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CLINICAL CASE

VERTICAL PREPARATION OF TEETH IN PERIODONTAL DISEASES

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ABSTRACT

Vertical preparation techniques (VPT) have gained popularity in restorative dentistry due to their conservative approach to preserving tooth structure and improving aesthetic outcomes.

Purpose of this article is to discuss the advantages and disadvantages of the vertical tooth preparation technique, as well as to provide evidence-based recommendations for its clinical application, based on the analysis of a specific clinical case.

This study is based on a comprehensive review of relevant literature and is further supported by the detailed analysis and discussion of a specific clinical case. Conversely, when preparing teeth with intact periodontal structures, we advocate for the use of the horizontal preparation concept.

In addition, we will present the results of our own clinical research. As can be seen from the clinical case we have presented, the vertical preparation method is very effective for deep, subgingival fractures of the hard tissues of the crown part of the tooth.

This method allows to obtain the most correct marginal fit in the fracture zone and facilitate the integration of the edge of the artificial crown to the periodontal tissues. It should also be noted that we believe that the most effective use of zirconium artificial crowns is in combination with vertical preparation, since the bacteriophobic properties of zirconium contribute to faster and more adequate integration of the edge of the artificial crown to the periodontal tissues.

The vertical margin preparation technique proves to be effective when managing teeth affected by periodontal pathology. However, in cases involving intact periodontal tissues, horizontal marginal adaptation demonstrates greater clinical efficacy. We recommend the use of the vertical preparation technique in cases involving teeth with compromised periodontal support.

Keywords: parodontal deaseses, tooth preparation, horizontal preparation techniques, vertical preparation techniques (VPT)

INTRODUCTION

The development of new materials and equipment, as well as a better understanding of the biology of soft tissues, has contributed to the resurgence and evolution of a revolutionary concept in prosthodontic dentistry: preparation without shoulders.

Tooth preparation is usually performed by horizontal preparation with a clearly defined finish line or by vertical preparation (VPT) without a clearly defined finish line[1].

The preparation of the stump using horizontal finishing lines (shoulder and chamfer) has been widely practiced for the past three decades or more and has been recognized by the academic world as the gold standard of preparation[2]. Proponents of horizontal preparation argue that preparing with a shoulder helps avoid undercuts and overhanging edges of the restoration, maintains the integrity of the biological width, and simplifies the identification of the finishing line on the model by the dental technician, thereby facilitating communication between the clinician and the technical laboratory[3].

Minimally invasive methods of tooth preparation improves aesthetics and plays an important role in stress distribution, crack resistance and long-term durability [4,5].

Based on these points, the academic world has considered the concept of vertical preparation to be untenable[6]. For a long time, proponents of vertical preparation used two main techniques:

- Preparation without a shoulder, but with a bevel
- Preparation without any defined boundary.

The vertical preparation method is more conservative and defines the finish line as an area, and not as a linear border, unlike the traditional horizontal method, which often requires the removal of a significant amount of tooth tissue and can jeopardize the long-term prognosis of the tooth[7].

It is important to note that preparation without a shoulder is the most conservative method of shaping the hard tissues of the tooth and helps avoid the formation of gaps between the tooth's hard tissues and the restoration.

Preparation without any boundaries is reflected in the concepts of the Mascarella and Ignazio Loi (BOPT) schools[8]. The vertical preparation method of a full crown was first introduced by the Porta Mascarella Group in the 1980s and is defined as "periodontal" because its main indication is teeth with periodontal disease and it aims to obtain healthier periodontal tissues. The root surface that has lost periodontal attachment consists of necrotic cementum and dentin, which contains microorganisms capable of producing toxins. VEP removes unhealthy tissues, and the restoration protects the root from the oral environment. VEP is more appropriate in patients with a thick periodontal phenotype and a probing depth of more than 2 mm[9,10]. The subgingival margin of the crown will be well covered by the healed gingiva.

This approach, unlike preparation "with a bevel", involves subgingival preparation and placing the boundary of the restoration more coronally relative to the prepared boundary[11]. This method is suitable for teeth with periodontal disease but not for healthy teeth, as such preparation often results in irreversible damage to the connective tissue attachment. In the case of a healthy periodontium, this preparation is unnecessarily aggressive in the pericervical zone, as part of the prepared area remains uncovered by the restoration and is even left unpolished, leading to obvious consequences.

The proposed burs and the Mascarella School and BOPT protocols are challenging to use, especially in the absence of high magnification (microscope), requiring exceptional dexterity and skill in tooth preparation. Dentists and dental technicians typically face the following issues when applying these protocols:

- Undercuts
- Excessive taper of the prepared tooth
- Inevitable damage to the connective tissue attachment
- Profuse bleeding
- A six-week waiting period (healing phase) before taking an impression
- Unpredictable soft tissue regeneration
- Multiple relining of temporary crowns during the healing period
- Lack of certainty in determining the finish line position VPT and Periodontal Aspects[12].

the vertical preparation technique in cases involving teeth with compromised periodontal support shoes good clinical results[13-16]. Vertical preparation of the crown edge promotes the natural contour of the gum and prevents its recession.

Considering that the concept of Biological Width includes the gingival sulcus, attachment epithelium, and connective tissue attachment it is important to

emphasize, that the only structure that must not be damaged during tooth preparation is the connective tissue attachment. The attachment epithelium is merely a "connection" of epithelial structures (gingiva) with the surface (enamel) via hemidesmosomes. The epithelial structure can also be "connected" to other surfaces, such as cementum, dentin, composite material, or zirconium dioxide, under two conditions:

- The surface is smooth, hard, and clean.
- The patient does not have periodontopathy (marginal periodontitis or periodontosis).

Gingitage is essentially a curettage technique using rotating instruments (burs), performed within the sulcus or attachment epithelium zone, creating a smooth rather than torn and grooved wound surface, as seen with electrosurgery or retraction cords (when using retraction cords, additional negative factors include ischemia and tissue necrosis as a consequence). Such a wound heals through reepithelialization. The formation of a new epithelial attachment and mucosal layer, along with the return to the original tissue quality and microvascularization, occurs quickly and predictably.

The earlier definitive restoration of the tooth's hard tissues (permanent crown) is performed, the better, faster, and more predictably the regeneration and formation of new gingival epithelium will occur. This approach is borrowed from implantology: when applying the immediate loading method on an implant, the crown neck's anatomy, modeled by the dental technician, will stimulate and guide soft tissue regeneration.

Damage to the connective tissue attachment (specifically, the root cementum into which connective tissue fibers are embedded) induces an inflammatory response, leading to the release of inflammatory factors (proteases, cytokines, prostaglandins, and other molecules/enzymes), which activate osteoclasts, thereby inducing bone tissue resorption. This, in turn, increases the risk of soft tissue recession. Therefore, violations of the connective tissue attachment must be strictly avoided.

In the technique proposed by Di Febo, Loi, and others in recent years, the depth of the bur insertion into the sulcus remains quite unpredictable, highly dependent on the skills and sensitivity of the operator.

In the Vertepreparatory technique, damage to the Biological Width (BW) is virtually impossible, as the non-working end of the special bur is calibrated to avoid touching the first millimeter of the root, i.e., the area where connective tissue fibers embed into the. Furthermore, the ability to use a smaller bur tip compared to traditional vertical preparation methods allows for rotational curettage that includes only the epithelial component of the sulcus, with minimal or no bleeding and faster healing.

It is crucial that for subgingival finish lines, the restoration is designed with an adequate contour profile that will cause the gingiva to form a tight "gingival cuff" that closely fits the tooth's neck. A tight cervical cuff will protect against food impaction into the gingival sulcus and prevent the accumulation of plaque and tartar in the loose gingival tissue on the untreated tooth surface[17]. The intended contour profile is borrowed from the anatomy of the enamel profile in recently erupted teeth and its relationship with the gingival tissues, meaning it is somewhat excessive compared to conventional standards.

The technique proposed by the authors, using a bur with a non-cutting end, not only allows for better control of the degree of invasion into the gingival sulcus, but also:

- Guarantees a more conservative approach to the tooth's hard tissues.
- The final convergence of the prepared root with the adjacent tooth and the unchanged interradicular distance create better conditions for the predictable growth of the gingival papilla (see central diagram).

Predictability of gingival papilla growth.

Basis of Preparation for Vertiprep: Preparation Using a Diamond Bur with a Tapered Shape and Rounded Inert Tip

In endodontics, this bur is widely recognized as the *Batt-bur*(Figure. 1).

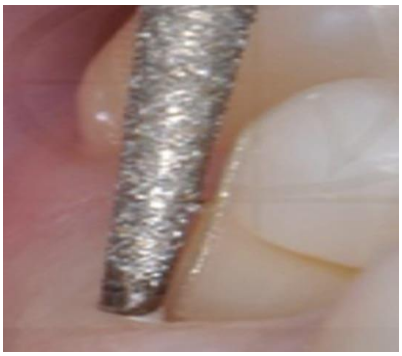

Figure 1. Batt-bur

This bur offers the following advantages:

- The conicity of approximately 2 degrees promotes the optimal taper of the stump.
- The coronal diameter of 1.2 mm and the apical diameter of only 0.7 mm minimize the reduction of the tooth's hard tissues.
- The inert, non-cutting tip of the bur, 1 mm in length, reduces or prevents damage to the connective tissue, simplifying the preparation process.
- The non-cutting tip allows for almost bloodless gingival tissue retraction, creating space for direct impression taking and easy

rebase of temporary restorations.

- The non-cutting tip enables work in the presence of a retraction cord or Teflon tape without causing damage to them.
- The bur's design helps even novice practitioners avoid undercuts.
- The non-cutting tip also allows the bur to function as a periodontal probe if necessary.
- The design of the *Batt-bur* differs from that of the flame-shaped bur used in Mascarella and BOPT approaches, enabling precise, geometric cutting of the tooth's hard tissues and thereby contributing to the creation of truly vertical finish lines.
- It facilitates immediate, seamless impression taking and temporization (fabrication of temporary crowns), unlike other approaches.

This bur is specifically designed to provide controlled and efficient tooth preparation, offering numerous benefits in terms of precision and preservation of tooth structure.

After the analytical theoretical part of the article, we find it necessary to present a clinical case of using the Vertiprep technique.

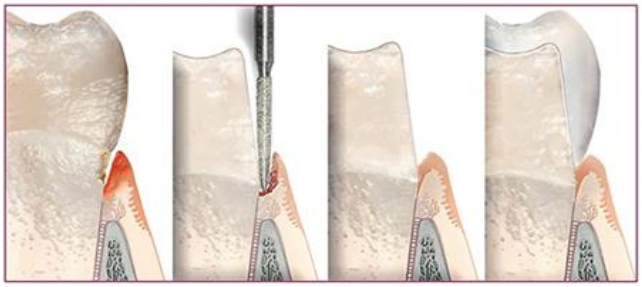

Figure 2.VEP Vertical Edgeless Preparation
Periodontal dominance in prosthetic preparation[18]

Our clinical studies and analysis of literature sources show that vertical preparation of hard dental tissues in periodontal problems not only improves the marginal fit of the tooth, but also facilitates the integration of the edge of the structure to the periodontal tissues, while saving tooth tissue.

Clinical case

A 50-year-old patient presented to us after endodontic treatment of tooth 4.6. The root canal treatment was carried out quite effectively; however, during one of the visits, the therapist accidentally fractured the medial section of the lingual wall of the coronal part of the tooth (Figure 3,4).

Figure 3, 4. Clinical situation after wall fracture

The fracture extended deeply under the gum, which led the dentist to consider tooth extraction for 4.6. The patient sought our help with the hope of saving technique.We decided to fabricate a prosthetic crown that would fit the fracture zone with a vertical finish line, while in the intact areas, we planned to create a traditional horizontal adaptation. The decision was made to manufacture the crown from zirconia oxide, given its bacteriophobic surface properties. In the intact parts of the tooth, we formed a classic chamfer margin (Figure. 5).

Figure 5. Zirconium crown with vertical fit in the fracture area

The patient has been under dynamic observation for 3 years, without complaints, and the functionality of the tooth has been fully restored.

DISCUSSION

Various tooth preparation techniques have been described,these can be generically categorized into horizontal (chamfer or shoulder) and vertical preparations (feather edge, biologically oriented preparation technique [BOPT]).[18]

Despite the various preparation designs available, clinicians often prefer the horizontal one because it provides neat margins on the initial restorations and facilitates better placement of the final restoration.

However, Agustin-Panadero et al. showed that teeth prepared using BOPT presented better periodontal outcomes in terms of gingival inflammation than those of restorations prepared using conventional horizontal finish lines. the vertical design reduces marginal gap of the restoration and creates a less irritating environment within the gingival sulcus[19].

Vertical preparation has revolutionized orthopedic dentistry and radically changed the approach to crown preparation and manufacturing. This is a new technique that became widely known about ten years ago and is now being studied and implemented in clinical practice.

Before the prosthetics of the damaged tooth, its hypersensitivity was observed, in particular, from external temperature irritants. The gums in the fracture area were swollen and hyperemic.

Dynamic clinical observation over three years shows a stable lack of response to any external stimuli. The gums in the fracture area are absolutely healthy.

The effectiveness of using the vertical preparation method in the area of the tooth fracture is obvious.

Vertical Preparation technique involves extending the subgingival preparation to ideally treat the entire exposed root surface to the epithelial attachment[20-22]. Instead of a defined finish line and associated transition angle, the technique creates a vertical tooth wall extending from the bottom of the sulcus on which the edge of the prosthetic crown can be positioned at a flexible height while still providing a secure seal, leaving the prosthetic-use area of the axial wall without corners or edges, i.e. without edges.

Main advantages of vertical preparation

- Minimally invasive in the cervical area.
- Preserves tooth structure and allows preservation of enamel in the cervical area.
- Possibility of positioning the final finishing line at different levels, either more coronal or more apical within the gingival sulcus, without affecting the quality of the marginal adaptation of the restoration.
- Possibility of modulating the emergence profile.
- Easy and quick to perform.
- Easy to take an impression.
- Easy to fabricate and finish temporary structures.

VPTs are applicable to small carious lesions below the gingival margin and are ideal for teeth with short clinical crowns, such as mandibular incisors, where horizontal preparation would result in significant loss of tooth tissue, facilitating oral hygiene and creating a natural appearance, which is especially important in the anterior regions where aesthetics are important[23-25].

VPTs disadvantages are also noticed.

- Tooth preparation is highly demanding because of the gingival sulcular involvement.
- It is very difficult to remove the excess luting cement from the gingival sulcus.
- It is also difficult to evaluate the marginal fit of the restoration

This method allowed us to avoid excessive preparation of the tooth in the fracture area and save it from extraction. It is also necessary to note the beneficial effect of zirconium on inflamed periodontal tissues, given its bacteriophobic properties.

All of the above allows us to recommend not only the vertical preparation method for periodontal problems, but also the use of zirconium prostheses.

Noè, G.et al. (2023)in their “Vertical Edgeless Preparation: Periodontal Dominance In Prosthetic Crown Preparation” sience article published in 2023 believe that the vertical preparation method is indicated for all types of periodontal pathology, as well as for short clinical crowns of abutment teeth[26].

The studies of these authors led us to the idea of the possibility of using this method in our clinical case, when the preparation contributed not only to the preservation of hard dental tissues but also to a more harmonious integration of the edge of the artificial crown to the periodontal tissues.

CONCLUSION

In conclusion of our article, we would like to recommend the method of preparing vertical finishing lines, known as Vertiprep, for patients with periodontal issues. This preparation technique is highly effective.

However, in cases involving healthy periodontium, we still recommend the traditional horizontal preparation method.

DECLARATIONS

Conflict of Interest

The author declares that he has no conflict of interest and there was no external source of funding for the present study.

Source of funding

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Informed consent

Informed consent was obtained from all individual participants included in the study.

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