**Aesthetic and patient preference using a bone substitute to preserve extraction sockets under pontics. A cross-sectional survey**

**Purpose:** To evaluate aesthetic and patient satisfaction after tooth extraction using a bone substitute (and soft tissue grafting when tissue thickness was lacking) under a pontic to preserve the alveolar ridge for aesthetic purposes. The contralateral natural tooth acted as internal control.

**Materials and methods:** All patients with at least one site under a pontic augmented with Bio-Oss® or Bio-Oss® Collagen with or without a concomitant connective tissue graft with at least a follow-up of 6 months after the ridge preservation procedure were eligible for the present retrospective study. Sites with a damaged buccal wall were excluded. Outcome measures were: aesthetics (pink esthetic score, PES) evaluated by an independent and blinded dental hygienist on the basis of clinical pictures, patient satisfaction, patient preference and complications.

**Results:** Twenty-six patients were consecutively treated, and 23 patients attended the evaluation visit. In seven patients, soft tissue grafts were performed in conjunction with Bio-Oss placement. Eight to 86 months after the ridge augmentation procedure (mean 38 months), there were no statistically significant differences observed in PES between preserved sites and control teeth. Patient satisfaction did not show any statistically significant difference between the two groups either. All patients declared they would undergo the same procedure again.

**Conclusions:** Bio-Oss placement in post-extractive sites with a remaining buccal bone plate lead to a good aesthetic result. Randomised clinical trials with suitable control groups are needed to identify the most effective techniques and/or materials to preserve ridges under pontics.

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**Introduction**

After tooth extraction, the alveolar bone remodels and resorbs\(^1\). Two-thirds of this reduction occurs within the first 3 months and within 1 year the clinical width of the alveolar ridge is reduced by approximately 50%\(^1\). The mean vertical loss of tissues at single extracted sites ranges between 1 to 4 mm\(^1\) depending on site location. This physiological phenomenon occurs at different rates and degrees among various individuals and in some cases it can be very pronounced\(^1\). In sockets previously damaged by trauma...
or chronic inflammatory processes, bone resorption may be more pronounced. Localised alveolar bone resorption does not affect the possibility of placing a conventional bridge for replacing the lost dentition, but may affect aesthetics and the possibility of placing dental implants. Particularly in aesthetic areas and in those patients exposing visible portions of gum when speaking and smiling, the resorbed alveolar crest could be a cause of social discomfort and embarrassment.

Various techniques are currently used for ridge preservation or reconstruction, ranging from soft tissue grafts to augmentation with bone grafts and/or bone substitutes. Despite numerous publications on this topic, the number of reliable randomised controlled trials is rather limited.

The aim of this cross-sectional survey was to evaluate aesthetic and patient satisfaction after tooth extraction using a bone substitute (and soft tissue grafting when tissue thickness was lacking) under a pontic to preserve the alveolar ridge for aesthetic purposes. The contralateral natural tooth served as internal control. This study is reported following the STROBE Statement (http://www.strobe-statement.org/) for observational studies.

### Materials and methods

This investigation was designed as a cross-sectional survey including consecutively treated patients who, at recall, were informed about the study procedure and signed a written informed consent form. All patients who underwent a procedure of ridge preservation after tooth extraction with Bio-Oss® (Geistlich Pharma AG, Wolhusen, Switzerland) with or without soft tissue grafting between 1 January 2001 and 30 September 2008 at a German private dental practice by a single operator (Markus Schlee) and having a follow-up of at least 6 months after the ridge preservation were considered to be eligible for this study. In cases of several augmented sockets in the same patient, only one site was randomly selected for each.

### Table 1

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<th>Decision tree for soft tissue grafting.</th>
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<td><strong>Socket</strong></td>
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<td>No recession</td>
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<td>Socket seal with pontic</td>
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<td>Socket seal with connective tissue graft</td>
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*Table 1 Decision tree for soft tissue grafting.*
patient by drawing a lot. The selected socket had to be under a pontic element. The corresponding contralateral natural tooth acted as a control (e.g. if the socket of tooth 14 was preserved, its control was the tooth in position 24). If the contralateral tooth was missing, the contralateral tooth most similar to the test site was chosen. In the case where the only augmented site was a central incisor, the contralateral lateral incisor was chosen as control to avoid evaluation of two adjacent teeth.

To be treated for ridge preservation, the patients had to be 18 years or older and require the removal or one or more teeth that were going to be rehabilitated with a fixed partial denture. Exclusion criteria were: pregnancy, denture systemic diseases, smoking of more than 10 cigarettes per day, sites with acute infection or not in aesthetic areas or not under pontic elements, and lack of patient interest in the preservation procedure.

The clinical procedures were the following: after local anaesthesia with Ultracain® D-5 forte (articaine hydrochloride, adrenaline hydrochloride, 1:100,000, Hoechst, Frankfurt, Germany), the periodontal fibres of the tooth to be extracted were dissected with a sharp blade (PFISCHLEE, Hu-Friedy, Chicago, USA) as far subcrestally as possible. Great care was taken to preserve the buccal bone. After being mobilised, the teeth were extracted as gently as possible with appropriate forceps. Granulation tissue and sulcular epithelium were carefully removed with sharp spoons and a blade (Lucas CL84, Hu-Friedy). After being moistened with blood, Bio-Oss or Bio-Oss Collagen was used as bone filler. Bio-Oss is composed of particles of deproteinised bovine-derived bone mineral to which collagen can be added (Bio-Oss Collagen). The material was discreetly condensed to the crestal edge of the bone. The choice between Bio-Oss or Bio-Oss Collagen was based on the clinician’s preference for clinical handling.

Connective tissue grafts (CTG) were performed in the presence of thin gingival biotypes or gingival asymmetries like recessions (Table 1 and Fig 1). An undermining tunnelling technique starting in the sulcus was used. The split flap exceeded the mucogingival junction apically to get a sufficient mobilisation of the flap. A CTG harvested from the palate was inserted under the periosteum to thicken the tissue on the buccal aspect, to close the extraction site and to balance soft tissue dehiscence in the sulcular area (Fig 2). 6-0 Premilene® (Braun, Melsungen, Germany) sutures were used to close the wounds. Only a slight contact between the CTG and the provisional restoration was allowed to avoid necrosis in case of swelling. Sutures were removed after 7 days. After 6 weeks the temporary prosthesis was removed and a cavity was prepared in the gingiva according the shape of a modified ovate pontic (mOP). The temporary prosthesis was adapted to the cavity with light-curing composites and then carefully polished. The profile of the mOP differs from a regular ovate pontic16-18. The surfaces buccally and proximally are flat, and the edges are just a little bit rounded. The lingual aspect is shaped conventionally. This supports the tissue and may result in a better and more natural shape of the ’pseudosulcus’ and the papillae (Fig 3).
In presence of thick biotypes and harmonious gingival levels, no soft tissue graft was implemented and the Bio-Oss was kept in place with the mOP (Figs 4 to 8). A certain migration of Bio-Oss granules occurred (Fig 9). Temporary prostheses were removed every 4 weeks to eliminate the embedded Bio-Oss granules until any migration came to an end (Fig 10). After a healing period of 6 months (Figs 11 and 12) impressions for the final restorations were taken. Major efforts were taken to preserve the
gained soft tissue contour for the impression. To reproduce the gained soft tissue profile, the frame was lined with polyether (Impregum™, 3M ESPE, Neuss, Germany) and the stone casts were adapted by the dental technician. Final restorations were accurately polished before and after glazing to obtain a smooth and homogenous surface in contact with the soft tissues.

Patients were identified electronically by browsing the patient database with a search tool by a dental assistant (Ulrike Huemmer) using the keywords ‘socket preservation’. It was decided to include in the present study only patients having preserved buccal bone at the extraction sites, therefore 11 patients not fulfilling this requirement were not included in the study or evaluated. All eligible patients were recalled to attend the dental practice for the evaluation. It was annotated if a patient could not be contacted or refused to attend the follow-up assessment. In that case, the reason of the refusal was noted. Outcome measures were the following.

- Aesthetics were evaluated using the pink esthetic score (PES)\(^{19}\). At the recall visit, two clinical pictures (one vestibular and one occlusal digital photograph) were taken, including both adjacent teeth of both the test and control sites under the same light conditions and using similar framing (Fig 13). Once all pictures were collected, an independent and blinded trained dental hygienist (Tatjana Huck) scored the pictures visualised on a computer screen for aesthetics. In brief, seven variables were evaluated: mesial papilla, distal papilla, soft tissue level, soft tissue contour, alveolar process deficiencies, soft tissue colour and texture. A 0-1-2 scoring system was used, 0 being the lowest and 2 being the highest value, with a maximum achievable score of 14\(^{19}\).
- Patient satisfaction: at the recall appointment, an independent outcome assessor (Ulrike Huemmer) provided a mirror to the patients to show both test and control teeth on which patients had to express their opinions and were asked ‘are you
satisfied with the aesthetic outcome of the gum surrounding this tooth?’ Then, indicating only the preserved site, the outcome assessor asked ‘Would you undergo the same procedure again?’ Possible answers were: i) definitively yes, ii) yes, iii) uncertain, iv) no and v) absolutely not. The questions were always posed with exactly the same wording.

- Patient preference: patients were asked which of the two sites they preferred, focussing their attention to their gums. Possible answers were: i) the augmented site, ii) the natural site, iii) both are equally nice and iv) both are equally bad.

Data analysis was carried out according to a pre-established analysis plan. A biostatistician with expertise in dentistry analysed the data, without knowing the group codes. Differences in PES and patient satisfaction (ordinal data) were compared between groups using the Wilcoxon signed-rank test. Patient preference was calculated with odds ratios (OR) between patients preferring the preserved site and those preferring the natural control site using the McNemar test. All statistical comparisons were conducted at the 0.05 level of significance.

### Results

A total of 26 patients with preserved buccal bony wall were consecutively treated. Three patients (12%) did not want to attend the recall visit (dropouts). Of the attending patients, 20 (87%) were females and three (13%) males. Age at the time of the preservation procedure ranged from 29 to 69 years (mean 53 years). Eighteen patients (78%) declared themselves to be non-smokers and five (22%) to be smokers. In 16 (70%) patients the socket was filled with Bio-Oss only, whereas in seven (30%) patients the sites were also augmented with a soft tissue graft. Follow-up ranged from 8 to 86 months after the preservation procedure (mean 38 months). The location of the preserved sites
and their control contralateral natural dentition is illustrated in Table 2.

Frequencies for PES assessed at preserved and control sites by an independent and blinded hygienist are illustrated in Table 3. There were no statistically significant differences in PES between preserved and control sites (Wilcoxon signed-ranks test $P = 0.248$).

The degree of patient satisfaction with respect to the aesthetic outcome at both preserved and control sites can be seen in Table 4. There were no statistically significant differences with respect to aesthetics according to patient opinion between preserved and the control sites (Wilcoxon signed-rank test $P = 0.527$). All patients declared that they would do the ridge preservation again. Fifteen patients (65%) replied with a ‘definitively yes’ and eight patients (35%) with a ‘yes’.

Patient preferences between preserved and control sites are summarised in Table 5. There was no statistically significant difference with respect to patient preference (OR 0.43, 95% CI 0.07 to 1.88; McNemar test $P = 0.34$), with trends favouring preserved sites.

### Discussion

The main finding of the present study was that, between 8 and 86 months after the ridge preservation procedure (mean 38 months), no statistically significant differences could be found in PES and patient satisfaction when comparing post-extraction sites with intact buccal bone filled with granular Bio-Oss under pontics with their natural contralateral dentition. This is a positive result indicating that this type of ridge preservation procedure can lead to a good aesthetics as evaluated by both an independent and blinded outcome assessor and the patients themselves. This is in agreement with other studies showing that various preservation techniques can reduce ridge resorption$^{1,3,4,9}$, even though some preservation techniques are associated with a substantial number of failures and complications$^{3,20,21}$ or they appear to be ineffective$^7$.

No membranes were used in the present study, since they were not shown to have any advantages when used over a bone substitute in the case of socket preservation$^8$.
The major limitations of the present investigation were the small sample size, the retrospective design and the relatively high drop-out rates. Ideally, prospective studies with larger sample sizes should be conducted. Retrospective studies are not the ideal study design to evaluate efficacy of interventions\(^2\), nevertheless they can still provide some valuable information. Randomised controlled clinical trials (RCTs) are the gold standard to evaluate the efficacy of medical interventions. So far a few RCTs have been published evaluating various ridge preservation techniques\(^1\), showing that they are effective in minimising ridge resorption.

A drop-out rate of 12\% is acceptable. Several calls were made to invite all patients to attend the evaluation visit, but three patients expressed no intention to attend. This is an observational study that included a cohort of patients selected retrospectively. Patients were not informed initially that they would be assessed, as it happens in prospective studies, therefore patients that could have refused participation in the study, were counted anyway and this could explain why three patients refused to attend the evaluation visit. Another possibility is that they were unsatisfied with the outcome of the ridge preservation and decided not to attend. Unfortunately, the patients did not provide sufficient information to make an informed opinion, so the reasons why they refused to attend remain purely conjectural.

To date, this is the only study in which preserved post-extractive sites under pontics were compared with their contralateral natural teeth using aesthetic assessments. This choice was dictated at protocol formulation when it had to be decided which would have been the control sites, as contralateral dentition was the only available option.

The results of the present study can be extrapolated to comparable patient populations if similar interventions are provided by experienced professionals. However, it should be emphasised once more that in the present study only post-extractive sockets having preserved buccal bone were included. Consequently, these results may not apply to damaged extraction sockets.

### Conclusions

Placement of Bio-Oss in well-preserved post-extraction sites, sometimes in conjunction with soft tissue augmentation, was associated with good aesthetics as judged by an independent blinded hygienist and patients themselves when compared with contralateral sites with natural dentition. Randomised clinical trials with suitable control groups are needed to identify the most effective techniques and/or materials to preserve post-extractive sites under pontics.

### Acknowledgements

The authors wish to thank Tatjana Huck (dental hygienist) for serving as blinded outcome assessor for the aesthetic outcome, and Ulrike Huemmer (dental assistant) for identifying the patients and recording their satisfaction and preference. This study was not sponsored in the sense that free material was given, however it was initiated on the request of Geistlich Pharma AG.

### References


