Modern procedure for the creation of an ovate pontic. A new, minimally invasive surgical-prosthetic protocol - The “Bonn Concept”

Walter Lückerath

Department of Prosthodontics, Preclinical Education and Materials Science, University of Bonn, Bonn, Germany

KEYWORDS

Aesthetics, fixed partial denture, mucosal margin, ovate pontic, ridge preservation.

ABSTRACT

Aim Loss of a tooth produces a 3D alteration in the contact area of the alveolar mucosa in the desired emergence site of the latter pontic basal area. The simultaneous volume loss produces an impairment of the aesthetic result of the planned fixed prosthesis because of the necessary vertical and horizontal crown lengthening. The illusion of a natural tooth can only be obtained in the pontic area by an optimal connection between the mucosa and the basal pontic surface. For this purpose it is always necessary to prevent the volume loss which inevitably takes place after the extraction of a tooth. The aim of this study is to describe a minimally invasive, safe and simple surgical-prosthetic protocol which also reduces patient’s discomfort.

Materials and methods To establish an aesthetically ideal pontic positioning, it is advisable to implement a minimally invasive, ridge preservation, one-stage protocol with a simultaneous prosthetic rehabilitation of the post-extraction edentulous gap. At the same time, the functional and targeted modelling of the pontic area during regeneration improves the initial situation, allowing the subsequent and final rehabilitation of the patient to be performed with lower risks and excellent aesthetic results. It is therefore reasonable to avoid the invasiveness and pain of other procedures, implement a surgical technique which is safe and simple, avoid possible comorbidities and increase the patient’s comfort.

Results This procedure eliminates the once necessary multiple modelling procedures in the pontic area, targeted to modify the basal surface of the temporary pontic in order to apply pressure on the soft tissues to obtain an aesthetically appropriate pontic morphology. It also considerably reduces the patient’s discomfort while increasing the aesthetic success of the fixed prosthesis after extraction.

Conclusion The suggested single stage protocol to create a perfect pontic mucosa site whilst using a modified ridge preservation technique might simplify the final esthetic rehabilitation of a visible site after extraction. The use of a fixed temporary restoration increases the acceptance of the technique and promotes uneventful healing of the extraction site to the benefit of our patients.

Introduction

Ensuring perfect aesthetic results when modelling an intermediate element (pontic) in a bridge is an almost daily challenge for the specialists in reconstructive dentistry and fixed prostodontics. This requires that planning the 3D shape of the pontic and its relation to the alveolar process takes into consideration the aesthetic, functional, technical and hygiene aspects depending on the pontic’s position (1).

The aesthetic result of a pontic within a bridge structure depends not only on the so-called “white” aesthetics (shape, texture, brightness, color and other photo-optical properties and material properties) but also, with equivalent if not greater importance, on the so-called “pink” aesthetics and, even more, on the illusion of the presence of a healthy natural tooth.

For this purpose it is necessary that the pontic emerges from the surrounding mucosa in the same way as a natural tooth. An excellent aesthetic result is only possible by successfully imitating a healthy gingival sulcus on the pontic vestibular surface by modelling the available mucosa. However, such modelling only appears totally realistic when it is possible to preserve a sufficient volume of soft tissue despite the post-extraction healing and remodelling processes (9).

Any post-extraction volume loss, both in the vertical and horizontal dimensions, should be masked through a 3D modification of the spatial positioning of the pontic basal area, which dentists generally try to obtain by palatal and apical displacement of the basal
section. This procedure, nevertheless, implies a forced modification of the pontic morphology and therefore a change in the aesthetic appearance and a worsening of the periodontal hygiene condition (self-cleaning properties) related to the fixed prosthesis design. About 40% of patients wearing a fixed partial denture in the front upper segment report food debris impaction (8). Post-extraction volume loss is a very well documented consequence of the natural healing process (1, 3, 4) and is accompanied by a modification of the 3D spatial positioning in the contact area between mucosa and dental surface/underside of the pontic (10). The greater the volume changes in the soft and hard tissues, the more the aesthetic aspect is impaired (Figure 1).

Several ridge preservation (RP) techniques have been described, which aim at minimizing any unfavorable changes. It is widely accepted that RP procedures can limit but not totally prevent these changes. Moreover, up to now no "gold standard" has been defined regarding the choice of graft material (Table 1) and/or the use of a standardized surgical and/or prosthetic protocol (4, 5).

Several techniques have been described for modelling gums to insert a pontic, which differ widely in their surgical invasiveness, in the clinical demands of repeated treatment to modify the basal section of the bridge body, in the amount of pain for the patient and also in their final aesthetic and biological outcome. The aesthetic standard for the relationship between pontic and mucosa is identified in the so-called "ovate pontic" (6, 7, 8, 9, 10, 11, 12).

The aim of this contribution is to present a combined surgical-prosthetic minimally invasive one-stage protocol, which includes both a modified ridge preservation technique and an immediate modelling of the subsequent ideal "ovate pontic" through the provision of an immediate fixed bridge to restore the edentulous gap (Table 2).

**Materials and methods**

**Clinical protocol**

To define the desired 3D positioning of the pontic base for the final reconstruction, an analysis of the patient’s original aesthetic condition is required. The general principles of the aesthetic shape of front restorations have been widely described, Fradeani (13) and Magne et al. (14) have provided an overview on this subject.

Particular importance must be paid to the desired 3D positioning of the basal section of the pontic in the final bridge. It is essential for this purpose to have an interpretative definition of the spatial positioning of the pontic based on the assessment of the desired aesthetic result and of the actual possibilities of biological regeneration. The "actual possibilities of regeneration" are obviously dependent on factors

<table>
<thead>
<tr>
<th>Materials - Ridge Preservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autogenous bone marrow (aBM)</td>
</tr>
<tr>
<td>Bioglass (BG)</td>
</tr>
<tr>
<td>Calcium sulfate (CaS)</td>
</tr>
<tr>
<td>Deprot. bovine bone material (DBBM)</td>
</tr>
<tr>
<td>Hydroxyapatite (HA)</td>
</tr>
<tr>
<td>Magnesium fenriched hydroxyapatite (mHA)</td>
</tr>
<tr>
<td>β-Tricalciumphosphate (TCP)</td>
</tr>
<tr>
<td>Freeze-dried bone allograft (FDBA)</td>
</tr>
<tr>
<td>Mineralized freeze-dried bone allograft (MFDBA)</td>
</tr>
<tr>
<td>Demineralized freeze-dried bone allograft (DFDBA)</td>
</tr>
<tr>
<td>Absorbable collagen sponge (ACS)</td>
</tr>
<tr>
<td>Absorbable bovine collagen sponge (ABCS)</td>
</tr>
<tr>
<td>Polylactid-polyglycolic acid (PLGA)</td>
</tr>
<tr>
<td>Recombinant human BMP (RhBMP-2)</td>
</tr>
</tbody>
</table>

**Table 1** Overview of materials used in ridge preservation techniques
such as the extent of periodontal damage, the ridge preservation techniques selected, the materials used, the size and position of the defect and so on, but also on the operator's clinical-surgical experience (technical awareness of the different procedures) (Figure 2).

**Surgical protocol**

The main difference versus other ridge preservation techniques consists of the use of an alloplastic particulate filler, which polymerizes on contact with blood and can create a rigid, cross-linked, almost 3D structure, by means of an activatable polylactic acid covering layer (15).

The clotted and stabilized filler particles make it possible to cover the graft material with other resorbable or non-resorbable membranes, with connective tissue obtained from the oral cavity or free epithelium transplantations or by mobilization of the vestibular tissues through elevation of a partial or total flap making a primary closure unnecessary. In this regard it is particularly important to prepare the sockets by excochleation of the granulation tissue and removal of the internal marginal epithelium and to fill them with increments of clotted and compacted material (Figure 3).

If the sockets are not sufficiently filled, the regeneration process may be incomplete; therefore the application of the graft material should not be limited to the anatomical bone margin of the sockets, but should be extended to the aesthetically appropriate basal area of the ovate pontic. The filling of the post-extraction sockets up to the mucosal margin is crucially important, because only such stabilization of this area can prevent the invagination of soft tissues (16) and the consequent immediate volume modification, in the horizontal and vertical dimensions (Figure 4).

Augmentation beyond the bone margin is particularly important when no vestibular bone plates are present, which means that the structural support of the soft tissues must be provided by the graft material polymerizing in situ. In this way it is possible to avoid techniques using non resorbable membranes or supporting structures for the graft material which require a subsequent surgical procedure (17).

---

Table 2 Treatment plan with pontic/ridge preservation

<table>
<thead>
<tr>
<th>Surgical-posthetic protocol</th>
<th>Definition of final restorative position of gingiva=subsequent augmentation height=pontic basal position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aesthetic analysis</td>
<td>a. Mod. tooth</td>
</tr>
<tr>
<td>2. Preparation of temporary fixed prosthesis</td>
<td>b. Mod. prosthetic crown</td>
</tr>
<tr>
<td></td>
<td>c. Adhesive bridge</td>
</tr>
<tr>
<td></td>
<td>d. Conventional bridge i. Long-term provisional manufactured in the dental laboratory</td>
</tr>
<tr>
<td></td>
<td>ii. Chairside temporary bridge</td>
</tr>
<tr>
<td>3. Abutment teeth preparation (conventional bridge)</td>
<td></td>
</tr>
<tr>
<td>4. Atraumatic extraction and ridge preservation</td>
<td>a. Segmental augmentation (vertical height as defined at point 1, at least over the mucosa)</td>
</tr>
<tr>
<td>5. Fixed temporary prosthesis</td>
<td>a. Modified oral hygiene / 0.2% chlorexidine 3-6 days, normally no antibiotic</td>
</tr>
<tr>
<td>6. Maturation stage (3 months)</td>
<td></td>
</tr>
<tr>
<td>7. Reassessment - Volume preservation, positioning of mucosa with respect to reference line?</td>
<td></td>
</tr>
<tr>
<td>8. Maturation stage (3 months)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Implant after 12 months</td>
</tr>
</tbody>
</table>
Figure 2a Teeth 11 and 21 must be removed because of a recurrent deep marginal periodontitis. The planned treatment consists of a fixed aesthetic rehabilitation of the upper front segment by means of an "ovate pontic" with the preservation of the maximum possible volume in the area of teeth 11 and 21.

Figure 2c Aesthetic analysis result. In addition to the indispensable modification of the crown length (white aesthetics/white arrows) also changes to the vertical position of the gingiva must be performed through mucogingival procedures (red arrows). Which spatial positioning of the mucosa is predictably obtainable after extraction of teeth 11 and 12?

Figure 2d The aesthetic analysis identifies a reference line for a harmonious and scalloped mucogingival contour which defines the spatial positioning of the mucogingival junction on the natural teeth and on the basal surface of the pontics. According to the treatment plan the dentogingival junction should coincide with the reference line at the sites of teeth 13, 23 and of the bridge pontics 11, 21, and be positioned 1 mm underneath the reference line at the sites of the teeth 12 and 22.

Figure 2b Extraction has become necessary because of tooth 11 fracture and recurrent periodontitis on tooth 21.

Prosthetic protocol
After defining the desired basal positioning of the pontic based on the aesthetic analysis results and the aesthetic wax-up, it is possible to start manufacturing the temporary fixed prosthesis, ideally a long term temporary pontic manufactured in the dental laboratory (Figure 5). At this stage it is possible to properly shape the basal surface of the pontic, as the basal surface of the temporary represents the positive mould of what will be the pontic's morphology.

In the case of a single tooth reconstruction, it is possible to consider even an adhesive bridge with one or two wings, the adhesively cemented "old" restoration, the shortened and adhesively integrated original tooth, adhesively secured prosthetic crown and a chairside temporary bridge. Therefore particular attention is required for the basal modelling and the perfect polishing of the basal surface.

This is because the basal contour acts as the crestal "guideline" while the cross-linked particulate graft material represents the basal "guideline" for the epithelial regeneration which will allow the shaping of the future pontic without further intervention (Figure 5b).

The temporary bridge has to be left in situ for 3-6
months. It is recommended to not clean the underside of the pontic by using dental floss.

Discussion and conclusion
Since the outcome of the natural post-extraction healing process is extremely individual, the approaches to the realization of an aesthetic pontic, the so called 'ovate pontic', are based on a gradual correction of the mucosa until the remodelling processes come to a standstill. Therefore attempts to obtain the ideal shape of the pontic were often based either on application of composites, through additive techniques, or on application of pressure, in order to obtain a targeted modelling of the soft tissues (10). The workflow of the procedure described does not comply with this standard.

As part of the aesthetic-prosthetic planning of a case, before starting the treatment, an analysis of the prosthetic risk is performed, with the description of the need of aesthetic-prosthetic treatment for each tooth and subsequently for the entire front aesthetic segment. The analysis includes both treatment for the so called pink aesthetics and the technical/prosthetic requirements. The resulting treatment plan offers to the patient a more accurate idea of the kind of therapy, of the time needed for the biological regeneration and healing and of the individual possibilities for the final reconstruction.

The prosthetic backward planning includes first of all the planning of the 3D spatial positioning of the basal portion of the pontic in order to be able to predict the position and length of the pontic and therefore the overall prosthetic outcome.

It is important not to adopt the existing 3D spatial position (determined by periodontal or peri-implant diseases and not suitable for the final reconstruction) but to apply the available augmentation techniques (alveolar ridge preservation) in order to obtain a spatial positioning of the pontic that may be aesthetically advantageous (Figure 5c).

Since the planned wearing time of the temporary prosthesis is about 3-6 months, it is certainly possible to obtain a high quality result with a long term provisional manufactured in the dental laboratory, which can comply with a series of requirements: it allows the immediate prosthetic rehabilitation of the patient after tooth extraction, it assures physical protection to the graft material, reduction of micromovements on the graft material, testing of the basal position of the future pontic and creation of a regeneration 'guideline' for
Socket filling up to the anatomical mucosal margin avoiding supracrestal collapse of soft tissues. 3D concave modelling of the in situ polymerizing material to include the ideally shaped base of the pontic epithelial migration over the graft material. At the same time, the control over the aesthetics of the bridge structure as a prototype of the future final reconstruction means a guarantee of aesthetic success (Figure 5d).

From a morphological point of view, the long term temporary can reproduce both the 3D spatial positioning of the whole bridge body, and therefore of the pontic too, and the spatial positioning of a gingival sulcus predefined by adjacent teeth. The result is a 3D morphology as accurate as possible in the basal area of the pontic, necessarily established by the attachment of fixed epithelial cells migrating over the graft material.

Contrary to the established approaches, the described technique defines a targeted and predictable spatial positioning of the pontic basal area and therefore a crown length which is as predictable and aesthetically successful.

If conventional prosthetic solutions have been planned after the extraction of a tooth, it is

Post-extraction situation: ridge preservation and temporary rehabilitation using a fixed long-term provisional. It is important to point out that both teeth preparation and reconstruction should not be based on the anatomical position of the gingiva on abutment teeth, but on the position planned in the aesthetic analysis.

It was possible to achieve the planned vertical positions of the gingiva on teeth 13, 12, 22, 23 and of the mucosa in the area of the intermediate elements 11, 21. The implementation of this clinical protocol allowed avoiding volume loss after extraction of teeth 11 and 21.

Regeneration result after 3 months of wearing the temporary prosthesis. 3D modelling of the soft tissues for the inclusion of the intermediate elements of a fixed prosthesis with a one-stage, minimally invasive clinical protocol. The subsequent maturation time can be used to improve the spatial positioning of the gingiva on the abutment teeth by covering the root surface with connective tissue transplantsations through a minimally invasive pouch technique.

Situation after aesthetic rehabilitation through prevention of alveolar volume loss after extraction by a minimally invasive one-stage protocol.
possible to obtain excellent aesthetic results with an immediate, minimally invasive and one-stage aesthetic rehabilitation without the need for a more aggressive procedure (18). It is also possible to exploit the soft tissue in a targeted manner to obtain a volume augmentation through techniques with crestal or vestibular access.

If implant-prosthodontic solutions have been planned, the probability of having to perform a simultaneous augmentation at the moment of implant placement can be reduced by 50%. At least the starting condition, in view of possible further augmentation measures, appears notably improved (5).

Conflict of interest
The author has no conflicts of interest to declare.

References