

# TOOTH PREPARATION USING GUIDE PIN INSTRUMENTS AND THE BIOLOGICAL WIDTH

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## Introduction

Previous surveys have shown that subgingival restoration margins generally lead to significant inflammation of the marginal periodontium<sup>6, 13, 16, 17</sup> and, inter alia, trauma of the "biological width". This term is defined as the area of the coronal periodontium of the limbus alveolaris, which consists of the connective tissue and epithelial attachment as well as the gingival sulcus (Figure 1a). It is assumed that, physiologically, these structures each extend approximately 1 mm vertically. The biological width of a healthy periodontium therefore has a dimension of approximately 3 mm in total<sup>5-11</sup>. An injury to this area, caused, for example, by a subgingival preparation placed too deeply, will irritate the marginal periodontium. As a general rule, this is followed either by recession or by persisting gingivitis/periodontitis<sup>6, 7, 10, 14</sup>. For this reason, it is desirable to always place restoration margins supragingivally. However this is frequently not possible due to defective morphology as well as for aesthetic reasons<sup>9</sup> particularly in the anterior region. The subgingival placing of a restoration margin required in such situations must therefore be carried out as atraumatically possible taking into consideration the biological width.

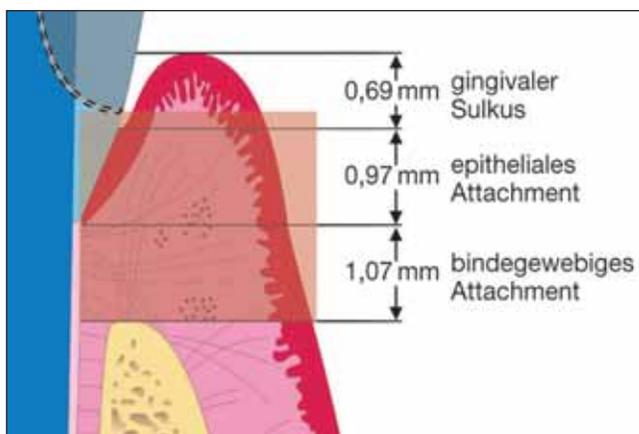


Figure 1a: Average dimension of the "biological width" of a healthy periodontium (area shaded grey): approx. 2.0 to 2.5 mm distance from the limbus alveolaris to the intrasulcular subgingival preparation margin. It is essential to respect this distance to keep the periodontal attachment healthy.

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Figure 1b: The biological width mimics the shape of the alveolar bone, i.e. its arch corresponds to the circular contour of the cemento-enamel junction.

It is important to ensure that the biological width follows the shape of the alveolar bone, i.e. that its arch corresponds to the circular contour of the cemento-enamel junction. (Figure 1b)<sup>5</sup>. The contour of the healthy gingiva serves as a guide. When preparing intrasulcular restoration margins, these should not be embedded deeper than 0.5 mm in the sulcus, thus avoiding possible injury to the soft tissue and epithelial attachment<sup>1, 9, 15</sup>. Should the retention not be sufficient due to a short clinical crown, a surgical crown extension should be performed prior to restoration, in order to prevent a subgingival preparation from extending into the area of the biological width. The restoration of the tooth can be carried out approximately 8 – 12 weeks after such surgical crown extension. At this point, the healing process of the periodontium is almost complete, clinically as well as histologically<sup>4</sup>.



Figure 2: Diamond abrasive instruments with non-coated guide pin in the designs 'tapered round' for pronounced chamfers, respectively available in normal grit for shaping and fine grit for finishing; 'Torpedo tapered' for slight chamfers (Brasseler, D-32657 Lemgo).

In practice, the preparation of a chamfer has proved successful<sup>9, 13</sup> for crown restorations. Diamond grinding instruments with non-coated guide pins are particularly suitable, causing



**Figure 3:** Starting point, the periodontally sound tooth 14 is to be crowned.

**Figure 4:** Occlusal orientating grooves: Occlusal orientating grooves (depth: approx. 1.5 mm) are prepared using a slightly tapered diamond abrasive (Brasseler, D-32657 Lemgo) in order to guarantee even occlusal substance reduction while retaining the occlusal shape.



**Figure 5a:** Buccal and palatal orientation grooves: The same diamond abrasive is used for preparing vertical orientation grooves vestibularly and palatally parallel to the surface of the tooth.

**Figure 5b:** According to the orientation grooves the tooth is vestibularly and palatally prepared up to the proximal surface, supragingivally, leaving merely a small proximal area to be prepared.

**Figure 6:** Initial proximal separation and preparation up to the height of the marginal gingiva by using a thin diamond (Brasseler, D-32657 Lemgo). It is essential to ensure that the preparation margin corresponds to the contour of the gingiva, from proximal to vestibular and palatal.



**Figure 7a:** Retraction rings (Epipak® rings) and plunger (Applicator Packer® 170 Ultradent, USA).

**Figure 7b, c:** Dilatation of the sulcus via a retraction ring; the marginal gingiva is displaced laterally and apically by a largely non-traumatic insertion of the ring using a suitable retraction thread plunger, thus creating a barrier between the preparation instrument and the periodontium which prevents an invasion into the area of the biological width as far as possible.

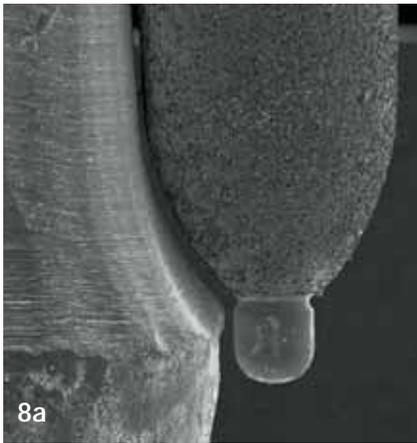
minimal trauma to the periodontium while carrying out a restoration, after first opening or extending the gingival sulcus by means of a thread or a retraction ring<sup>2,3</sup>. Experience has shown that rings are frequently more suitable than threads for this purpose. Diamond instruments with non-coated guide pins in various shapes, grit sizes and dimensions are available from several companies, for example Brasseler, Lemgo (Figure 2), Orthodontics (Switzerland) or DIT-Diamanttechnik (Wustenbrand/Saxony). A step by step description of a mostly atraumatic tooth preparation, taking into consideration the biological width.

### Systematic procedure

The following steps for tooth preparation are to be carried out causing as little trauma as possible. A pre-requisite is a healthy

periodontium, which can be achieved when preceded by systematic periodontal therapy, if required (Figure 3).

- Occlusal and/or incisal shortening of the tooth (Figure 4); initial preparation of (orientation) guide grooves (approx. 1.5 – max. 2 mm).
- Supragingival preparation (reduction) of the vestibular and lingual tooth surface, again following initial preparation of groove markings on two levels (see Figures 5a, b), and then
- Initial proximal separation and preparation of the tooth to marginal gingiva level using a thin diamond (for example S6878.314.012; Brasseler, D-32657 Lemgo) (Figure 6)
- Dilatation of the sulcus via a thread or a retraction ring (Figures 7a – c) by careful insertion (for example Epipak® rings; ESPE, Seefeld) using a suitable plunger (for instance Packer® 170, Ultradent, USA). During this process the marginal gingiva



**Figure 8a:** REM-illustration of the preparation margin with diamond abrasive and non-coated guide pin (8878KP.314.021; Brasseler, D-32657 Lemgo).  
**Figure 8b, c:** Vestibular and palatal intrasulcular preparation. The final fixing of the preparation line merely requires a minimal reduction of hard tooth substance, which is finally followed by finishing the preparation margin and, if required, the smooth surfaces.



**Figure 8d:** For all ceramic and veneer crowns the cutting depth is increased using a congruent diamond instrument without guide pin (Brasseler, D-32657 Lemgo).  
**Figure 8e:** An identically shaped fine grit diamond with non-coated front can be used for finishing the smooth surfaces. Finish the margin area with fine grit diamonds or abrasives; round off edges, corners and angles (Brasseler, D-32657 Lemgo).  
**Figure 8f:** Condition after preparation of teeth (proximal-lingual: less pronounced chamfer; vestibular, mesiovestibular and distovestibular: more pronounced chamfer, in order to prevent an overcontouring of the ceramically veneered restoration); retraction ring still in situ.



**Figure 10: Impression:** It is recommended to check the impression with magnifying glasses. Preparation margins are clearly visible.

**Figure 9: Control of substance reduction by means of an impression.**

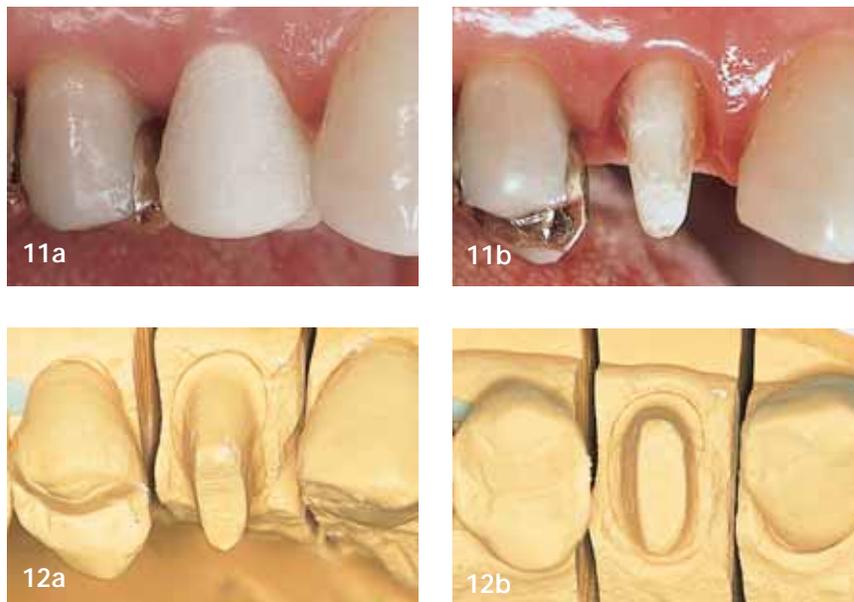
is moved laterally and apically. The ring (or thread) forms a barrier between the preparation diamond and the periodontium, thus preventing an encroachment of the biological width as far as possible.

- Intrasulcular preparation (Figures 8a – d): The final setting of the preparation margin merely requires a minimal reduction of hard tooth substance.
- Finishing in the margin area using fine grain diamonds or abrasives; round off edges, corners and angles, finish smooth surfaces if required (Figures 8e, f);
- Substance reduction control at the prepared tooth by preparing an impression prior to preparation (Figure 9).

- Impression (Figure 10): Depending on the clinical situation and/or the sulcus depth, the “two-threads technique” can be put to use, i.e. the retraction ring or thread is combined with a further thread (for example Ultrapak® #00, #0, #1; Ultradent, USA). In order to match the subgingival area of the prepared tooth exactly, the impression material can be evenly distributed by carefully applying a stream of air.
- Temporary care (Figures 11a, b): It is recommended to leave the retraction ring in the sulcus during the preparation of the temporary. The patient should be informed that conscientious oral care and scrupulous cleaning of the temporary appliance are of utmost importance during the phase of temporary care.
- Stone die (Figures 12a, b) and final care following insertion (Figures 13 a – b): In order to maintain a healthy periodontium, the margins of the restoration must not penetrate the area of the biological width and the patient must ensure efficient plaque control.
- Recall (clinical control directly after cementing and then again after 3 weeks, 3 months, 6 months, 12 months etc.) in order to guarantee long term success of the restoration (Figures 14 a – e).

**Discussion**

There is little scientifically-based research regarding the possible interaction between the so-called “dentogingival complex” and restorative measures such as preparation, impression and



**Figure 11a:** Temporary restoration (temporary plastic appliance) after preparation. The temporary appliance should be contoured “physiologically” and have a smooth, easy-to-clean surface and a satisfactory marginal seal. It is particularly important that the adjacent soft tissue is neither displaced nor traumatised.  
**Figure 11b:** A week after the preparation, the gingiva shows a physiological contour and height.  
**Figure 12a, b:** Stone die of the prepared tooth.

fillings/crowns. A prospective clinical study came to the conclusion that, as a general rule, a crown reaching into the zone of the biological width causes gingival inflammation in the long run<sup>6</sup>. In addition, a clinical survey held over a period of 12 months showed that a carefully performed intrasulcular preparation as described in this article can maintain the periodontal health of crowned teeth<sup>7</sup>.

Parallel to the few existing scientific/clinical studies, there are a number of reports on individual cases which are frequently used as a basis for generally valid therapeutic recommendations. For instance, biological variables relevant to restorative therapy are described and paradigms for tooth preparation<sup>10,11</sup> are assumed, based on clinical experience. Observations like these are without doubt very important for the practice-oriented dental professional, but they should also give rise to long-term clinical studies. It should be stressed at

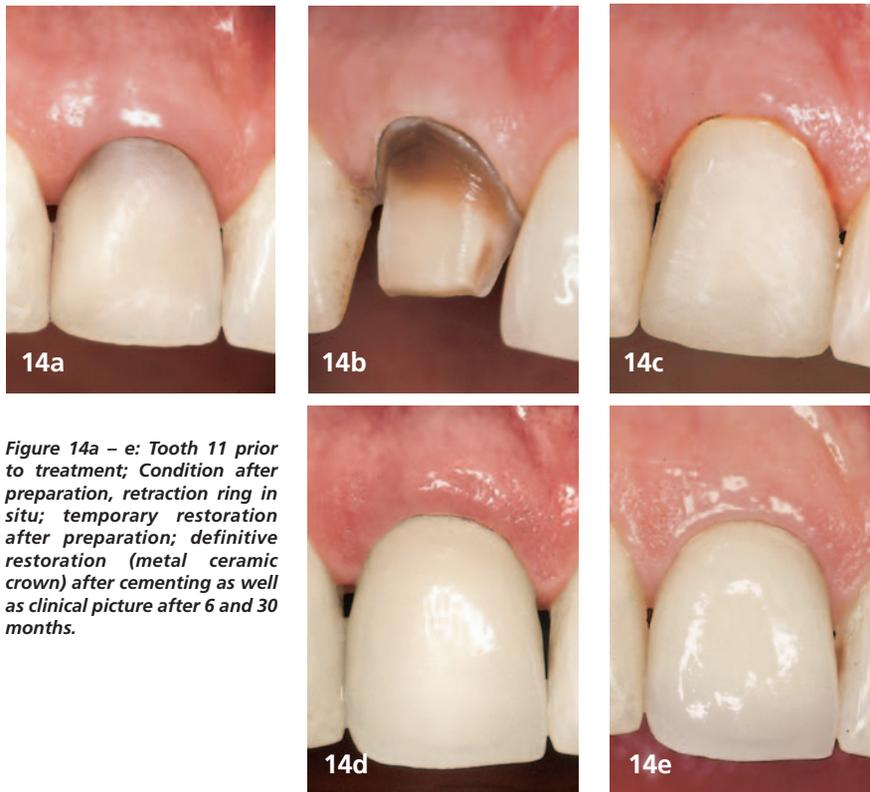
this point that practice-oriented investigation presents an excellent opportunity for joint research to be carried out between dentists in practice and academia.

**Conclusion**

A long-term successful restoration requires the maintenance of a healthy periodontal attachment. The accumulation of plaque, marginal seal, crown contour, proximal shaping, surface structure, biological width, host factors as well as easy hygienic maintenance of the reconstruction are all deciding factors contributing to the health or disease of the gingiva and the periodontal supporting tissue. In order to minimize the threat of iatrogenic damage to the periodontium, special attention has to be paid to the subgingival preparation and to the shaping of the subgingival crown margin. The preparation technique detailed in this article, supported by a preceding



**Figure 13a:** Metal ceramic crown: vestibular, mesiovestibular and distovestibular: ceramic shoulder; proximal-palatinal: metal margin.  
**Figure 13b, c:** Definitive metal ceramic crown following cementing.



**Figure 14a – e: Tooth 11 prior to treatment; Condition after preparation, retraction ring in situ; temporary restoration after preparation; definitive restoration (metal ceramic crown) after cementing as well as clinical picture after 6 and 30 months.**

prospective clinical study, respects the area of the biological width, especially in the proximal area, thus fulfilling a vital condition for keeping the marginal periodontium healthy. The required controlled and tissue-friendly hard substance reduction, particularly in the intrasulcular area, is facilitated by the use of special preparation diamonds with non-coated guide pins, various modifications of which can be obtained from several manufacturers.

**Expression of thanks**

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