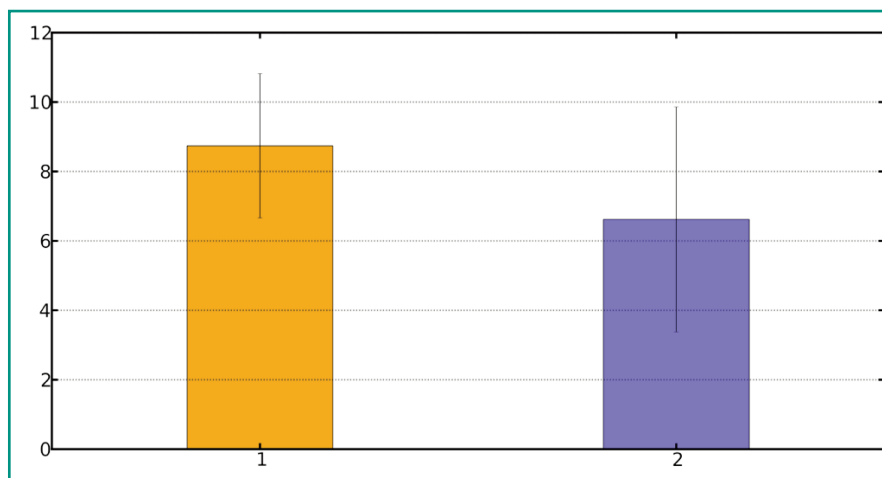
The calculated mean values of the single parameters are depicted in Figure 13; statistical differences between groups are provided in Table 2.

The mesial papilla rating of the four groups was 0.84 (SD 0.74, Group 1) and 0.85 (SD 0.76, Group 2).

The distal papillae scored 1.04 (SD 0.79, Group 1) and 1.00 (SD 0.76, Group 2).

Regarding the outcome of soft tissue contour, findings were 1.56 (SD 0.60, Group 1) and 1.03 (SD 0.84, Group 2).





**Figure 12**

Overall PES results with standard deviations in the two treatment groups. 1 (Group 1) immediate implant and immediate restoration whit seal socket. 2 (Group 2) immediate implant and immediate restoration without seal socket.

**Table 1** - PES statistical difference between groups.

1	2
statistically significant * (P<0.05).	0,015*

**Table 2** - PES single parameters \*statistically significant.

Group 1	Group 2
<b>Mesial papilla</b>	
1	1,000
<b>Level of soft tissue margin</b>	
1	0,184
<b>Soft tissue contour</b>	
1	0,025*
<b>Alveolar process</b>	
1	0,152
<b>Soft tissue texture</b>	
1	0,088

For the buccal contour of the alveolar process, results were 1.25 (SD 0.62, Group 1) and 0.88 (SD 0.72, Group 2).

With regard to gingiva color, values of 1.16 (SD 0.74; Group 1) and 1.05 (SD 0.75, Group 2) were found.

For gingiva texture, ratings were 1.38 (SD 0.65, Group 1) and 0.97 (SD 0.76, Group 2).

## Discussion

The esthetic outcome of immediate implant placement and immediate restoration (Group 1) was compared with more conservative protocols. As the overall PES ratings show, Group 1 reached a score of 8.47 which was higher than in all other groups. However, a statistically significant difference was found only in comparison with Group 2 (Figure 12, Table 1).

The study showed that all two treatment options turned out to be reliable in terms of implant survival. Statistical analysis indicated that the PES serves as a reproducible tool to evaluate the esthetic outcome of soft tissues around single-implant restorations, as investigation of the reviewers' homogeneity for overall PES results revealed. Krippendorff's alpha confirmed an acceptable strength of agreement between the five evaluators. Similar conclusions were drawn in several studies in recent year, attesting the viability of the PES for its designated purpose (15). The hard tissue condition in the implant cases of the study at hand was generally characterized by bone deficiency, which showed a variability ranging from almost intact socket walls to considerable resorption. The soft tissue dimensions were still relatively stable because of the presence of the failing tooth (16, 17). The favorable result of group, as showed in Figure 12, may be explained by the fact that, apart from bundle



bone, no further resorption has occurred. Moreover, soft tissue was still available in adequate volume to cover the augmented site. The installation of an immediate provisional crown that seals the socket allows better management of soft tissue. Obviously, the combination of physiological hard tissue shrinkage and minor tissue conditioning appears to be responsible for the least favorable outcome of the Group 2 (Figure 13).

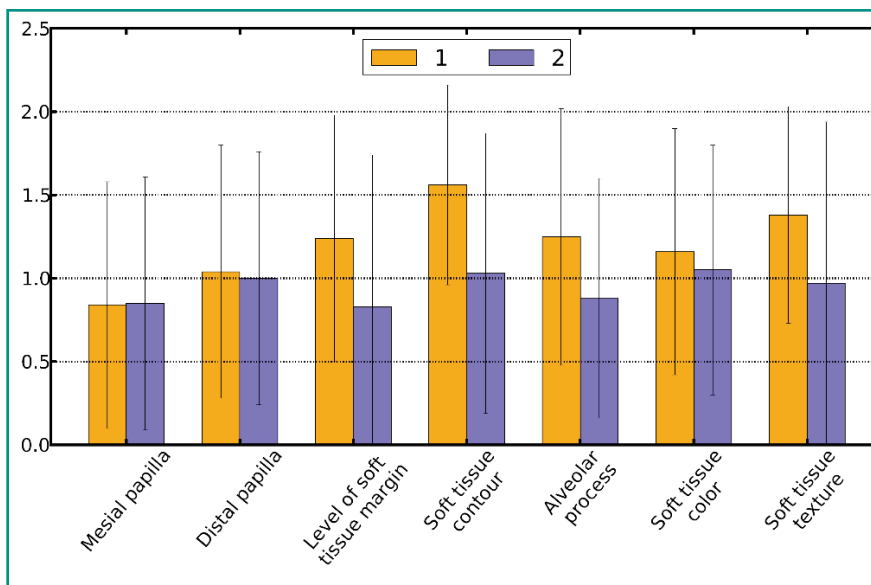
To analyze PES single parameters, the Kruskal-Wallis test was applied first. Mesial papilla, level of soft tissue margin, soft tissue contour, alveolar process, and soft tissue texture showed a P-value  $<0.05$ .

The evaluation of the soft tissue in Group 2 significantly lower in Group 1. In addition, the Group 2 for the alveolar process has made a significantly lower when compared to Group 1. The respective P-value are described in Table 2.

The evaluation of medial and distal papilla are similar in both groups with an immediate restoration (Figure 13).

The investigation of the soft tissue margin level showed the best result in the Group 1. In Group 1, the soft tissue can appear immediately suited to the ideal temporary crown without further trauma caused by subsequent treatment step (Figure 13). In Group 2, the soft tissue has suffered a narrowing, given the lack of support of a

provisional, it closed completely the socket and it went to 3 mm apical to hold their own tissues. Also the immediate restoration may have applied a greater pressure on the gingiva and left a minor space for the growth of soft tissue. The soft tissue contour is the result of papilla height and level of soft tissue margin. In Group 1 an ideal restoration with a temporary crown, which simulates the first 3 mm of the root, it may be responsible for the greater similarity with the contralateral site in a 12 week time. Despite a temporary period of 12 weeks it may be maintained also in the Group 2, the result of Group 1 was significantly higher. However, in Group 2, the tissues are already in a state of pronounced shrinkage after only four weeks for failing to support soft tissue by the temporary crown. The resulting less favorable gingival margin height could have had a negative effect on the outcome. Although a temporary restoration might encourage tissue maturation, the absolute need for and timing of a provisional crown has not yet been systematically illustrated (18). A state of reduced bone and soft tissue 6 weeks after tooth extraction demands contour reconstruction in height and width (5). Immediate implant placement requires ridge augmentation in a majority of cases as well, either due to alveolar bone loss already present, or to counter in advance any re-



**Figure 13**  
Mean scores with standard deviations for the seven single PES parameters in the four treatment groups.

sorptive processes induced by tooth extraction. Whereas, the necessity for contour restoration is undisputed, the quantity of augmentation for a harmonious symmetrical curvature may be difficult to determine (19, 20). It seems possible that using a combination of autogenous bone and bovine hydroxyapatite to re-establish the original contour could have advantages due to its higher osteogenic potential (19). The evaluation of the alveolar process shows a clear difference between the lowest results of the Group 2 than in Group 1. The detailed statistical analysis shows, however, a significant discrepancy between two groups. This disparity may have been caused by the different restoration schedules, as the timing of implantation was identical in these groups. Therefore, it might be assumed that the combination of procedures can be relevant for the outcome of the alveolar process (21).

The color and texture of the tissues can be affected by different prosthetic procedures used in Groups 1 and 2. The choice of a single step in the procedures for the groups can be reflected in a good color and texture.

## Conclusions

Our study shows a good result of the conditioning of fabrics in the total PES in Group 1 because it was a great result for all seven parameters indicated in the PES. The gingiva shows a great color and texture without showing signs of bone loss that was likely to cause after tooth extraction.

Gum parables show a harmony and with respect to the system, which does not show gum deficit for coloring and drawing that respects the tooth profile contralateral. The overall result of gum parables is perfectly integrated into the patient's smile.

In conclusion, we can say that the procedures performed in the protocol Group 1, have documented a reproducible and stable results over time, both for the visual level achieved that for implant success.

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