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VEP

Vertical Edgeless Preparation:
periodontal dominance
in prosthetic preparation

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INTRODUCTION

The central theme of this work is a description of vertical edgeless preparation (VEP). We describe all its aspects to clearly differentiate it from other prosthodontic preparations, especially other vertical techniques.

VEP is a full-crown preparation technique extending subgingivally along the root. It is specifically designed to treat prosthodontic-periodontal cases and is therefore indicated not only for teeth with lost periodontal support due to pockets of average or greater depth but also for teeth that have a gingival sulcus within physiologic probe values (≤ 3 mm). It is additionally beneficial as a preprosthetic preparation for teeth where attachment loss is expected to occur eventually as the treatment plan unfolds. A key concept of VEP lies in its extension apical to the gingival margin to treat the part of the root surface that has already undergone attachment loss and consequently become biologically and structurally altered. When performed correctly, VEP does not risk any periodontal attachment damage because it affects only areas that have no remaining attachment due to previous events or causes.

The term VEP was coined as an updated version of a technique developed by the Bologna Porta Mascarella group known as *preparazione protesica verticale a finire* (translatable as “vertical feather-edge preparation”). Although VEP is an original technique in its own right, it is based largely on the same biologic and biomechanical principles underlying the intraoperative prosthetic preparation (*preparazione protesica intraoperatoria*) method that has been being developed since the 1980s by a team comprised of doctors Gianfranco di Febo and Gianfranco Carnevale, along with dental technicians Luciano Trebbi and Roberto Bonfiglioli.

In common with teeth prepared during open-flap surgery, once the periodontal tissues have healed, VEP abutments present no defined margin at their apex. Consequently, there is no finish line, and the

prosthetic margin may be placed in slightly differing positions within the cervical area while still ensuring an efficient marginal closure. This means that the most apical point reached by the bur tip (ie, where the abutment preparation ends) is distinct from the prosthetic margin. Instead of being constrained by the finish line, the prosthetic margin may be determined according to the overall prosthetic-periodontal evaluation.

The dominant role of the periodontium in VEP is due to various factors. First, this technique is indicated exclusively for teeth with some degree of attachment loss and reduced periodontal support, even though this may be minimal, as indicated by near-healthy probe readings (≤ 3 mm). Second, the periodontium of teeth treated with VEP is affected by root tissue preparation apical to the gingival margin. Finally, a significant contribution is made by the periodontal tissue’s healing response to the gingival rotary curettage performed with the bur during preparation, which results in the edgeless effect on the apical portion of the abutment and creates the prosthetically usable area for margin placement. This technique offers many advantages for both the clinical and laboratory management of prosthodontic treatment, especially when paired with new dental prosthetic materials and technologies.

Alongside a discussion of the many other classifications found in the literature, the first chapter proposes a revised classification dividing tooth preparation methods into two major groups according to whether the abutment presents with an apical edge (ie, a distinct finish line with an angle of transition). In the other chapters, VEP is examined in detail. The second chapter analyzes its underlying principles, its distinguishing features, and its close relationship with the marginal periodontium. In the third chapter, we explain the execution of the technique and its sequential steps, as well as the geometry of the preparation in relation to its dental and periodontal aspects. The fourth chapter discusses indications and contraindications for this technique, along with its advantages and disadvantages.

Periodontal Dominance in VEP



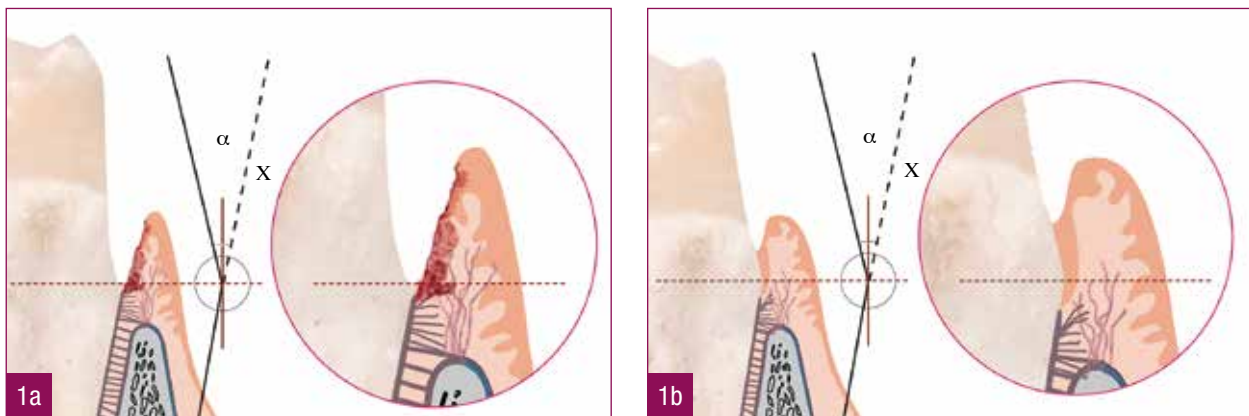
Instead of a finish line, vertical edgeless preparation (VEP), like intraoperative prosthetic preparation, results in a postpreparation cervical area referred to as the closure area, or the prosthetically usable area.^{1,2} (Later, we illustrate how this feature can be extremely advantageous therapeutically when prosthodontic treatment affects the marginal periodontium and actively interferes with it.) The prosthetic closure margin position is therefore not conditioned from the commencement of treatment by a margin created on the tooth wall but may ultimately be placed at a variable height on the dentoradicular wall according to the position of the gingival margin after healing and stabilization.

It is true, however, that a perfect prosthetic crown-abutment fit relies on the abutment being prepared with some degree of wall convergence.³ There will always be an angle of transition between the natural root divergence and the convergence created by prosthodontic preparation.³⁻⁷ With VEP, however, the absence of a transition angle or edge at the end of the prepared area is explained by the fact that, while creation of an angle may be inevitable, it does not lie within the prosthetically usable area. This is because the transition angle is submerged in the gingiva after

natural healing of the soft tissues that were injured during subgingival preparation (Fig 1).¹ Upon completion of abutment preparation and periodontal tissue healing, there remains an exposed prosthetically usable vertical wall free of transition angles and undercuts (ie, edgeless) (Fig 2). This is also true of any steps, ridges, or borders created during intrasulcular preparation (Figs 3 to 5).^{2,8-12}

VEP AND RADIOGRAPHY

Radiographic examination reveals what the soft tissues may conceal. As discussed previously, an angle of transition within the prepared area is formed where the natural root divergence meets the convergence created by hard tissue reduction. The degree and visibility of the transition angle and the ability to clinically assess it may vary significantly due to several factors. These factors include original tooth anatomy, axial wall morphology, any superimposition or interference from other anatomical structures, and the tooth's position within the arch and its relationship with adjacent teeth.



Figs 1 a and b (a) Abutment preparation transforms the natural dentoradicular wall divergence and creates a convergent area apical to the gingival margin, forming a transition angle (α) between the natural tooth and the abutment. (b) Following gingival healing, this transition angle is submerged in freshly grown soft tissues of the marginal periodontium. The result is a continuous vertical wall extending from the bottom of the sulcus to the coronal limit of the abutment. Leaving aside other considerations, this edgeless surface enables positioning of a prosthetic margin seal at slightly varying heights.



Figs. 2 a and b Clinical images of postpreparation edgeless abutments. Note that the total absence of undercuts on the entire prosthetically usable surface enables the technician to obtain a satisfactory closure margin that could be positioned anywhere between the bottom of the sulcus and any point on the entire abutment.



Figs 3 a and b Edgeless abutments. The prosthetically usable dentoradicular surface extends approximately 2 mm apical to the gingival margin.



Figs 4 a and b During a maxillary incisor gingivectomy, a butt joint margin from previous prepping was revealed at the apex of the maxillary left central incisor, outside the prosthetically usable area. The shoulder of the left central incisor was eliminated by reworking the tooth with the VEP technique.



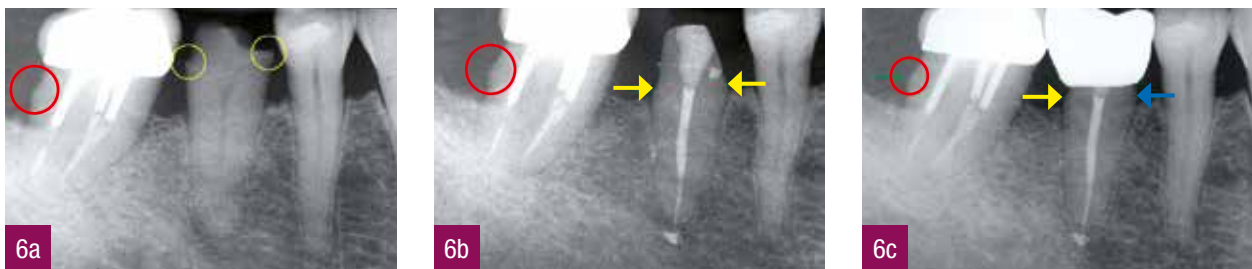
Fig 5 After healing and regrowth, the transition angle is submerged in the marginal tissues.

Consequently, radiographic imaging of teeth treated with VEP may lead to a misinterpretation of apparent crown-abutment seating defects. Radiographs of VEP-treated teeth, or teeth that have been otherwise prepared intraoperatively,² may show margins, finish lines, and transition angles as being in a significantly more apical position than the emergence of their corresponding prosthetic crowns. Radiographically, there may appear to be significant underextension and prosthetic margin gaps where in fact a perfect seal is formed on the abutment's axial wall in a position coronal to the end of the prepared area. The finish line and related edge, minimal though this may be, remain submerged in the gingiva and consequently outside the area of prosthetic usability (Figs 6 and 7).

SUBGINGIVAL PREPARATION IN A PERIODONTAL CONTEXT

Because VEP extends subgingivally and involves the part of the root where attachment loss has occurred, a preliminary review of the anatomy and histology of the marginal periodontium is warranted (Figs 8 and 9).

There is a tendency in the literature on prosthetic preparation to use teeth with ideal periodontal health as a model, especially when the preparation extends subgingivally. The tooth in question is always illustrated in perfect condition with structurally intact enamel from the tip of the crown to the cemento-enamel junction and is surrounded by healthy periodontal



Figs 6 a to c (a) Radiograph of a mandibular right first molar that was intraoperatively prepped many years previously and fitted with a gold-ceramic crown. A postpreparation marginal design on the distal side lies considerably apical to the prosthetic margin. The image also shows the second premolar prepped with shoulders. (b) The same premolar after endodontic-reconstructive treatment and VEP. (c) Note how the definitive prosthetic crown margin is distinctly coronal to the point where the abutment preparation ends.



Figs 7 a and b In certain cases, due to an abutment's shape or the way it was prepared and/or other reasons, radiography may fail to show one or even all four of the factors described in chapter 1 including the inevitable angle of transition.

tissue—a healthy tooth in an intact and healthy periodontium.¹³ Additionally, discussion of subgingival abutment preparation has always raised several standard questions:

1. Is it clinically acceptable to extend a prosthetic preparation subgingivally while safeguarding the marginal periodontium and specifically its attachment apparatus?
2. Assuming that subgingival preparation is admissible, what is the maximum depth (in mm) to which the bur tip may be allowed to reach apical to the gingival margin?
3. If a postpreparation margin is subgingival, what design is most indicated?
4. Can we establish ideal spatial relationships between the prosthetic margin and the gingival margin? If so, what are they?

The different finish designs proposed over the years by many authors are all located at the gingival margin or slightly apical to it, within the enamel of the

anatomical crown and coronal to the cemento-enamel junction. This reference model appears to be common to all authors, regardless of the time of publication and the authors' background and school of thought (Fig 10).^{6,14–16}

This common dento-periodontal model exhibits an unprepared enamel wall in perfect condition apical to the prosthetic margin finish line. The unprepared enamel surface extends approximately 1 mm apical to the gingival margin. Its periodontal counterpart is the sulcular epithelium lining the interior of the free gingival margin. Between the enamel and the sulcular epithelium lies a space known as the gingival sulcus, or crevice. The junctional epithelium closes the sulcus and extends apically to cover the entire remaining enamel of the anatomical crown as far as the cemento-enamel junction. In healthy conditions of the marginal periodontium, the cemento-enamel junction marks the anatomical boundary separating the epithelial tissue comprising the enamel and junctional epithelium from the connective attachment

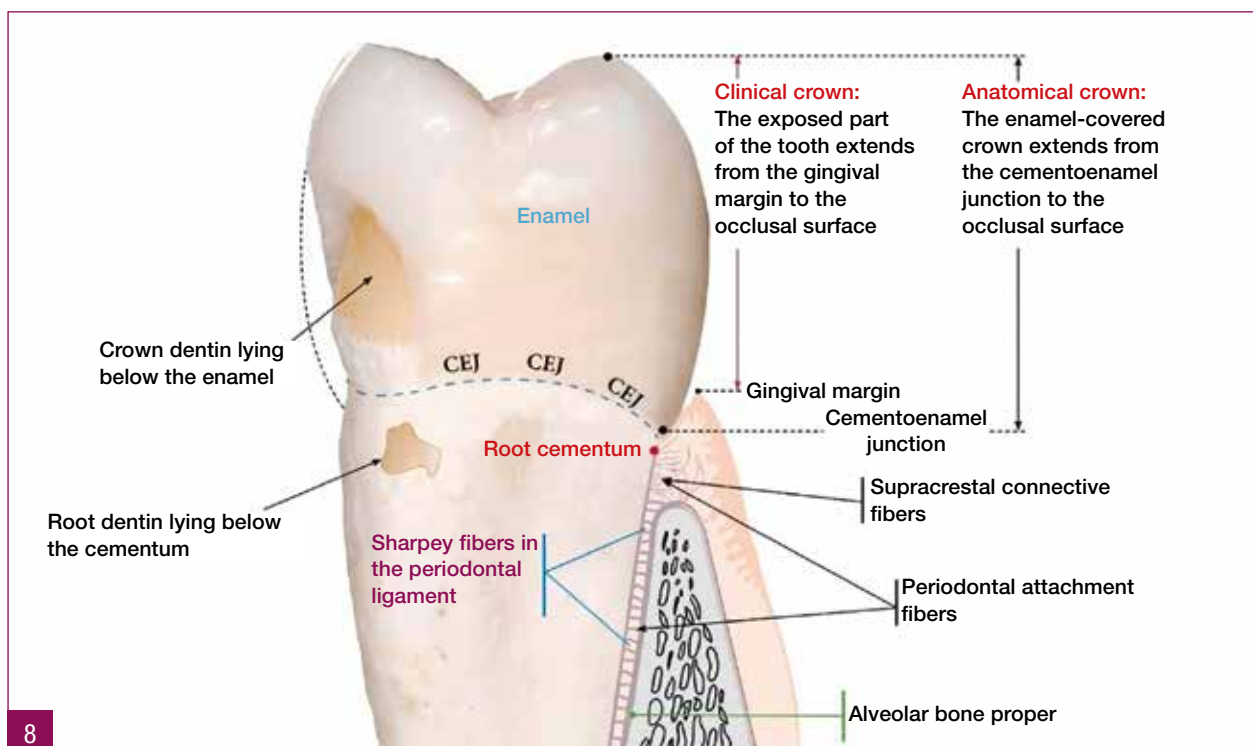


Fig 8 Anatomical illustration of a tooth with a healthy and intact periodontal margin.

apparatus apical to it, which consists of the radicular cementum with the supracrestal periodontal fibers inserting into it (Figs 8 and 9).

Obviously, if a patient were to present in a condition aligning with this reference model with intact healthy periodontal tissue surrounding the tooth and no attachment loss (Figs 8 to 10), it would be unthinkable to extend prosthetic preparations apical to the gingival margin. To violate the space beyond the cemento-enamel junction and instrument the root would almost certainly cause irreparable damage to the periodontal attachment apparatus in teeth without attachment loss (Figs 11 and 12).

When addressing subgingival issues, the major review of the literature on crown-periodontium

relationships (Kosyfaki et al, 2010)¹⁷ does not clarify whether it is clinically appropriate to perform subgingival preparations and design prosthetic margins apical to the gingival margin. Neither their review nor the many publications on the subject contain any clear reference to periodontal margin tissue health or to the loss of periodontal support and/or attachment levels in the context of subgingival preparation. There seems to be no data concerning the position of the gingival margin with respect to the cemento-enamel junction or probing depths, nor is there comparison of this data with equivalent readings taken prior to causal periodontal treatment or in periodontal patients. Furthermore, there is no data addressing unprotected root surface areas and characteristics when connective attachment loss has occurred.

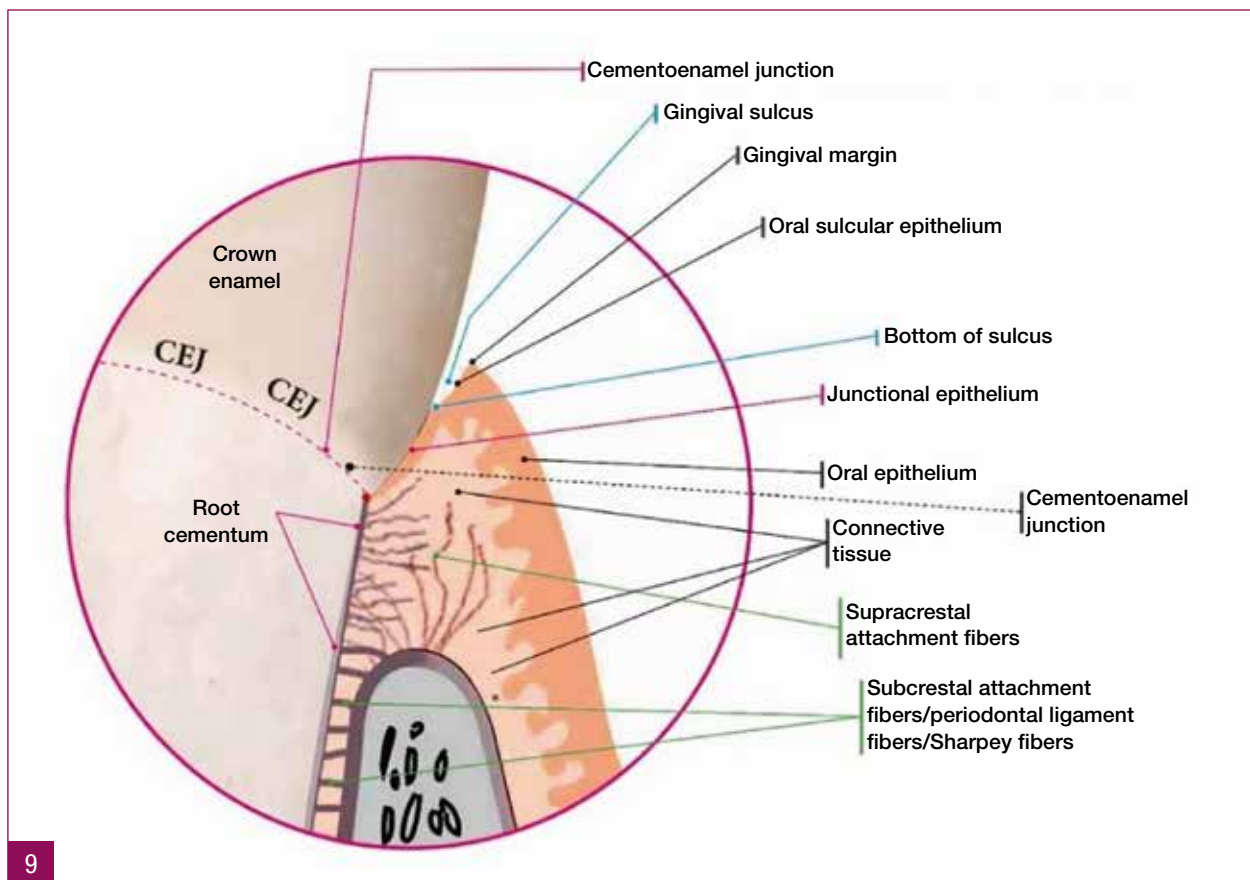


Fig 9 Illustration of healthy marginal periodontium. Unless otherwise specified, by the term “healthy,” we mean periodontium in its original anatomically and histologically sound condition rather than treated or regenerated periodontal tissue. It is therefore essential to understand and assess the histologic profile to determine whether the tooth still has connective tissue attachment and to what extent.

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EDOARDO FOCE

Dr Edoardo Foce graduated with a degree in Medicine and Surgery from the University of Genoa, Italy, with postgraduate specialization in dentistry and prosthodontics. He is an alumnus of De Chiesa–Pescarmona Saluzzo Institute and Carnevale–Di Febo Bologna Mascarella Institute. From 1988 to 2019, Dr Foce was as an active member of the Italian Society of Conservative Dentistry, the Italian Society of Endodontics, the European Society of Endodontics, the Italian Academy of Prosthetic Dentistry, the Italian Society of Oral Surgery and Implantology, and the Italian Society of Periodontology and Implantology. He is currently active as a member of the Italian Society of Periodontology and Implantology and the Italian Academy of Prosthodontics. Between 2009 and 2013, Dr Foce served as Visiting Professor of Periodontology at San Raffaele University in Milan, Italy. He has been a guest speaker at conferences and congresses related to various dental specialties. Currently, Dr Foce works in private practice in La Spezia, Italy, where he deals with multidisciplinary dentistry with a special interest in dental implantology and prosthetic-periodontal cases. Dr Foce's publications include the following: coauthor of various articles on implantology and implant prosthodontics; coauthor of chapter 10 of the *Manuale di Chirurgia Orale - SICOI* (Elsevier); author of *Endo-Periodontal Lesions* (Quintessence, 2011); coauthor of four monographic articles on VEP published in four issues of *Quintessenza Internazionale*; coauthor of chapter 22 (Classifications and Management of Endodontic-Periodontal Lesions) in *Endodontic Advances and Evidence-Based Clinical Guidelines* (Wiley, 2022); coauthor of *Building Better Bone: A Comprehensive Guide to GBR Techniques* (Quintessence, 2024).



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Dr Di Febo has held lectureships in fixed prosthodontics at the University of Bologna, Italy, Faculty of Dentistry from 1983 until the present. He has been a guest speaker at many conferences, lifelong learning courses, and Italian and international congresses. Dr Di Febo currently works in private practice limited to fixed prosthodontics at Porta Mascarella Medical Center in Bologna, Italy.

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