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CASE REPORT

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Biomechanical, operative and biological aspects of the cervical margin relocation: a case report

Aspectos biomecânicos, operatórios e biológicos da recolocação da margem cervical com resina composta em cavidades classe II com margens profundas: um relato de caso

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ABSTRACT

The clinical success of tooth-colored indirect restorations has been confirmed in several studies. However, inlays and onlays restorations in Class II cavities with deep gingival margins can still be considered a clinical challenge. With the purpose of facilitating the execution of the operative procedures in intrasulcular margins and reducing the risk of restorative failures, the technique of cervical margin relocation has been explored as a noninvasive alternative to surgical crown lengthening. This work aims at discussing through a case report the biomechanical, operative and biological aspects in the treatment of teeth with deep gingival margins. Therefore, given the therapy applied in the clinical case presented, it is concluded that the cervical margin relocation with composite resin is advantageous since it eliminates the need for surgery, allowing the implementation of indirect restorations in fewer clinical sessions, not causing damage to periodontal tissues once it provided good finishing and polishing with the establishment of a correct emergence profile, allowing flawless maintenance of gingival health after one year.

KEYWORDS

Dental restoration failure; Dental marginal adaptation; Dental Cavity Preparation; Composite Resins; Inlays.

RESUMO

Sucesso clínico das restaurações indiretas livres de metal tem sido confirmado em diversos estudos. No entanto, restaurações parciais indiretas em cavidades do tipo classe II com margens profundas ainda podem ser consideradas um desafio clínico. Com a proposta de facilitar a execução dos procedimentos operatórios em margens intra-sulculares e reduzir a ocorrência de falhas, a técnica de elevação da margem gengival em resina composta tem sido explorada como alternativa não invasiva à cirurgia de aumento de coroa clínica. Este trabalho tem a intenção de discutir através de um relato de caso clínico os aspectos biomecânicos, operatórios e biológicos no tratamento de dentes com margens cervicais profundas. Sendo assim, conclui-se que a técnica de elevação da margem gengival com resina composta é vantajosa, pois elimina a necessidade de cirurgia permitindo a execução de restaurações indiretas em menos sessões clínicas, não gerando danos aos tecidos periodontais, desde que haja um bom acabamento e polimento, com estabelecimento de um correto perfil de emergência.

PALAVRAS-CHAVE

Falha de Restauração Dentária, Adaptação Marginal Dentária, Preparo da Cavidade Dentária, Resina Composta, Restaurações Intracoronárias.

INTRODUCTION

When indirect tooth-colored partial restorations are cemented into fully surrounded by enamel cavities, their clinical prognosis is great [1]. However, in restorations with deep proximal boxes, data related to clinical success, such as marginal quality and fracture strength, are few [2], since these clinical cases are challenging especially when there is loss of interproximal contact and the presence of intrasulcular margins [3]. The cervical margin relocation technique is also an ally in reducing the risk of fracture of indirect restorations by reducing the height of ceramic proximal box [4,5].

The clinical problems with these situations are that they compromise the execution of several operative steps including cavity preparation, impression techniques, rubber dam isolation, and detection and removal of excess cement during adhesive cementation [3,6,7].

In such cases, restoratives treatments like or cervical margin relocation [3], or surgical treatments such as crown lengthening, may be indicated, as an attempt to position the margin of the cavity in a supragingival position, making the operative procedures more favorable [8].

Cervical margin relocation or Proximal box elevation or Deep margin elevation consists in the use of a pre-molded metallic matrix, and the application of an increment of composite resin (flowable or packable) over the pre-existing margin, in order to make it supra gingival (1-1.5 mm) [6,9-11], facilitating subsequent restorative procedures [12].

The main idea of cervical margin relocation was proposed more than 15 years ago [13] and, in the last decade, it has become increasingly popular among dentists, and it is possible to find several studies that demonstrate satisfactory *in vitro* results [2,12,14-19]. Although, clinical trials are still scarce; however, some positive results can be found that corroborate their use [20-23].

The complexity of restorations with deep cervical margins should be borne in mind, as, in addition to tissue loss, sealing can be challenged due to subgingival clinical management [20]. In view of this, choosing the treatment plan correctly becomes important for clinical success, due to the lack of protocols and the lack of consensus on the ideal method of restoration in these cases [8].

Therefore, the objective of this case report is, in addition to the clinical procedure considered representative, to present a protocol and justify its use in biomechanical, operative and biological aspects.

CASE REPORT

The patient involved in this case report was informed of the disclosure of her data for didactic/scientific purposes through the free and informed consent form developed in accordance with Resolution no. 196 of the National Health Council, Ministry of Health, Federal District, Brazil, 10/03/1996, which was signed in duplicate, one belonging to the volunteer and the other to the dentist.

A 30-year-old white leukoderma female patient came to the dental office, complaining of unsatisfactory restorations in the right lower first molar and the right lower second premolar. The review of her medical history did not reveal any medical illness. The patient also informed that she was not a smoker and did not use medication. When performing the clinical examination, in the teeth #45, an occlusal-distal class II cavity and unsatisfactory restoration in composite resin were observed, without contact point, and with cervical margin of the cavity at the gingival level. In the first right lower molar (teeth #46) it was observed a class II occlusal-mesial cavity with cervical margin at the gingival level, restored with a zinc oxide-eugenol temporary filling (Figure 1A, Figure 1B). Both teeth received endodontic treatment, as can be seen in (Figure 1C). There were also signs of health periodontal tissues, absence of occlusal interference in the protrusion and laterality guides, as well no complaints of orofacial pain or temporomandibular joint disorders.

After clinical, radiographic and anamnesis, the treatment plan was to perform onlay restorations in composite resin on the teeth #46 and #45. Because they have gingival margins, absence of gingival inflammation, and non-invasion of biological width, it was decided to perform cervical margin relocation with composite resin [24], in order to facilitate clinical steps such as absolute isolation, dental preparation, molding and adhesive cementation [9,11].

Thus, initially it was made the remnant color analysis being established as B1 of the

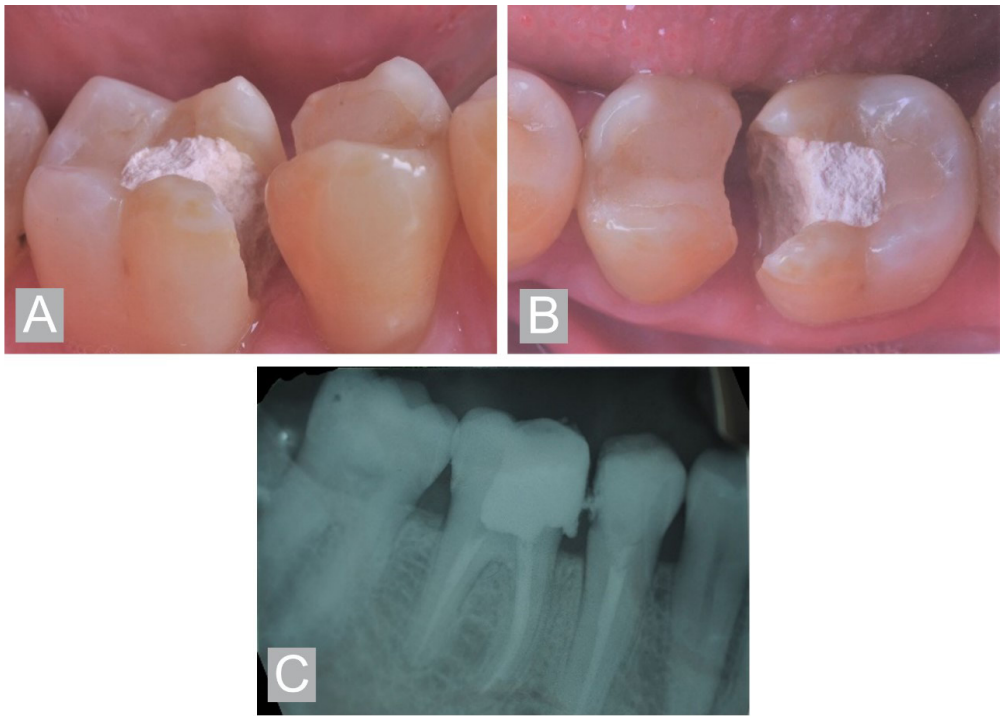

Figure 1 - (A) Initial photographs and radiography of the clinical situation; (B) Occlusal and lateral view of teeth #46 and #45. It is possible to observe that both have deep gingival margins with extensive Class II cavities; (C) Initial radiography showing the deep gingival margins.

VITA Colour Guide. Then, rubber dam isolation was performed (Dental Dam, Nic Tone, Jalisco, Mexico), the temporary fillings were removed and the limit of the gingival margin of the tooth preparation was defined. All dental remnants less than 1.5 mm thick were removed using diamond burs (Komet, Santo André, Brazil) [25].

After removing previous restorations, prophylaxis was performed using 2% chlorhexidine paste (Concepsys Scrub, Ultradent, South Jordan, USA), in order to decontaminate the remaining tooth. Then, a circular steel matrix with an emergency profile (Tofflemire n°1, TDV, Pomerode, Brazil) was used, adapted in a Tofflemire matrix holder, positioned and stabilized with wooden wedges. Then, immediate dentin sealing was performed using a two-step self-etching adhesive (Clearfil SE Bond, Kuraray Noritake, Tokyo, Japan), for which the self-etching primer was actively applied to the surface for 30 seconds, followed by mild air-spray, and then, an adhesive layer was applied, and dispersed again with a mild air-spray (Figure 2A), the adhesive system was light cured for 15 seconds (1200 mW/cm^2; wavelength between 440 and 480 nm - Valo, Ultradent, South Jordan, USA).

The cervical margin relocation was performed after immediate dentin sealing. Thus, an increase of a maximum of 4 mm of dual-cure composite resin (FluoroCore 2+, Dentsply Sirona, Milford, USA), being inserted in the gingival wall and in the entire cavity, establishing a distance of around 1-1.5 mm high of the proximal box margin from the gingival margin, and filling all irregularities and regions without dentin support, giving an ideal geometry to the cavity [9,11], then the resin was light-cured for 10 seconds with high LED intensity (1200 mW / cm^2; wavelength between 440 and 480 nm - Valo, Ultradent, South Jordan, USA) (Figure 2C).

Prior to tooth preparation, occlusal contacts were checked using carbon paper (Trollfoil, Trolldental, Oakdale, USA), in order to determine the restoration limits, and to prevent the margins from being located in occlusal contact with the antagonist tooth (Figure 2B). The cavity extension was guided according to the affected dental structure or from the pre-existant unsatisfactory restoration [9,26]. The preparations followed the following principles: a) rounded internal angles [26]; b) depth of the occlusal box of at least 1.5 mm from the central groove region [26]; c) cusps reduction when the thickness of the remnant is less than 1.5 mm or coincides with the occlusal contact point [26]; d) cusp reduction should allow a thickness of 1.5 mm for the restorative

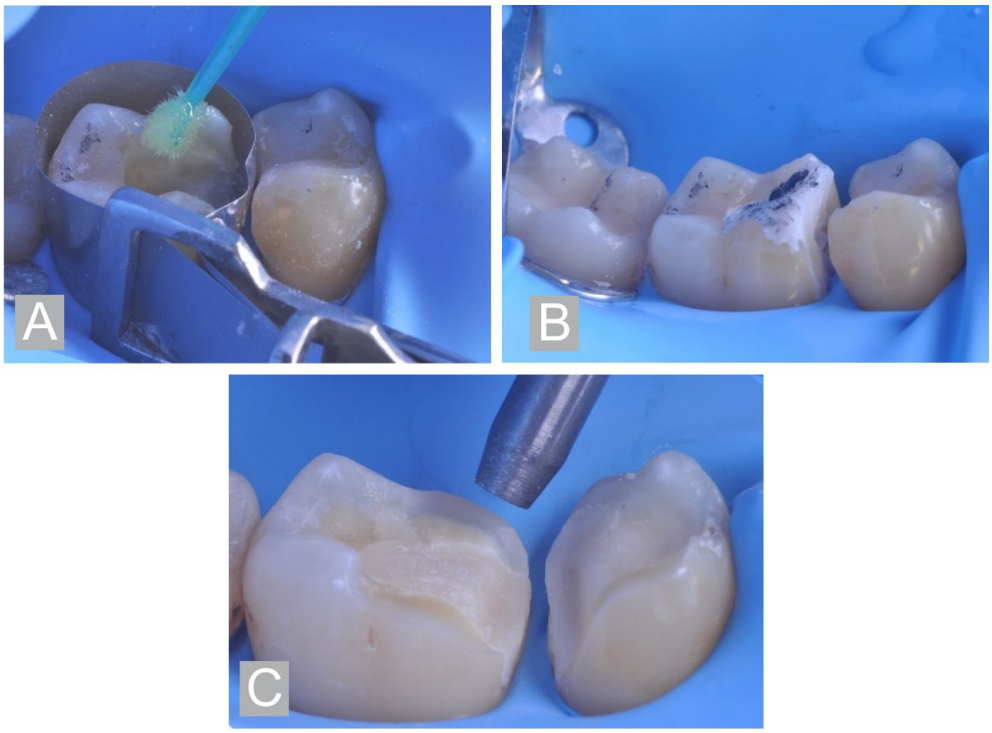

Figure 2 - (A) Immediate dentin sealing with self-etching adhesive system application; (B) Occlusal contacts were checked using carbon paper in order to determine the restoration limit; (C) Final aspect of the onlay preparations. Cavity air-abrasion with aluminum oxide.

material [25] e) transition angle of the buccal and lingual walls of the proximal box with a 90 ° tooth surface [26]. After the preparation, the finishing was carried out using fine diamond tips, Arkansas stone and carbide multi-laminated burs from kit # 666.314 (Komet, Santo André, Brazil), in a 1:5 multiplier hand-piece under irrigation with air/water spray.

After finishing, impression was performed using the two-step and double mixing technique with polyvinylsiloxane (Futura AD, Nova DFL, Taquara, Brazil) to obtain dental casts, on which the restorations were made by the semi-direct technique using a laboratory nanohybrid composite resin (Fill Magic, Coltene, Rio de Janeiro, Brazil) in colors A2 for cervical third and B1 for occlusal third.

Prior to cementation, the restoration was tested and adjusted using extra-fine diamond burs under irrigation. IvoClean cleaning paste (Ivoclar Vivadent, Schaan, Liechtenstein) was applied to the internal surface of the restoration, acting for 20 seconds. Then, it was rinsed with water spray.

Under rubber isolation, the preparation surface was air-abraded with aluminum oxide (50-100 μm; 1-1.5 bar) for 5 seconds (Figure 2C). Conditioning with 37% phosphoric acid (Total-Etch, Ivoclar Vivadent, Schaan, Liechtenstein) was performed for 30 seconds on the enamel, then the preparation was rinsed with a jet of water for 30 seconds. A layer of the Tetric N-Bond Universal adhesive system (Ivoclar Vivadent, Schaan, Liechtenstein) was actively applied to the preparation with a microbrush for 20 seconds and dispersed with light jets of air (Figure 3A).

The resin restoration surface was also sandblasted with aluminum oxide (50 μm; 1-1.5 bar) for 5 seconds. Then, the restoration was cleaned in an ultrasonic bath containing ethyl alcohol (70%) for 1 minute. Tetric N-bond Universal adhesive system (Ivoclar Vivadent, Schaan, Liechtenstein) was actively applied for 20 seconds to the restoration internal surface, and over the preparation surface (Figure 3A). Then, Variolink Esthetic DC (Ivoclar Vivadent, Schaan, Liechtenstein) resin cement was applied, using the self-mixing tip, on the internal walls of the restoration, which was brought into position and kept under light pressure with the tip of an explorer (Figure 3B).

Excess cement was removed with a brush on the free faces and with dental floss in the interproximal areas, taking care not to displace the restoration. Liquid Strip oxygen inhibitor (Ivoclar Vivadent, Schaan, Liechtenstein) was applied to the margins of the restoration, and

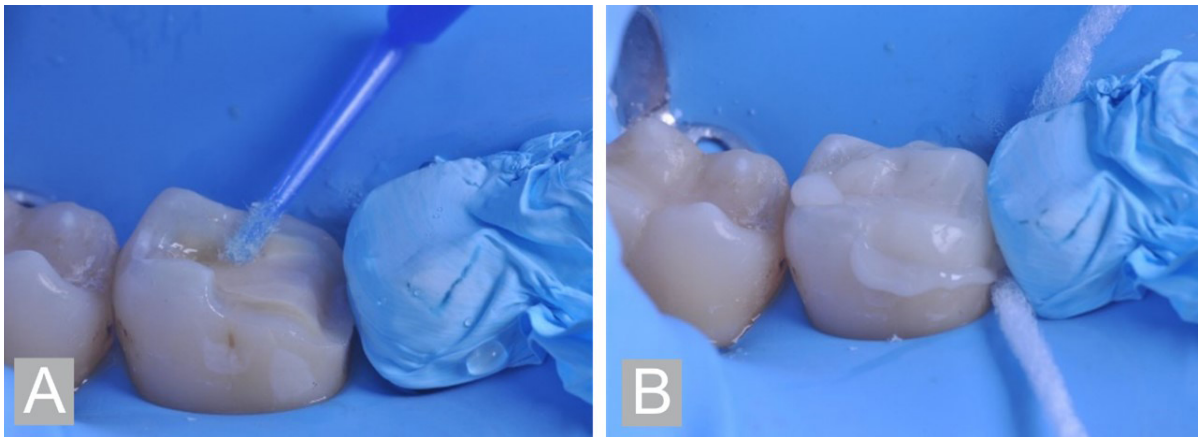

Figure 3 - (A) Self-etching universal adhesive system application; (B) Onlay adhesive cementation.

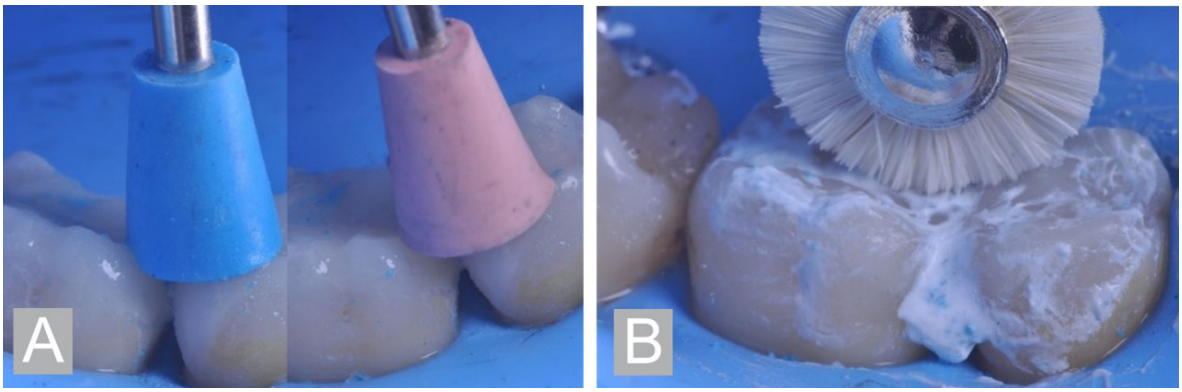

Figure 4 - (A) Finishing and polishing with diamond impregnated rubber cup; (B) Polishing with diamond paste and goat hair brush.

five 40 seconds photo-curing were performed on each surface (vestibular, palatal, occlusal, mesial and distal) (Valo, Ultradent, South Jordan, USA).

After cementation, the restoration and margins were finished and polished using the Flexicup diamond rubber point kit (Cosmedent, Chicago, USA) (Figure 4A), and a goat hair brush with diamond paste (Enamelize, Cosmedent, Chicago, USA) (Figure 4B).

The absolute isolation was removed and the occlusal contacts were checked using carbon paper (Trollfoil, Trolldental, Oakdale, USA). Occlusal interference in maximum intercuspidation and laterality movements were removed with high-speed extra-fine diamond tips under irrigation and the regions were polished again. Figure 5A show the final appearance of cemented restorations.

DISCUSSION

Objective to present the difficulties and solutions for the most vulnerable points found when performing the cervical margin elevation technique, the discussion was divided into topics to contextualize the biomechanical, operative and biological aspects.

Operative aspects

We chose to perform the cervical margin relocation for the insertion of a portion of composite resin to the floor of the proximal box can be considered a fast procedure, with less technical sensitivity, than the cementation of a ceramic restoration with subgingival finishing line with the constant risk of contamination by blood/saliva [6]. The rubber dam isolation, although it can be a complex procedure in some situations, can reduce the inclusion of defects in subsequent steps [27]. A clinical trial has shown that operator influence can impact negatively in the failure rate (about 10% reduction) [28]. Thus, carrying out the margin relocation can facilitate the execution isolation, improving the clinical performance of the final restoration.

In view of these advantages, it has been discussed which the most opportune situations

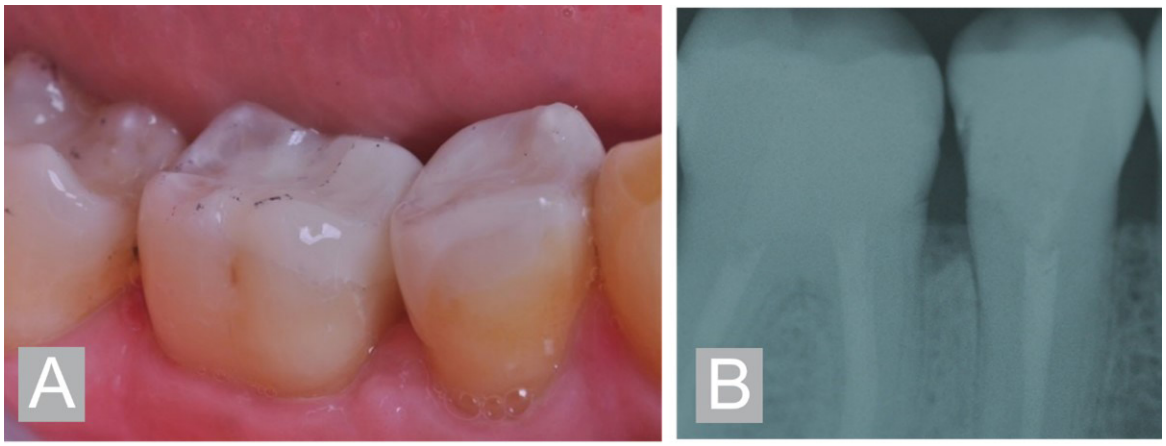

Figure 5 - (A) Final aspect of the restorations; (B) Initial and final radiographic aspect of the restorations.

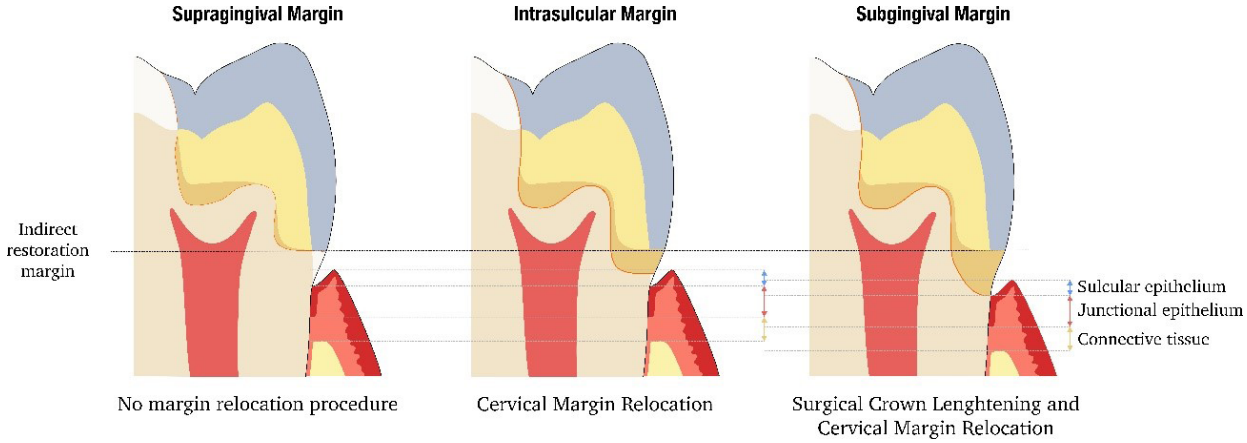

Figure 6 - Schematic model representing treatment with the cervical margin relocation in different clinical situations.

for performing cervical margin relocation with composite resin are. Among them, the most consensual are (Figure 6): class II cavity affecting pulp tissue, close to the gingival margin; class II located in the groove (similar to the case presented by us); class II with margin in contact with the junctional epithelium and finally, class II reaching the bone crest [8]. Among these situations, the last one is characterized as the most complex to restore and, for that, a range of options has been proposed to correct it, according to the amount of healthy tooth structure remaining [29]. Among them extraction (in cases of extreme structure losses), orthodontic or surgical extrusion, and crown lengthening with 2 mm osteotomy associated with cervical margin relocation, being the latter, considered the most practical and least aggressive alternative [3,8]. The choice of approach must be established bearing in mind that the preservation of the tooth structure is the basic principle in dentistry, as it maintains a balance between biological, mechanical, functional and aesthetic parameters [30].

Biomechanical aspects

Restorative procedures in the cervical region are potentially risky from a biomechanical point of view. Since the axial loads on the posterior teeth can cause deflection of the cusps in the vertical plane [31], generating a resultant of tensile stress in this region, this can result in the fracture or gap formation on the composite resin margin, and consequently, causing the failure of the entire treatment [32].

Intending to minimize the occurrence of these problems, studies have evaluated the influence of restorative materials and the technique related to cervical margin relocation. It was observed that the type of material used to reallocate the margin had no influence on marginal quality and resistance to fracture after mechanical fatigue [33-35].

Glass-ionomer cements (GIC) were the first base material proposed, being the procedure called

at the time "open sandwich technique" [34,36,37]. Later, newer base materials were introduced such as resin-modified GICs [33] and flowable composites [38].

Currently, composite resins have been used more for this purpose. When performed with packable composite resins, three consecutive 1 mm layers results in better performance than a single increment in relation to the marginal quality [39]. Bulk-fill resin composite is recommended when only one increment is used [40]. There is no difference in the clinical and in vitro results between the flowable and packable resin [15,18,33,41]. Although flowable resin composites have a superior internal adaptation to packable resins [42].

As for the insertion techniques of the restorative material, the meticulous stratification with 3 consecutive layers of 1 mm of the restorative material, is capable of presenting marginal quality, but increases the risk of crack formation between the increments [6]; Snowplough technique provides the combined use of a fluid composite resin and one of regular consistency molded together in a non-polymerized state, followed by final polymerization of both materials, which essentially contributes to obtaining a homogeneous tooth-restoration interface and non-porous [21]; and finally, the application of a single layer of fluid bulk fill resin or of regular consistency, which due to its improved curing depth of at least 4 mm, provides a procedure that is easy to perform, fast and with significantly greater surface smoothness [9,35]. Therefore the last two techniques are the ones with more predictable satisfactory results.

The point that both techniques have in common is the use of composite resin with low modulus of elasticity, which when present in the cervical margin, acts as a buffer of functional stresses, protecting the remaining tooth, in addition to demonstrating greater fluidity, leading to a good adaptation; elasticity and low polymerization contraction stress due to its composition, which reduces microleakage, postoperative sensitivity and secondary caries [43]. Therefore, the material of choice for our case. Composite resins have a more homogeneous surface than other materials, a characteristic that, in combination with oral hygiene, is one of the basic conditions to avoid gingival and periodontal inflammation [9]. Therefore, it is most indicated for this type of procedure [44,45].

Biological aspects

Regarding biological aspects, it is claimed that the presence of a subgingival margin is associated with increased bleeding on probing (BoP). Therefore, it is highly recommended that the restoration margins should be positioned supragingivally [46-48]. However, the recent literature has shown that well-finished and polished adhesive restoration can be placed subgingivally without harm the periodontal health if the apical margin of the restoration is not violating the former called "biological width", now the supracrestal tissue [49,50]. Therefore, margin reallocation procedures have been indicated.

Classically, the distance from the restorative margin to the alveolar crest is less than 3.0 mm [51], in order to avoid invasion of biological width and prevent periodontal inflammation over time [52,53].

However, it is possible to obtain a good tolerance between periodontal tissue and composite resins [54,55]. This is possible because the periodontal inflammation is more related to the presence of overhanging margins and surface roughness that can lead to the accumulation of bacterial biofilm and consequently, periodontal breakdown [21,55,56]. This was reported in a clinical trial which showed an increase in bleeding on probing after elevation with composite [57].

Composite resin restorations with a well-adapted marginal seal are possible, and are related to a tolerance of the surrounding tissues, in which it is possible to observe the ability of epithelial tissue fibers to bind to the surface of resin restorations, as long as respected the conditions adaptation, polishing and hygiene [22]. It has been shown that changes in Probing depth and BoP are similar in sites with teeth treated with DME or DME associated with surgical crown lengthening [22].

In the face of the facts presented above, it is possible to support the assumption that subgingival restorations with well-polished composite resin and with correct emergence profiles may be located in the groove epithelium in cervical margin relocation, safely for clinical practice. As long as the margins are at least

2.04 mm from the alveolar bone, respecting the extension of supracrestal tissue height, since no adverse reaction such as chronic inflammation on soft and hard tissues, loss of insertion or bone resorption is found, this may be a good option, under the condition of maintaining control of oral hygiene and periodic visits to the dental surgeon [21,23,47,48]. In situations in which the restoration margin exceeds the connective tissue attatachment, the cervical margin relocation procedure can be performed in combination with surgical crown lengthening (Figure 6) [3-24]. However, if performed in depth and with unsatisfactory contour, the literature reports the appearance of an intense inflammatory infiltrate, followed by bone resorption [57].

CONCLUSION

Through this case report, it is concluded that the cervical margin relocation can be performed to control the factors that affect the adhesion protocols and, thus, it can reduce the need for surgical crown lengthening. The choice of composite resin has technical advantages and allows for adequate periodontal health as long as the restoration is polished and without overhanging.

Authors' Contributions

TPP: Investigation, Resources, Writing – Original Draft Preparation, Writing – Review & Editing. EPC: Conceptualization, Methodology, Funding Acquisition. MGA: Writing – Review & Editing, Visualization, Validation, Supervision. PB: Formal Analysis, Visualization, Writing – Review & Editing. EDAG: Data Curation, Visualization, Supervision. GSFAS: Conceptualization, Visualization, Supervision. IFMS: Methodology, Visualization, Supervision. MPS: Conceptualization, Methodology, Investigation, Visualization, Supervision. GSA: Conceptualization, Methodology, Resources, Writing – Review & Editing, Visualization, Supervision, Project Administration.

Conflict of Interest

The authors declare no conflict of interest.

Funding

None.

Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of: Ethics Committee and the Research of the Institute of Science and Technology of the São Paulo State University. The approval code for this study is: 59937322.7.0000.0077.

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