

## Technical Note

# Vertical Edgeless Preparation: Periodontal Dominance in Prosthetic Crown Preparation

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**Abstract:** This article aims to describe Vertical Edgeless Preparation (VEP), a full-crown vertical preparation technique initially introduced by the Porta Mascarella Group in the 1980s. The method is defined as “periodontally driven” because its main indication is teeth with a loss of periodontal attachment, and it aims to obtain healthier periodontal tissues. This work describes the step-by-step procedure for performing this prosthetic technique and its indications, contraindications, impression phases, temporary crown management, and its biological concept of periodontal dominance.

**Keywords:** prosthodontics; vertical preparation; full crown



**Citation:** Noè, G.; Toffoli, A.; Foce, E.; Di Febo, G.; Carnevale, G.; Bonfiglioli, R.; Macaluso, G.M.; Manfredi, E. Vertical Edgeless Preparation: Periodontal Dominance in Prosthetic Crown Preparation. *Prosthesis* **2023**, *5*, 358–367. <https://doi.org/10.3390/prosthesis5020026>

Academic Editor: Marco Cicciu

Received: 15 March 2023

Revised: 29 March 2023

Accepted: 30 March 2023

Published: 5 April 2023



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## 1. Introduction

This work describes the Vertical Edgeless Preparation technique, its advantages and limits, and the biological concepts on which the technique relies.

Vertical Edgeless Preparation (VEP) is a full-crown preparation technique that extends to the subgingival part of the root and is indicated for teeth with a loss of periodontal attachment. As described in communications, presentations, and books [1], VEP has been used since the 1980s, being devised by the Porta Mascarella Group, a team of dentists and dental technicians composed of Dr. Di Febo, Dr. Carnevale, Mr. Trebbi, and Mr. Bonfiglioli, who were also founding members of the Italian Academy of Prosthetic Dentistry. At that time, this prosthetic preparation was performed by prosthodontists on patients who suffered from periodontal disease as part of a treatment plan which involved the prosthetic rehabilitation of teeth with reduced periodontal support, regardless of the presence of augmented probing depth after the initial periodontal treatment. The Porta Mascarella Group also published the procedure of open-flap preparation, but not the technique known at the time as “preliminary prosthetic preparation” or “vertical feather edge preparation”. Regarding the latter definition, it is necessary to specify that there were many different interpretations of feather-edge preparations. The one from which VEP was developed was known as “feather edge according to Porta Mascarella” [2–4].

In 2015, Bedendo, Di Febo, and Foce published, in an Italian journal, an article under the name “Vertical preparation Technique”, which detailed the technical aspects, the tools to use, and the operative phases relating to the general principles of vertical preparations, describing the various stages of this procedure step-by-step. This work described the operative technique of this prosthetic preparation, its advantages, and its limits without addressing the biological principles and the relationship with the marginal periodontium, which represents one of the main features of this procedure. These aspects have been addressed from 2020 to 2021 in a series of four articles in Italian and a monograph [1].

Teeth prepared according to the VEP technique present an area prosthetically usable for marginal closure, with no steps, transition angles, edges, and undercuts; hence the name “edgeless”. This particular and unique feature allows the prosthetic margin to be positioned at different heights on the abutment surface, maintaining a reliable marginal closure. The convergence between the final part of the prepared surface and the unprepared surface results in a transition angle which, however, will be fully covered by the regrowth of the healed periodontal tissues (junctional epithelium) injured during the preparation procedures and will hence be irrelevant from the clinical perspective. To avoid interference during tissue-healing processes, the margin of the provisional crown will be placed extra-gingivally. On the basis of evaluation based on tissue thickness, materials used, and esthetic needs, the clinician will be able to decide where to position the final prosthetic margin.

The root surface whose periodontal attachment is lost consists of necrotic cement and dentin; these tissues are exposed to pathogens and could be compromised by toxins and bacteria. Preparing these parts of the tooth helps protect the dental tissues from the oral environment and eliminates the external and more compromised part of the root [5]. This procedure is possible only on teeth with a loss of periodontal attachment, as performing it on a periodontally intact tooth would result in periodontal damage. It is essential to underline that the loss of periodontal attachment is not a synonym of active periodontitis, which is a contraindication for prosthetic treatments [6]. Still, it refers to all those teeth which have lost support in the past without active disease in the present, a widespread occurrence in the adult population [7]. Subgingival preparations with diamond burs clearly create periodontal damage, which have been shown to increase periodontal inflammation indexes temporarily [8]. However, it is well-known from the classic literature that the periodontal tissues wounded during tooth preparation will ultimately recover if left to heal undisturbed [9,10]. The VEP technique, therefore, requires the provisional crown margins to be left coronally to the gingival margin so that they cannot interfere with the periodontal healing.

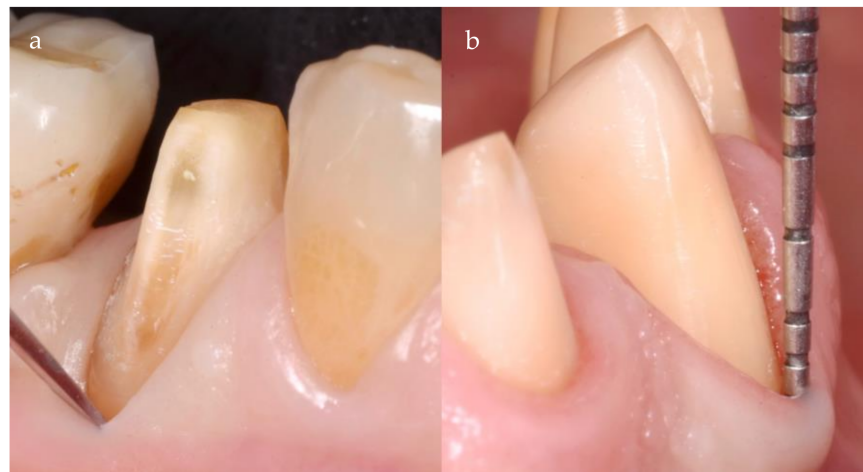
While most prosthetic crown preparation techniques are bur-shaped because the tooth/root surface is shaped as the counter-mold of half of the bur, the VEP technique implies that the bur is used at different angles, resulting in an edgeless, not-bur-shaped abutment.

VEP differs from other vertical preparation techniques since, unlike VEP, traditional feather-edge or knife-edge preparations present a defined finishing line (Figure 1), and they often use the provisional crown to manage soft tissues.

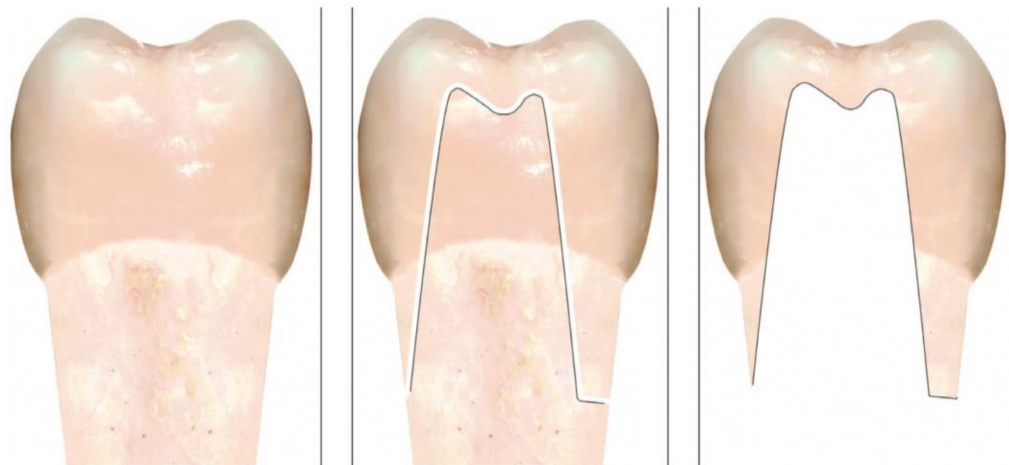
This technique is indicated for patients with thick/medium periodontal phenotype, and when the tooth presents a loss of periodontal attachment and a probing depth greater than 2 mm. Moreover, VEP is particularly indicated when extending the prosthetically usable area is necessary to obtain more excellent retention and stability and to hide the crown margin below the gingival level. Additionally, it helps approach old preparation or restoration margins and small carious lesions below the gingival margin. Finally, it is indicated when the clinician needs to bypass morphologic or structural alteration in the gingival margin area, or when preparing a tooth with a long clinical crown in which a horizontal preparation technique would result in a more significant loss of dental tissue (Figure 2).

On the other hand, VEP is contraindicated when the tooth requiring a complete crown preparation allows maintaining the finishing line on enamel or does not present periodontal attachment loss unless the treatment plan includes a reduction of the clinical attachment. Additionally, it is fundamental to underline that the patient should not suffer from active periodontitis when considering definitive prosthetic therapies and that periodontitis must be treated before prosthetic planning and delivery.

The presented technique consists of a simple, effective, and easy-to-manage vertical preparation philosophy, which also represents an essential inheritance of the School of Porta Mascarella, one of the most important Italian study centers in prosthetic dentistry.



**Figure 1.** (a) Subgingival finishing line on traditional vertical preparation. (b) A periodontal probe shows the absence of a finishing line on a tooth prepared with the VEP technique.



**Figure 2.** Amount of tooth reduction with VEP (left) and with a horizontal preparation (right).

## 2. Technique

1. Periodontal mapping: The first step is to map the periodontium of the tooth with a periodontal probe. Hence, the evaluation is repeated with a steady Komet 862 bur (Komet Dental, Germany). The tip of the steady bur tilted  $30^\circ$  leans on the root surface. Moving it in the sulcus allows the periodontal site mapping as if it were a probe, obtaining the necessary anatomical information.
2. Initial reduction: Subsequently, the occlusal part of the tooth is reduced to create adequate prosthetic space. The amount of occlusal reduction is defined by the necessary thickness of the material used for the crown and the distance between the to-be abutment and the opposing tooth. Usually, and specifically, when the tooth is close to other dental structures not included in the prosthetic rehabilitation, the preparation phase is preceded by an interproximal separation phase which prevents sound structures from being damaged by the burs during subsequent steps.
3. Primary progressive reduction: This procedure is performed by using the bur with an inclination of  $30^\circ$  so that only the final part of the bur is in contact with the tooth structure. The bur is kept more coronal than the previously measured depth of the gingival sulcus of that site. In this way, the tissue of the root surface and a small component of the internal part of the gingival sulcus is removed. This reduction will result in a small step at the level corresponding to the tip of the bur. At this point, the preparation is “bur-shaped” as with most of the complete crown techniques (Figure 3).

4. Secondary progressive reduction: The previously performed reduction of tooth structure and the push of the bur on the gingival margin, together with the unavoidable gingivage, will result in an augmented space between the tooth structures and the gingival margin. This allows the clinician to obtain better vision and access to the deepest parts of the sulcus and, therefore, to see and remove any calculus, steps, grooves, or undercuts from the root surfaces. Using a “toe-heel” technique, the apical part of the root surface is structured, creating the edgeless profile of this preparation. Then, the coronal portion of the abutment is reduced by using a bur with reverse angulation. In this phase, it is also necessary to connect the different reduction planes created during the various stages (Figure 4).
5. Finishing: At the end of these steps, which are performed with coarse-grain burs, the abutment preparation is finished with fine-grain burs.
6. Temporary crown relining and delivery: Next, the insertion and the housing of the temporary crown are checked and then relined. It is essential not to move the crown during the relining stage so that the margin will not open, guaranteeing an adequate closure (Figure 5). After that, refining is necessary, keeping the margin as thin as possible. After polishing, the temporary crown is cemented with eugenol-free temporary cement. With the VEP technique, as with the intraoperative preparation technique, the apical part of the abutment reached by the bur does not correspond with the prosthetic margins, both for the provisional crown and the ceramic one. The cervical margin of the temporary crown is placed coronally to the corresponding gingival margin to allow undisturbed healing of the soft tissues surrounding the abutment (Figure 6).



**Figure 3.** Primary progressive reduction.

The abutment now presents a “prosthetically usable surface” which is edgeless in all its extensions rather than a defined preparation margin. VEP is a vertical prosthetic preparation technique because due to the fact that as the drill penetrates apically inside the sulcus or pocket, its removal of tissue from the root wall will tend to decrease until it is zero. It will therefore result in the formation of a transition angle between the prepared part of the root and the unprepared part. This angle will not be exposed as it will be submerged by sulcular epithelium adhering to the root wall after the healing phase. Therefore, it will be irrelevant from a clinical-practical point of view. At the end of soft tissue maturation, choosing the ideal position of the final prosthetic margins will also be possible (Figure 7).

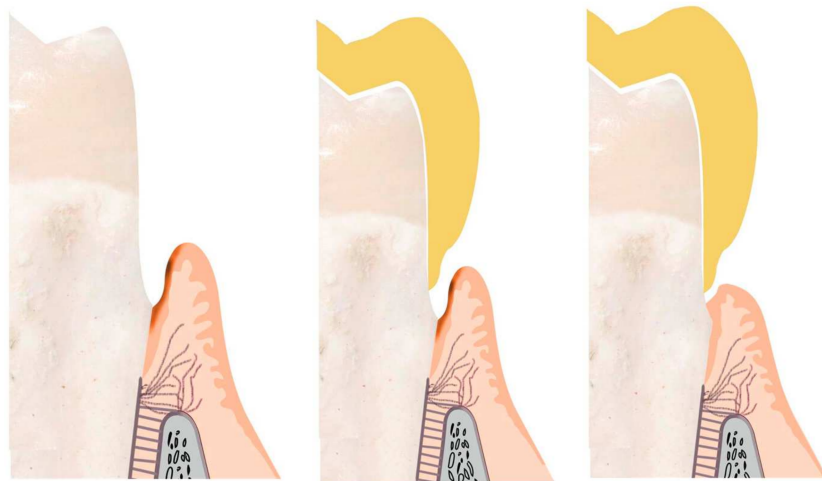




**Figure 4.** Secondary progressive reduction.



**Figure 5.** Relined provisional FPP: the absence of a beyond-preparation area makes the refining procedure faster and more straightforward.



**Figure 6.** Provisional crown delivery and tissue healing.



**Figure 7.** VEP-prepared tooth after soft-tissue healing.

### 3. Discussion

#### 3.1. Tooth Reduction

The amount of tooth reduction is lower with VEP than other preparation techniques. Dental tissues saving is essential to preserve structural strength, which is a fundamental aspect of tooth preparation [11], and it is far more critical when preparing a non-endodontically treated tooth to maintain its pulp vitality [12,13].

#### 3.2. Temporary Crown Management

The absence of undercuts in all the abutment “prosthetically usable” area and of a beyond-preparation zone, which is usually positioned in an undercut, allows the clinician to avoid an “on-off” movement during the temporary crown relining, avoiding the opening of the margins and the consequent need to reperform the relining procedure. Additionally, the absence of a preparation margin lets the clinician prevent lining the temporary crown external wall to beyond the preparation surface; this procedure is necessary to obtain a correct emergence profile when using techniques with a defined preparation margin.

As previously described, with the VEP technique, temporary crown margins should be positioned extra-gingivally so that they do not interfere with the healing procedures of the soft tissues injured with the bur during the preparation phases. However, other aspects must be considered; if the esthetic area is involved, the probing depth of the tooth

is low, and it does not need periodontal surgery, it is possible to place the temporary crown margin under the gingival level, since this would improve the esthetic outcome of the provisional restoration and there are no predictable factors which can cause movements of the gingival level.

### 3.3. Impression Phase

Final impressions require great precision to correctly reproduce the details of the abutment, adjacent teeth, and soft tissues so that the final crown can fulfill all of its esthetic, functional, and biological requirements. From this perspective, standard impression techniques are very effective and reliable for VEP-prepared abutments. The clinician should simply consider that, being an “edgeless” abutment, there are no margins nor a beyond-preparation zone, which are essential elements in different, not edgeless, preparations, but that sometimes are difficult to read correctly, both with analog and digital impression systems. With VEP, the prosthetically usable (and readable) area defines the apical extension of the preparation, making the impression phase easier to manage (Figure 8).



**Figure 8.** Impression taken on VEP-prepared abutments.

### 3.4. Crown Margins

With techniques that involve a defined preparation margin, the position of this margin establishes the position of the crown margin, be it a shoulder, a chamfer, a knife edge, or other edges created by the bur during the preparation phases. If these preparation techniques are used, the technician should also be able to see the beyond-preparation (beyond-edge) zone so that the profile of the crown is coherent and aligned with the unprepared part of the tooth, avoiding undercontours and overcontours. With VEP, instead, during lab procedures it is fundamental to point out on the model the position of the margin itself. Once the position of the margin and the final form of the crown have been defined, the part of the model representing the surrounding soft tissues is removed until the most apical part of the abutment is displayed. Then, a groove is created under the displayed apical area (ditching procedure). VEP does not require the integration of the crown on the prepared abutment; consequently, it will always lead to a positive misalignment (controlled overcontouring) of the crown. The thickness and the height of the prosthetic margin are therefore defined by the soft tissues' characteristics and not by the position of an edge. Once again, VEP proves to be a periodontally driven tooth preparation technique.

The apical part of the prosthetic margin, whose section presents a triangular form, must be as thin as possible so that it does not create overcontours. The presence of overcontours leads to more plaque retention and potentially to periodontal diseases [14]. Horizontal preparation techniques allow the creation of a thicker and, therefore, more resistant margin. With vertical preparations, attention to detail and respecting indications are critical factors in determining a long-term successful therapy. In particular, attention to occlusal contacts and dynamic schemes is of the utmost importance, since an occlusal

overload could lead to a severe restoration failure. However, complete ceramic materials such as zirconia and lithium disilicate proved to be a safe and reliable choice for complete crowns on vertical preparations and showed excellent performance in the long term and a failure rate comparable to those on horizontal preparations, even when monolithic lithium disilicate was used in the posterior region [15,16].

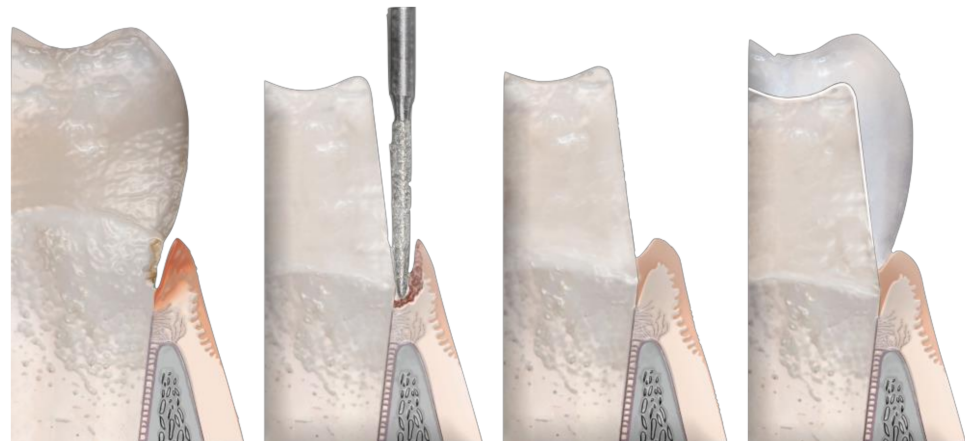
The possibility of deciding the position of the prosthetic margin after soft tissue healing and maturation guarantees an excellent esthetic since the crown margin is always placed in the sulcus. Typically, subgingival clinical precision checks are difficult to perform, and the correctness of margin adaptation on the preparation finishing line is not always evident. With VEP, thanks to the presence of a prosthetically usable area, the margin closure on the abutment is far more predictable; as with all the vertical preparation techniques, VEP guarantees a better marginal closure of the prosthetic crown, particularly after cementation [17,18]. Furthermore, the creation of an undercontour is virtually impossible.

It is well known from the classic literature that the correct seating of prosthetic restoration on their abutment is more predictable on vertical preparations than on horizontal preparations, or at least comparable and in the range of clinical efficacy [18–21]. On the other hand, more recent studies suggest that horizontal preparation could lead to a more precise marginal fit [22].

When using metal–ceramic restorations, more factors must be considered: to maintain the crown margin thickness below certain limits, the apical part of the margin is made of metal alone, starting with the esthetic part as soon as the thickness allows the presence of metal, opaque, and ceramic. The metal margin can therefore create esthetic concerns, especially in cases of gingival recession. Modern complete ceramic materials prevent these issues, guaranteeing an excellent esthetic even if a gingival recession occurs in the future.

### 3.5. Soft Tissues Management

The preparation of a subgingival area and the light gingivage caused by the bur help remove bacteria from contaminated hard and soft tissues and can therefore lead to a healthier periodontium [5] (Figure 9).



**Figure 9.** Tissue behavior during different VEP phases.

As previously described, temporary crown margins are placed extra-gingivally so that they can not interfere with the healing process following the gingivage. This procedure allows the subsequent impression phase to be more predictable, avoiding the risk of inflammation and consequent tissue bleeding because of the resin crown margin in the sulcus.

## 4. Conclusions

The presented biological and clinical concepts suggest that VEP allows a more effortless relining procedure and overall management of the temporary crown, a more predictable impression phase, and a more significant saving of dental tissue (Figure 10).



The Vertical Edgeless Preparation technique represents, therefore, a viable and robust option among vertical preparation techniques.



**Figure 10.** VEP abutments.

**Author Contributions:** Conceptualization, G.N., E.F., G.D.F., G.C. and R.B.; methodology, G.D.F. and G.C.; validation, E.M. and G.M.M.; formal analysis, A.T.; resources, G.N.; writing—original draft preparation, A.T.; writing—review and editing, G.N., E.F. and E.M.; visualization, R.B.; supervision, G.M.M. All authors have read and agreed to the published version of the manuscript.

**Funding:** The authors declare that they did not receive external funding for the development of this technical note.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** No new data were created or analyzed in this study. Data sharing is not applicable to this article.

**Conflicts of Interest:** The authors declare no conflict of interest.

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