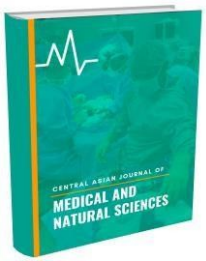

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Article

Biological Width Considerations in Vertical Crown Preparation: Clinical and Esthetic Outcomes

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Abstract: The biological width is regarded to be crucial for preserving gingival health. Vertical edgeless preparation improves flexibility of the prosthetic margin as well as emergence profile. Furthermore, it provides a conservative alternative in which the finish line has been represented by an area instead of a horizontal line. This review analyzes the biological width related with vertical crown preparation with an emphasis on clinical together with esthetic outcomes.

Keywords: Vertical edgeless preparation; biological width; periodontal health; biological oriented preparation technique

1. Introduction

Tooth preparation is the process of modifying diseased or sound tooth structures including (enamel, dentin, and cementum) in order to improve esthetics, function as well as structural integrity It is classified into two categories: horizontal and vertical (feather edge, biologically oriented preparation technique [BOPT]), the first type has clear finish line such as shoulder or chamfer whereas the second one employs no clear finish line [1]. Conventional techniques for tooth preparation for fixed dental prosthetics such horizontal design frequently necessitate extensive tissue removal, these challenges may cause gingival margin displacement, impair tooth integrity, along with impair long-term results. Optimal adaptation might be challenging when doing horizontal finishing lines, particularly at the subgingival level. whereas vertical preparation methods, which include feather-edge designs, are now considered more conservative alternatives [2]. Such approach effectively manages subgingival cavities and adjust gingival morphology through positioning crown margins below the gingival level. Furthermore, it provides a conservative alternative in which the finish line has been represented by an area instead of a horizontal line. In addition to being limit structural reduction whereas it handling with esthetic as well biological challenges.

This conservative method is suitable for teeth that have short clinical crowns, like mandibular incisors, that horizontal preparation will cause severe loss of dental tissue [3]. Also, in case of considering the patient's systemic health status, whenever invasive surgical treatments consisting soft tissue bleeding, which includes connective tissue grafts, need to be avoided. vertical tooth preparation, when performed properly following a carefully exploring the patient's gingival sulcus, offers a less invasive procedure to achieve the desirable outcomes of enhanced gingival emergence profiles for both abutment as well as pontic levels [4].

Biologic width means the dimensional correlations between the epithelial attachment, alveolar crest, sulcus depth, together with connective tissue attachment [5]. According to Gargiulo et al., the "biologic width" is consists of the following elements: 0.69 mm of sulcus depth, functional epithelium with a diameter of 0.97 mm (0.71–1.35 mm), in addition to

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supra-alveolar connective tissue attachment measurement about 1.07 mm (1.06-1.08 mm). Accordingly, the overall biologic width—which is the sum of the connective tissue and epithelial components—is frequently stated as 2.04 mm. Maintaining its integrity is essential for periodontal health [6]. Planning the location of restorative margins should takes these dimensions into account, it's advisable to leave not less than 3 mm between the crestal bone and the preparation finishing line to prevent periodontal issues [7]. Biological width violations are characterized by clinical attachment loss, chronic gingival inflammation, pocket formation surrounding the restoration, followed by bone loss, bleeding on probing.

Vertical Edgeless Preparation (VEP) refers to a full-crown preparation procedure that is designed for teeth where the periodontal attachment has been lost and extends to the subgingival portion of the root. Noè et al. emphasized the benefits of the vertical edgeless preparation technique, which entails preparing the tooth without the presence of a defined finishing line and improves the flexibility of the prosthetic margin positions as well as emergence profile [8]. Most significantly, (VEP) are particularly useful for individuals having periodontal biotypes that are thick or medium, periodontal attachment has been lost, or probing depths more than 2 mm, when horizontal techniques may worsen tissue loss. After assessment the depth of the gingival sulcus using a periodontal probe, 862 Flame diamond bur is used to further confirm the sulcus. In order to produce the necessary restorative space, the coronal region of the tooth is prepped first [9]. After that the subgingival part is prepared with a flame-shaped diamond, with just the tip in contact with the tooth surface. To do this, the bur's axis is inclined 30 degrees from the surface. The bur is maintained shorter than the gingival sulcus. To prevent the gradient of the tooth surface, the axial wall is farther polished. The crown edge has a triangular cross section and is very thin. It prevents over contouring, which reduces plaque accumulation. Zirconia and also lithium disilicate are the materials ideally suited for this purpose [10].

for fixed dental restorations, it is essential to provide stability as well as gingival margin adaption, despite of the preparation technique—vertical or horizontal. Gingival apical migration may cause inappropriate esthetics, that could be regarded as a major complication. The biological oriented preparation technique is a treatment designed to support long-term periodontal tissue stability which includes a particular kind of vertical tooth preparation. The approach involves rotational curettage of the gingival sulcus while the tooth has been prepared without a finishing line. A blood clot develops in the region of the supracrestal connected tissue as a result of the bleeding that occurs there. Immediate insertion of an interim prosthesis (0.5-1 mm subgingivally) with new prosthetic emergence profile helps stabilize the coagulum, that subsequently matures becoming connective tissue. This procedure has the potential to modify the gingival contour of the teeth, resulting in ideal gingival architecture. For this strategy to be successful, close cooperation with the dental technician is necessary. Because it is a vertical preparation with no finishing line, the newly constructed prosthetic margin is possible to put in a finishing area extending from the gingival margin till the gingival sulcus's bottom [11]. This enables long-term tissue stability and a substantial increase in gingival thickness.

2. Materials and Methods

Teeth prepared with the VEP approach have no steps, transition angles, edges, or undercuts, making the area prosthetically viable for marginal closure; This specific and unique characteristic permits the prosthetic margin to be placed at various heights along the abutment surface, ensuring a stable marginal closure. Transition angle that produced from the convergence between terminal part of the prepared and un prepared surfaces will be completely covered by the regeneration of the repaired periodontal tissues (junctional epithelium) that injured throughout the preparation, making them irrelevant in clinical point of view. To prevent interference throughout tissue-healing procedure, the margin of the provisional restoration will be positioned extra gingivally. The apical part

within the prosthetic margin, which has a triangle cross section, is required to be as thin as possible in order to prevent overcontouring that lead to increase plaque retention and may contribute to periodontal disease.

It has been shown that restorations with vertical preparations provide better periodontal health than restorations with horizontal preparations. For a thin periodontal phenotype, a subgingival vertical preparation can enhance soft tissue stability and prevent recession . Moreover, it possess a potential promoting an increase in phenotype in the submarginal portion of the supra-crestal soft tissues that surround the provisional restoration, histologic studies have shown that the sulcular & junctional epithelium is able to reconnect and organize upon smooth prosthetic surfaces, since the connective tissue attachment is not disrupted. The gingiva thickens and migrate in apical direction with greater emergence, while it tends to thin down together with coronal displacement with minor emergence. However, the properties of the restorative material as well as the crown margin's anatomical location affect how periodontal tissues react. These results emphasize the significance of restorative materials' physicochemical characteristics, such as surface roughness, chemical stability, and adhesive capability, in regulating tissue response. Since vertical margins form crowns having incredibly thin marginal portions, a material that is extremely strong as well as able to withstand fracturing in a thin section is required. It has been accomplished for a long time, with metal margins, for instance as those in full gold crowns and porcelain fused to metal crown, in more recent years, zirconia has been established as a material for crowns and can be made with a thin margin. Zirconia choice permits excellent aesthetics along with preservation of tooth structure together with a vertical preparation whereas restoring extremely damaged teeth.

3. Results

Fixed dental prostheses (FDPs) are still often used to replace lost teeth or to restore the shape, function, and esthetics of decayed teeth [12]. Vertical crown preparation techniques eliminate obvious finish lines by vertical milling and substitutes the natural crown emergence profile located at the cementoenamel junction with a prosthetic contour. The prosthesis has been placed in order to leave the gingival margin in an appropriate position, developing new prosthetic cementoenamel junction concurrently (achieving the ideal esthetic result in situations with compromised esthetics). Researches comparing both vertical and horizontal techniques have shown that vertical preparation produces comparable or better results in terms of clinical performance and periodontal health [13]. Vertical preparation for maxillary together with mandibular incisor teeth for full-coverage dental restorations demonstrated longevity, overall survival rates reaching 48-72 months, alongside excellent periodontal findings, characterized by stable gingival margins, improved tissue thickness, and minimum inflammation. A study found that posterior vertical preparation dental restorations improved marginal stability, decreased plaque accumulation, reduced gingival scores, and less deep periodontal pockets by more than 60 months in comparison to horizontal techniques. On the other hand, clinically, the vertical preparation method requires more time and is more complicated. Furthermore, because there is no clear finish line, it is challenging to position the prosthesis margin line appropriately. Additionally, if a dentist or technician with limited skill the procedure, there is a risk that the sulcus can invade uncontrollably. It was also challenging to remove excess cement [14].

4. Discussion

Furthermore, it is challenging to assess the marginal fitness of the restoration. Additionally, Excess luting cement is difficult to remove from the gingival sulcus. However, vertical tooth preparation is not recommended when the tooth needs a full crown preparation allow to preserve the enamel finishing line. Another limitation include that the clinician must maintain exact control over the preparation process, the interim relining phase, and the management of the prosthetic contours. Furthermore, the approach demands a correct comprehension of the protocol from the technician [15]. A

recent meta-analysis demonstrated no significant differences overall periodontal health status (plaque index, gingival index, gingival recession, survival, and success rates) between vertical and horizontal preparation procedures. Long-term researches are still required for this technique.

5. Conclusion

Periodontal tissues' health is largely dependent on well-designed restorations. The factors that must be considered when the margin is to be situated subgingivally are as follows: Correct crown contour inside of the gingival third. Correctly polish and round the margins. Adequate zone of the attached gingiva. And there is no violation of biological width by the margin. Optimal periodontal health requires regular maintenance visits, patient cooperation, and motivation for successful restorative procedures. Vertical tooth preparation promotes gingival adaptation to the restoration instead of forcing the prosthesis to follow pre-existing contours, to optimize biological and functional performance, the preparation design needs to be individualized to the gingival biotype, esthetic goal, and periodontal risk profile.

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