

Mariana Fernandes Pires

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comportamento biomecânico em dentes pré-
molares com lesões cervicais não cariosas e
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behavior of non-carious cervical lesions and MOD cavities
in premolar teeth*

Dissertação apresentada à Faculdade de
Odontologia da Universidade Federal de
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Mestre em Odontologia em Área de Clínica
Odontológica Integrada.

Uberlândia, 2023

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Coorientador: Prof. Dr. Alexandre Coelho Machado

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Iniciando os trabalhos o(a) presidente da mesa, Dr(a). Paulo César de Freitas Santos Filho, apresentou a Comissão Examinadora e o candidato(a), agradeceu a presença do público, e concedeu ao Discente a palavra para a exposição do seu trabalho. A duração da apresentação do Discente e o tempo de arguição e resposta foram conforme as normas do Programa.

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Nada mais havendo a tratar foram encerrados os trabalhos. Foi lavrada a presente ata que após lida e achada conforme foi assinada pela Banca Examinadora.



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RESUMO

Este estudo teve como objetivo avaliar a tensão de contração residual, deslocamento e deformação de cúspides gerados pela polimerização de restaurações de resina composta em dentes pré-molares com lesões cervicais não cariosas (LCNCs) e cavidades mesio-oclusal-distais (MOD). O comportamento biomecânico dos dentes foi analisado comparativamente entre diferentes metodologias: 1) simulação computacional da distribuição de tensão por análise de elementos finitos (MEF); 2) análise de deformação de cúspides por meio de extensometria. O MEF simulou a tensão de contração residual utilizando o critério de Von Mises modificado de acordo com a cavidade que seria restaurada primeiro (sequência restauradora) e o protocolo restaurador da MOD (técnica incremental e técnica Bulk fill) dividido em quatro grupos (G1-G4): G1- 1º LCNC e 2º MOD incremental; G2- 1º LCNC e 2º MOD Bulk fill; G3- 1º MOD incremental e 2º LCNC; G4- 1º MOD Bulk fill e 2º LCNC. Para o teste de extensometria, foram coletados quarenta pré-molares superiores humanos e divididos em grupos (n = 10) de acordo com o MEF. Dois extensômetros foram fixados em cada espécime para medir deformação de cúspide durante o procedimento restaurador, e os fios foram conectados ao Sistema de Aquisição de Dados (ADS2000, Lynx). Os valores de deformação de cúspide (vestibular e palatina) foram submetidos a análise estatística (ANOVA). A técnica incremental gerou maiores valores de tensão de contração residual, deslocamento e deformação de cúspides, independentemente da sequência restauradora. A sequência restauradora não afetou tensão de contração residual e deformação de cúspide, mas a restauração da LCNC antes da cavidade MOD gerou menores picos de tensão durante o procedimento e deslocamento de cúspides.

PALAVRAS-CHAVE: Análise de elementos finitos; Deformação cuspeídea; Tensão de contração de polimerização; Resina composta.

ABSTRACT

This study aimed to evaluate the residual shrinkage stress (ShrS), displacement of cusps (DC), and cuspal strain (CS) generated by the polymerization of composite resin restorations of premolar teeth with non-carious cervical lesions (NCCLs) and mesio-occlusal-distal (MOD) cavities. The biomechanical behavior of the teeth was analyzed comparatively between different methodologies: 1) computational simulation of stress distribution by finite elements analysis (FEA); 2) analysis of cuspal strain by strain gauge testing. The FEA simulated ShrS using modified von Mises criteria according to the cavity that would be restored first (restorative sequence) and the MOD restorative protocol (incremental technique and Bulk fill technique) divided into four groups (G1-G4): G1- 1st NCCL and 2nd MOD incremental; G2- 1st NCCL and 2nd MOD Bulk fill; G3- 1st MOD incremental and 2nd NCCL; G4- 1st MOD Bulk fill and 2nd NCCL. For the strain gauge test, forty human maxillary premolars were collected and divided into groups (n =10). Two gauges were bonded to each specimen to measure CS during the restorative procedure, and the wires were connected to the Data Acquisition System (ADS2000, Lynx). Cuspal strain values (buccal and palatal) were submitted to statistical analysis (ANOVA). The incremental technique groups indicated higher ShrS, DC, and CS values, regardless of the restoration sequence. The restorative sequence did not affect the ShrS and CS, but restoring NCCL before the MOD cavity resulted in lower stress peaks during the procedure and DC.

KEYWORDS: cuspal strain; finite element analysis; polymerization shrinkage stress; resin composite.

Introdução e Referencial Teórico

As lesões cervicais não cariosas (LCNC) são caracterizadas pela perda de tecido dentário na junção cimento-esmalte, sem envolvimento direto de bactérias.(1) A prevalência mundial entre adultos é de 46,7%, sendo maior em indivíduos de idade avançada em comparação com jovens.(2) As LCNCs possuem caráter multifatorial e três fatores específicos, combinados ou isolados, podem atuar na origem e progressão da doença, sendo eles: tensão, fricção e biocorrosão.(3) Essas lesões na região cervical estão associadas a prejuízos no comportamento biomecânico do elemento dentário e, conseqüentemente, há alterações no padrão de distribuição de tensões e deformação.(4-7) Para restaurar as LCNCs, materiais com boa adesão à estrutura dentária, resistência ao desgaste e capacidade de suportar a dissolução ácida devem ser considerados. (8)

Na prática clínica é comum a associação de dentes com LCNCs e cavidades extensas na região oclusal, como por exemplo, cavidades mésio-ocluso-distais (MOD). Para restaurar essas cavidades a resina composta é o material de escolha devido as suas propriedades físicas, mecânicas e estéticas. As resinas compostas apresentam módulo de elasticidade semelhante ao da dentina, sendo assim, podem reestabelecer o padrão de distribuição de tensão semelhante ao do elemento dentário hígido, além de promover a proteção da região cervical.(5, 6, 9)

O desempenho ideal das restaurações diretas de resina composta são dependentes da adequada polimerização. Durante este processo ocorre o efeito conhecido como contração de polimerização, devido a redução do volume da resina através da transformação dos monômeros em polímeros.(10, 11) A contração de polimerização pode induzir a falhas na interface adesiva se for superior à resistência de união entre o material e o tecido dentário remanescente, podendo acarretar em desadaptação marginal.(12) Em consequência, podem surgir microtrincas, pigmentações, microinfiltração, cárie secundária e sensibilidade pós-operatória.(11, 13, 14)

A utilização de um protocolo restaurador inadequado em restaurações MOD e LCNCs pode gerar maiores concentrações de tensões de contração residuais

e trincas na estrutura dentária.(7) Ainda não é definida a influência do protocolo restaurador na distribuição de tensões de contração e deformação de cúspides quando ambas cavidades estão presentes em um mesmo elemento dentário. Portanto, esse estudo é justificado pela necessidade de avaliar o efeito da técnica e sequência restauradora no comportamento biomecânico, a fim de estabelecer um protocolo restaurador para essas situações clínicas.

Capítulo 1

Influence of restorative protocol on the biomechanical behavior of non-carious cervical lesions and mesial-occlusal-distal cavities in premolar teeth

Pires MF, Machado AC, Bicalho AA, Nunes AP, Veríssimo C, Santos Filho PCF

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Clinical relevance statement: Non-carious cervical lesions and extensive occlusal preparations are associated with changes to the biomechanical behavior of the dental element. Knowledge about restorative techniques and their impact on stress distribution can guide dentist professionals to prevent the adverse effects of shrinkage stress, such as microfractures, pigmentation, microleakage, secondary caries, and postoperative sensitivity.

ABSTRACT

This study aimed to evaluate, through the finite element analysis (FEA) and strain gauge testing, the residual shrinkage stress (ShrS), displacement of cusps (DC), and cuspal strain (CS) generated by the polymerization of composite resin restorations of premolar teeth with non-carious cervical lesions (NCCLs) and mesio-occlusal-distal (MOD) cavities. The FEA simulated ShrS using modified von Mises criteria according to the cavity that would be restored first (restorative sequence) and the MOD restorative protocol: incremental filling technique (Filtek z350, 3M) and Bulk fill technique (Filtek Bulk One, 3M) according to study groups. For the strain gauge test, forty human maxillary premolars were collected and divided into groups (n =10). Two gauges were bonded to each specimen to measure CS during the restorative procedure. The wires were connected to the Data Acquisition System (ADS2000, Lynx), and cuspal strain values (buccal and palatal) were submitted to statistical analysis

(ANOVA). The incremental technique groups indicated higher ShrS, DC, and CS values, regardless of the restoration sequence. The restorative sequence did not affect the ShrS and CS, but restoring NCCL before the MOD cavity resulted in lower stress peaks during the procedure and DC.

1. INTRODUCTION

Composite resin for direct restoration is considered an effective material to substitute lost tissue due to its esthetics, mechanical, and physical properties.^{1; 2; 3} In addition, composite resins have an elastic modulus similar to dentin; therefore, they reinstate stress distribution similar to sound dental elements, restoring the biomechanical behavior of the teeth.¹ However, shrinkage polymerization is still considered its main limitation, mainly in high C factor cavities.⁴ The polymerization shrinkage stress leads to failures in the adhesive interface. It can lead to a marginal discrepancy if higher than the bond strength between the restorative material and remaining tooth tissue.⁵ As a result, microfractures, pigmentation, microleakage, secondary caries, and postoperative sensitivity may appear.^{6; 7; 8}

Detecting dental elements with non-carious cervical lesions (NCCL) can be challenging due to the high prevalence and multifactorial nature involved in developing these lesions.⁹ The literature explores the contributing factors by a triad involving stress, friction, and biocorrosion.^{10; 11} This association of factors has been increasingly studied and applied in diagnosing these injuries, as it reveals that causal factors may be related to occlusion,^{12; 13; 14} parafunctional habits,¹⁵ diets,¹⁶ and gastric problems.¹⁷

In clinical practice, it is also common to associate teeth with noncarious cervical lesions (NCCLs) and mesio-occlusal-distal (MOD) restorations. MOD cavities are present in the clinical routine due to the need to remove extensive caries involving marginal ridges or replace unsatisfactory restorations, leading to an extensive cavity preparation.¹⁸ These cavities result in weakened tooth structure and also contribute to the concentration of stress in the NCCL for the proximity of both cavities.^{12; 19} Therefore, it's necessary to use an adhesive restorative material to mimic the biomechanical behavior of the lost tooth structure and promote the protection of the cervical region.^{20; 21} But, the use of an

inadequate restorative protocol in MOD restorations and in NCCLs can generate higher concentrations of residual stresses and cracks in the tooth structure.^{22; 23}

Understanding this clinical situation, the incremental technique is recommended when restoring extensive preparations (MOD cavity) with a conventional resin.²⁴ The approach of controlling the volume control of resin (2mm) and using oblique increments avoids the union of opposite walls, resulting in less flexion of cusps.^{6; 25; 26} Nevertheless, this technique demands more clinical time and can result in greater incorporation of voids by lodging air bubbles during incremental insertion.^{25; 27; 28} On the other hand, the increased translucency of bulk fill resins allows insertion of the material in 4-5 mm increments, with polymerization uniformity and a higher degree of conversion of monomers, shortening the clinical procedure.^{6; 25; 29; 30}

Even though exists various restorative protocols and indications, It is still unclear the biomechanical behavior when both cavities are present in the same tooth. Thus, the study aimed to evaluate two factors: 1) Sequence of restorative technique (NCCL or MOD); 2) Restorative technique for the MOD cavity (Incremental filling or Bulk fill). The null hypothesis was that sequence and restorative filling techniques would not affect the biomechanical behavior of noncarious cervical lesions and mesial-occlusal-distal cavities in premolar teeth.

2. METHODS AND MATERIALS

2.1 Finite elements analysis – FEA

A three-dimensional upper premolar model was used from standard data of a maxillary premolar created by the Non-Carious Lesions (NCL) research group of the University of Uberlandia¹⁹ using computer-assisted design (CAD) software (Rhinoceros 3D 4.0; Seattle, WA, USA).

In this model, Boolean operations generated the geometries of MOD cavities and NCCL (Fig. 1). To create NCCL restoration volume, the solid was generated using Nurbs and Surfaces lines. The MOD cavity restorations were originated by the same Boolean operation of making the cavity and also by dividing this volume: Bulk fill technique into 2 horizontal increments and Incremental filling technique into 8 oblique increments.

The models were exported as Standard for the Exchange of Product Data (*.STEP) files to a preprocessing program (Patran Software 2010, MSC Software Corporation, Santa Ana, CA, USA) for the creation of a finite element mesh using 4-node solid tetrahedral elements. The mesh of each structure was exported to an FEA program (Marc and Mentat, MSC Software Corporation), where restriction of movement and all bonded structures were applied. Then, materials properties were inserted (Table 1), and polymerization shrinkage was simulated by thermal analogy. The notional temperature was reduced by 1 °C, while the post-gel shrinkage strain was entered as the coefficient of linear thermal expansion. This study considered all material responses linear elastic and isotropic, and all interfaces between materials were bonded.

The effect of polymerization shrinkage respected the following sequence of increments (Fig. 2), specific for each group: Group 1 - 1st NCCL (1 increment) and 2nd MOD oblique incremental filling technique (2 increments in the mesial marginal ridge; 2 increments in the distal marginal ridge; 4 increments in the occlusal cavity); Group 2 - 1st NCCL (1 increment) and 2nd MOD Bulk fill horizontal technique (2 increments in the occlusal cavity); Group 3 - 1st MOD incremental filling technique (2 increments in the mesial marginal ridge; 2 increments in the distal marginal ridge; 4 increments in the occlusal cavity) and 2nd NCCL (1 increment); Group 4 - 1st MOD Bulk fill horizontal technique (2 increments in the occlusal cavity) and 2nd NCCL (1 increment).

The residual shrinkage stresses (MPa) were evaluated by Modified Von Mises equivalent stress, using the compressive and tensile strength values (Table 2), and the average of the highest 10% stress values among all enamel and dentin elements were traced on a graphic.

2.2 Tooth Selection and cavity preparation

Forty maxillary premolar teeth of similar dimensions, free of cracks and defects, were used (Ethics Committee in Human Research approval [57028622.7.0000.5152]). The teeth had been extracted as part of periodontal treatment with the consent of patients who had attended the Dental Hospital of Federal University, Uberlandia, Brazil.

The size was standardized by including teeth with normal occlusal

morphology and measuring buccolingual widths for group randomization. Successively, teeth were cleaned with a pumice stone. The roots were embedded in an auto-polymerizing polystyrene resin (Crystal, Piracicaba, Brazil) 3 mm below the cervical limit to simulate the alveolar bone, and the periodontal ligament was simulated by using polyether impression material (Impregum Soft; 3M).

NCCLs were manually prepared on the buccal surfaces of premolar teeth at the cemento-enamel junction with a diamond bur (#3118 diamond bur, KG Sorensen, Barueri, SP, Brazil) using a high-speed handpiece (Kavo do Brasil Ltda, Joinville, SC, Brazil). The preparations were 2.0 mm deep and 2.0mm cervical-apical wide (Fig. 3A).

Class II cavities (mesio-occlusal-distal) were prepared with diamond burs (#1151 diamond bur, KG Sorensen, Barueri, SP, Brazil) in a high-speed handpiece (Kavo, Joinville, SC, Brazil) that was mounted in a custom-made standardized preparation machine (Federal University of Uberlandia, Uberlandia, Minas Gerais, Brazil). The preparations were 2.5 mm deep in the occlusal region, 1/2 isthmus cusps wide, and the proximal boxes below the level of the pulpal floor 1.5 mm deep (Fig. 3B). The diamond burs (#1151 e #3118) were discarded after every 3 preparations.

2.3 Strain Gauge Testing

Two strain gauges (PA-06-125AA-350L; Excel Sensores, São Paulo, Brazil) were bonded to each tooth with a cyanoacrylate adhesive (Super Bonder; Loctite, São Paulo, Brazil), with wires connected to a data acquisition device (ADS2000IP; Lynx Tecnologia Eletronica Ltda., São Paulo, Brazil) to record cusps strains (μ s) during the restorative procedure through a $\frac{1}{2}$ Wheatstone system bridge. One gauge was placed on the center of the palatal cusp, and the other above NCCL on the buccal cusp (Fig. 4). Two additional strain gauges were fixed on another tooth (dummy specimen) that did not receive the restorative procedure process to compensate environmental effects. Each gauge consisted of a grid with an area of 3 mm x 1,5 mm and had an electrical resistance of 350 Ω .

The teeth were randomly divided into four restorative filling technique groups (n = 10) and were etched with 35 % phosphoric acid (Ultraetch, Ultradent,

South Jordan, UT, USA) for 30 s on enamel. After a 30 s rinse, excess water was removed with absorbent paper. An adhesive (Singlebond Universal, 3M Oral Care, St Paul, MN, USA) was applied following the manufacturer's instructions and light cured for 20 s (Valo Grand, Ultradent, South Jordan, UT, USA).

The restorative technique followed the sequence described in the FEA analysis. All NCCL cavities were restored with 1 increment of a conventional resin (Filtek Z350, 3M ESPE, St. Paul, Minnesota, USA). MOD varied into incremental technique (Filtek Z350, 3M ESPE, St. Paul, Minnesota, USA) and Bulk technique (Filtek Bulk One, 3M ESPE, St. Paul, Minnesota, USA).

A Teflon matrix was used to standardize the composite volume before the composite insertion into the cavity for each filling technique. Each increment of NCCL and MOD incremental filling technique was light cured for 20 s and MOD bulk fill for 40 s with the Valo Cordless. The CS data were collected at 4 Hz during the restorative procedure and were monitored until 10 min after curing the last increment through the data analysis software (AqDados 7.05 and AqAnalysis, Lynx Electronic Technology).

3. RESULTS

3.1 Residual shrinkage stress (FEA)

To determine whether the restorative protocol affects the residual shrinkage stress of upper premolar teeth, FEA was conducted. The distributions of residual shrinkage stress, indicated by modified von Mises stress, are displayed in Fig. 5 and 6.

The Fig. 5 shows higher von Mises stresses for the Incremental technique groups, particularly on the buccal cusp, in contrast to the Bulk technique. When the MOD cavity was restored first in the Incremental technique, the stress concentrated at the center of the buccal cusp. While the NCCL was restored before MOD, it resulted in a distribution at all the face of the cusp.

The Fig. 6 represents residual shrinkage stress distribution at the sagittal cross-sectional area of the teeth in the procedure stage (A and B). Restoring the cervical area first generated a stress concentration below NCCL that increased after restoring the MOD cavity. Restoring the occlusal cavity area first generated

a stress concentration in the depth of the cervical lesion, which decreased after the NCCL cavity was restored.

The stress graph (Fig. 7) of the average of the highest 10% stress values among all enamel and dentin elements. The residual shrinkage was higher for the incremental technique illustrated by the end of the curves. Restoring the NCCL cavity first generated lower peaks of stresses at the enamel during the procedure. At least, Fig. 8 shows the displacement of cusps generated by the composite resin polymerization after the restorative procedure. The incremental technique and restoring MOD cavity before NCCL generated a higher displacement of cusps.

3.2 Cuspal Strain

Fig. 9 represents the cuspal strain graph for each group obtained by the strain gauge testing. The higher CS was represented by the palatal cusp for all sequences and techniques. The mean (buccal and palatal) microstrain (μs) values measured after 10 min with the strain gauges are shown in Table 3.

For the buccal cusp, the two-way ANOVA also showed no significant interaction between the factors of restorative sequence and filling technique ($P = 0.052$). Cuspal strain values were higher for the Incremental filling technique ($P = 0.001$). No statistical difference was found between the restorative sequence strain values ($P = 0.087$).

For the palatal cusp, no significant interaction was found between the factors of restorative sequence and filling technique ($P = 0.192$). Cuspal strain values were similar for the restorative technique ($P = 0.239$) and restorative sequence ($P = 0.125$).

For the combined (buccal and palatal) cusp, no significant interaction between the factors of restorative sequence and filling technique ($P = 0.064$). Cuspal strain values were higher for the Incremental filling technique ($P = 0.006$). No statistical difference was found between the restorative sequence strain values ($P = 0.153$).

4 DISCUSSION

The null hypothesis of this study was rejected because it was observed that sequence and restorative filling techniques affect the biomechanical behavior of NCCL and MOD cavities in premolar teeth. NCCL restorations are necessary to prevent the accumulation of stress in the cavity and its progression. These lesions have a high prevalence, and it is clinically typical to observe the association with occlusal cavities, such as a MOD. In this context, this study investigated the biomechanical behavior when restoring both cavities in the same teeth, actually in upper premolar teeth. The upper premolar was chosen to be analyzed due to its location in the dental arch, morphology, and crown-root proportion,³² high prevalence of dentin hypersensitivity associated with non-carious cervical lesions.³³

The relation between shrinkage stress and the tensile bond strength of materials can directly reflect the bond between the composite resin and the tooth structure. Suppose the stress generated during polymerization exceeds the tensile bond strength, it can result in complications within the adhesive hybrid layer.^{5; 6; 8} This highlights the significance of effectively managing shrinkage stresses during the restorative process. The FEA was used, which is capable of demonstrating the residual shrinkage stress through a computer simulation, as well as other studies that were previously carried out.^{34; 35; 36}

Previous studies showed that restoring with low shrinkage resins generated less stress^{30; 31; 37}. This becomes evident in our results because the Bulk technique exhibited lower residual shrinkage stress compared to the Incremental technique. Other studies involving premolar teeth revealed that the palatal cusp experienced higher levels of residual shrinkage stress than the buccal cusp³⁸, which can be attributed to the anatomy of the palatal cusp, which has a reduced structural volume.^{28; 30; 39} In contrast, the present study has shown that the buccal cusp led to higher levels of residual shrinkage stress. It can be inferred that the presence of NCCL altered the stress distribution pattern, weakening the specific cusp.

Regarding the restorative sequence on FEA, our analyses reveal that restoring the cervical area before the MOD cavity leads to a concentration of stress below NCCL for the buccal cusp. The cervical is considered a critical area

to restore due to gingival tissue proximity, the challenge of moisture control for the difficulty of using absolute isolation, and the presence of sclerotic dentin, which could affect the bond strength. On the other hand, restoring first the cervical area generated a concentration of stress in the depth of the NCCL of the buccal cusp, which could be associated with postoperative sensitivity depending on the proximity to the pulp.

Actually, the restorative sequence affected the distribution and concentration of stress. However, these results were not significant to suggest a generation of postoperative sensitivity or affect the bond strength of the cervical area, considering the residual shrinkage stress values were lower compared to the resistance of structures (enamel and dentin).³⁰ The association of methodologies was significant in this study to assess the mechanical behavior during and after the restorative procedure, like in other studies.^{40; 41; 42} Notwithstanding, the graph (Fig. 7) of the average stress values illustrated that the technique affected the residual shrinkage stress represented by the end of the curve, but also shows that restoring the NCCL cavity first generated a lower stress peak at the enamel during the procedure. At least, higher displacement occurred on the buccal cusp by FEA, as opposed to the higher cuspal strain values for the palatal cusp obtained by the strain gauge method. This highlights the difference in the displacement of cusps and cuspal strain.

The microstrains values submitted to statistical analysis showed differences by the technique and not by the restorative sequence for the buccal cusp. There was no statistical difference in the palatal cusp, and this evidence that the buccal cusp undergoes the factors (technique and sequence) by the presence of the NCCL. Even so, the graph (Fig. 7) of the average stress values illustrated that restoring the NCCL cavity first generated a lower stress peak at the enamel during the procedure. However, this is an *in vitro* study, and considering the methodological limitations, the results should be interpreted cautiously because they may not be significant to the clinical performance of NCCL and MOD restorations.

The loss of tooth structure related to NCCL and MOD preparation are considered relevant factors in modifying the stress pattern of the teeth, and the restoration protocol has an important paper on the replacement of the biomechanical of the teeth.^{20; 21} For the clinical success of the restoration, it is

essential to control the stress generated by the polymerization shrinkage, and sequence and restorative protocol are involved in this process. Therefore, knowledge of these factors will guide the dentist professionals breeding decisions regarding restorative teeth with both cavities in this situation. The results suggest restoring the MOD cavity with a bulk technique and beginning from the NCCL.

CONCLUSION

In conclusion, the sequence and restorative protocol of MOD cavity and NCCLs affect the biomechanical behavior in premolar teeth. The incremental filling technique resulted in the highest shrinkage stresses, displacement, and cuspal strain. Restoring the NCCL before MOD did not affect the residual stress and deformation, but it did lead to lower peak stresses during the procedure and displacement of cusps.

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FIGURES

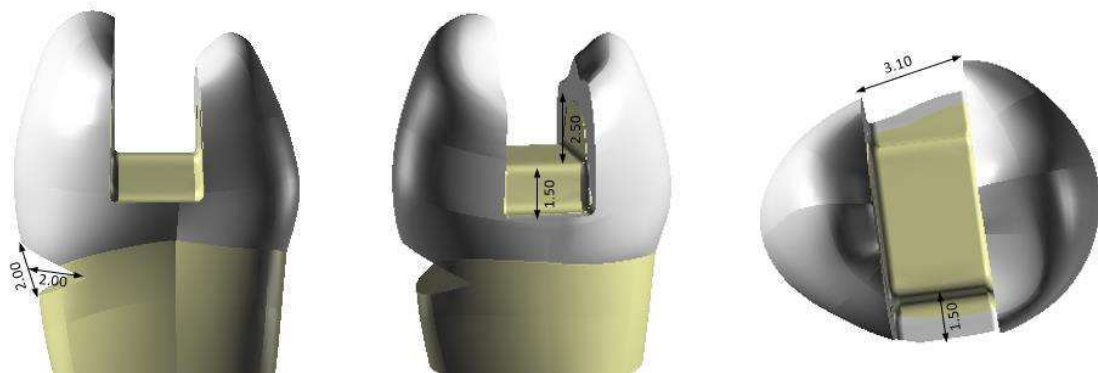


Figure 1. View of the 3D model and the NCCL and MOD preparation dimensions.

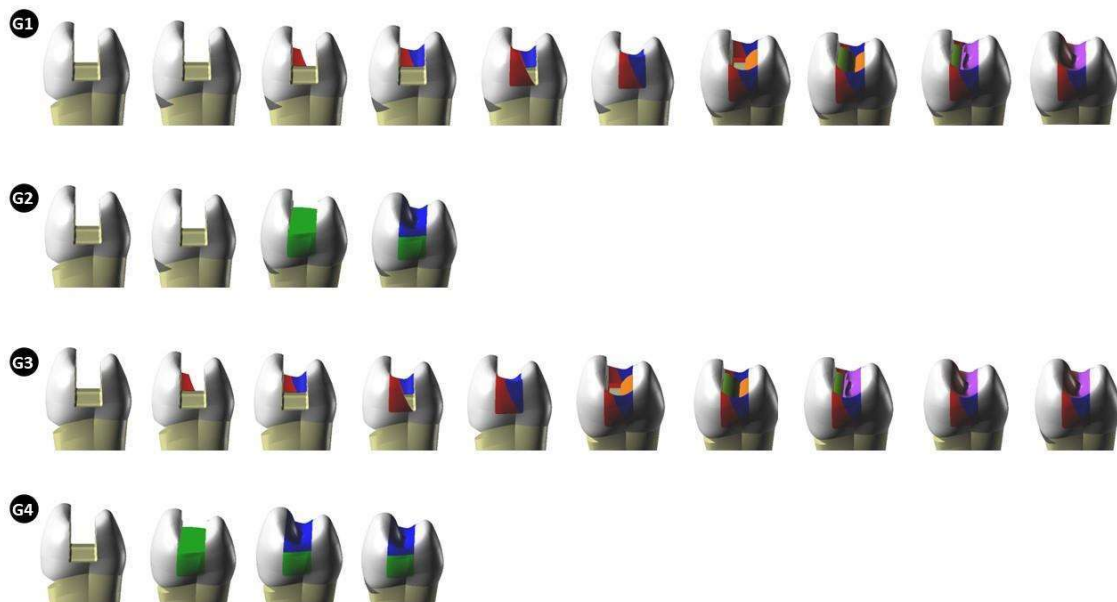


Figure 2. Overview of the simulated restorative techniques: G1 - 1° NCCL (1 increment) and 2° MOD incremental filling technique (1- first mesial increment; 2- second mesial increment; 3- first distal increment; 4- second distal increment; 5- first increment of dentin layer; 6- second increment of dentin layer; 7- first increment of enamel layer; 8- second increment of enamel layer); G2 - 1° NCCL (1 increment) and 2° MOD Bulk fill technique (1 increment of dentin layer; 2 - increment of enamel layer); G3 - 1° MOD incremental filling technique (1- first mesial increment; 2- second mesial increment; 3- first distal increment; 4- second distal increment; 5- first increment of dentin layer; 6- second increment of dentin layer; 7- first increment of enamel

layer; 8- second increment of enamel layer) and 2° NCCL (1 increment); G4 - 1° MOD Bulk fill technique (1 increment of dentin layer; 2 - increment of enamel layer) and 2° NCCL (1 increment).

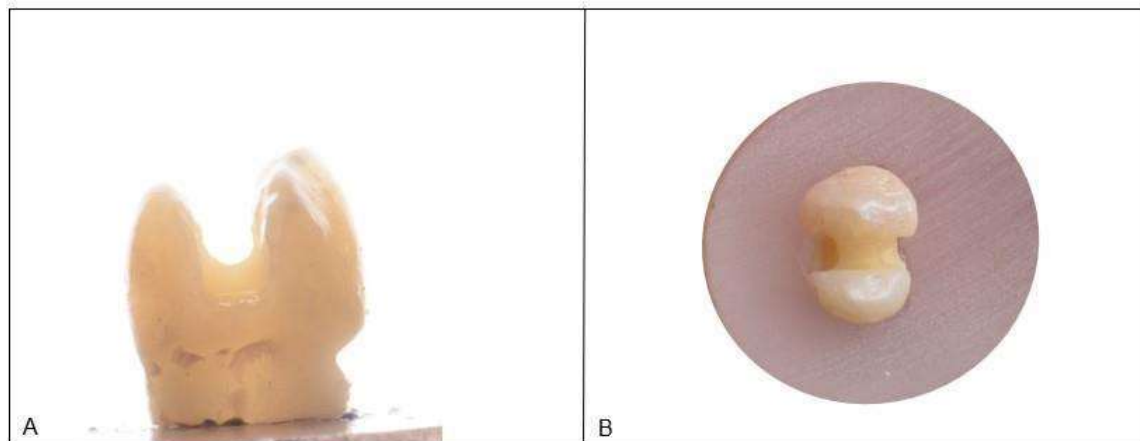


Figure 3. Side view (A) and occlusal view (B) of NCCL and MOD preparations.

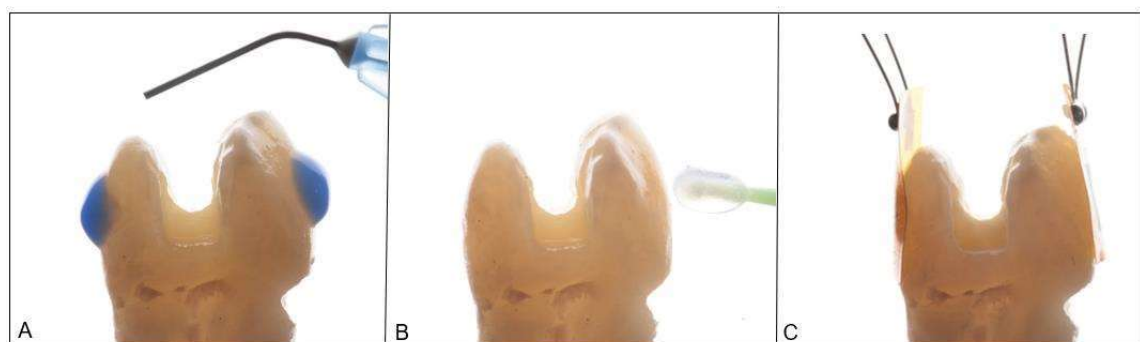


Figure 4. (A) Etching with phosphoric acid in the gauge fixation regions; (B) application of cyanoacrylate adhesive; (C) gauges already positioned.

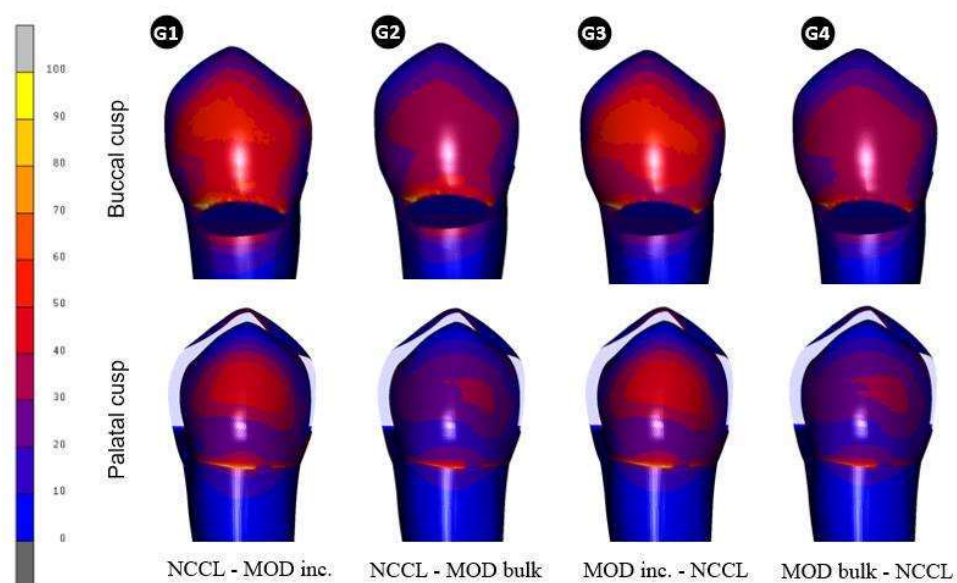


Figure 5. Modified von Mises shrinkage stress (MPa) distribution at the buccal and palatal cusps

for the different restorative materials and techniques. (G1) 1st NCCL and 2nd MOD incremental; (G2) 1st NCCL and 2nd MOD Bulk fill; (G3) 1st MOD incremental and 2nd NCCL; (G4) 1st MOD Bulk fill and 2nd NCCL.

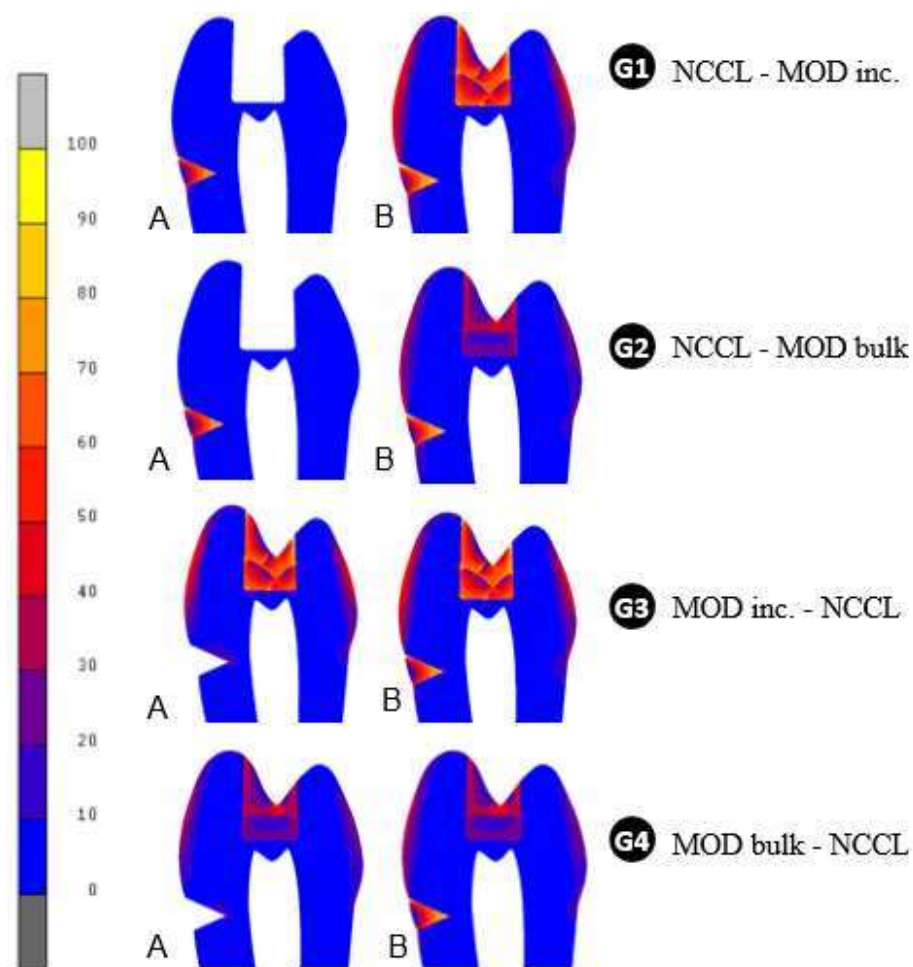


Figure 6. Modified Von Mises shrinkage stress distributions (MPa) at the sagittal cross-sectional area of the teeth. The letters A and B represent the procedure stage: (A) Shrinkage stress after the first cavity is restored (B) Shrinkage stress after both cavities are restored.

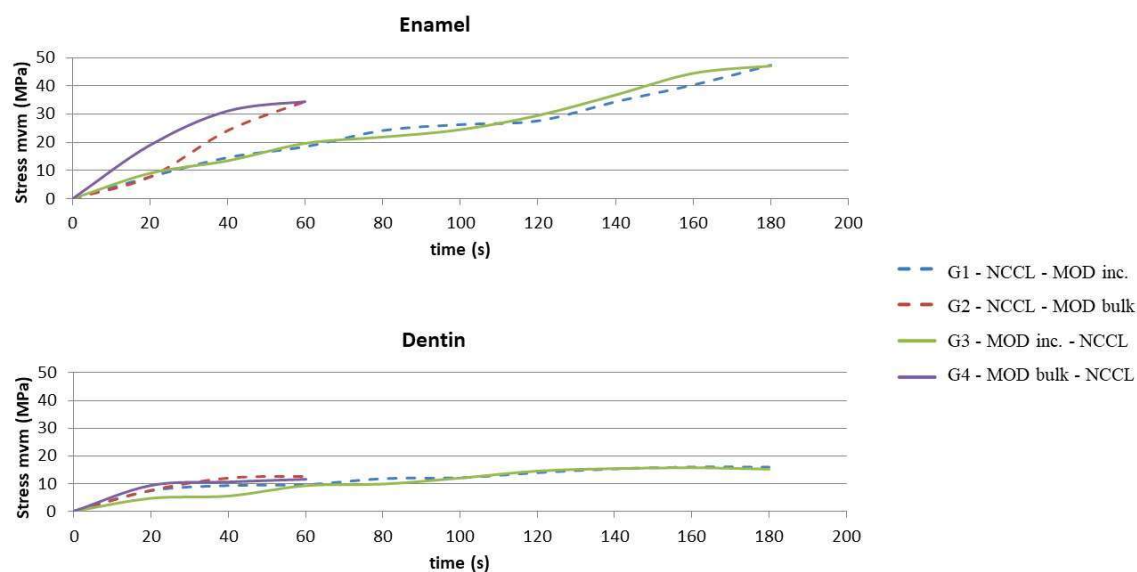


Figure 7. Shrinkage stress means (buccal and lingual cusp) at enamel and dentin during the

restorative procedure by finite element analysis. (G1) 1st NCCL and 2nd MOD incremental; (G2) 1st NCCL and 2nd MOD Bulk fill; (G3) 1st MOD incremental and 2nd NCCL; (G4) 1st MOD Bulk fill and 2nd NCCL.

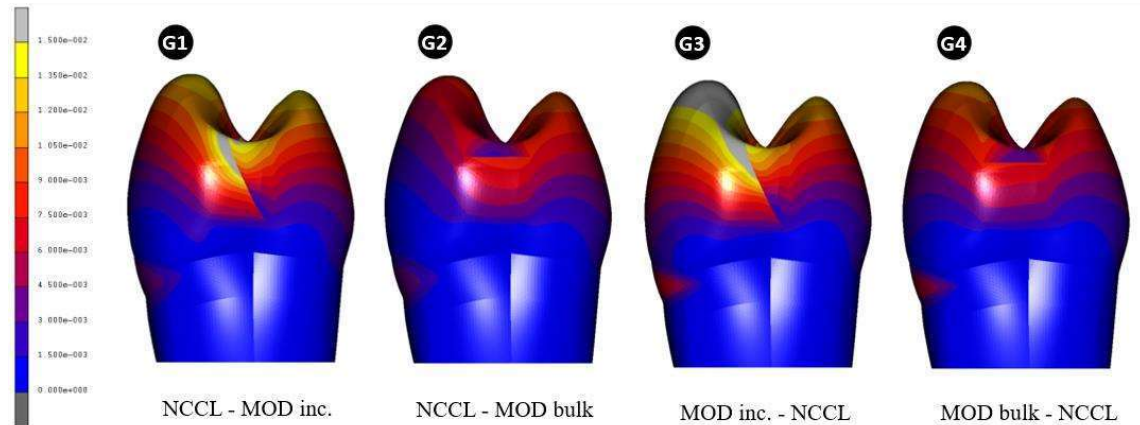


Figure 8. Cuspal displacements (mm) by finite element analysis: (G1) 1st NCCL and 2nd MOD incremental; (G2) 1st NCCL and 2nd MOD Bulk fill; (G3) 1st MOD incremental and 2nd NCCL; (G4) 1st MOD Bulk fill and 2nd NCCL.

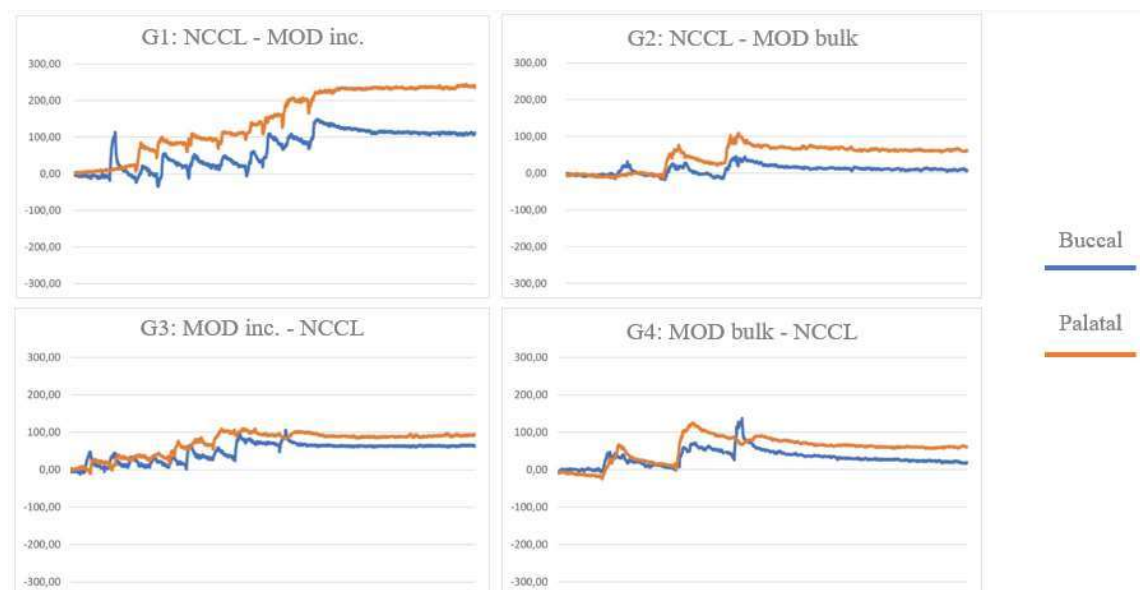


Figure 9. Partial results of cuspal strain at buccal and lingual cusp during the restorative procedure by strain gauge measurements: (G1) 1st NCCL and 2nd MOD incremental; (G2) 1st NCCL and 2nd MOD Bulk fill; (G3) 1st MOD incremental and 2nd NCCL; (G4) 1st MOD Bulk fill and 2nd NCCL.

TABLES

Table 1. Composition of resins used in the study.

Material	Organic Matrix	Shade	Manufacturers	Filler type
Filtek Z350	Bis-GMA, Bis-EMA, UDMA, PEGDMA, TEGMA	A2B	3M ESPE, St. Paul, Minnesota, USA.	Sílica 0,02 µm/zircônia 0,004 – 0,011 µm
Filtek Bulk fill One	AUDMA AFM DDDMA UDMA	A2	3M ESPE, St. Paul, Minnesota, USA.	Silica filler (20 nm) Zirconia filler (4–11 nm) Ytterbium trifluoride filler (100 nm particles)

Abbreviations: Bis-GMA, bisphenol-A-diglycidylether dimethacrylate; TEGDMA, triethylene glycol dimethacrylate; UDMA, urethane dimethacrylate; HEMA, hydroxyethylmethacrylate. Bis-EMA, ethoxylated bisphenol-A dimethacrylate.

Table 2. Elastic modulus, Poisson ratio, compressive and diametral tensile strength, and post-gel shrinkage applied in the finite element analysis.

Structure	Elastic modulus (GPa)	Poisson ratio (ν)	Compressive Strength (MPa)	Diametral tensile Strength (MPa)	Post-gel shrinkage (lin%)
Enamel ³⁰	84.0	0.30	384.0	10.3	-
Dentin ³⁰	18.0	0.23	297.0	98.7	-
ResinFiltek Z350 ³⁰	14.9	0.24	257.0	47.3	0.74
Resin Filtek Bulk One ³¹	13.30	0.24	117.91	52.91	0.197

Table 3. Mean cuspal strain values by strain gauge method after 10 min.

Group	Buccal strain	Palatal strain	Combined
G1: NCCL - MOD inc.	106.25 (59.98) ^{Ab}	93.92 (58.24) ^{Aa}	200.16 (99.89) ^{Ab}
G2: NCCL - MOD bulk	34.53 (32.12) ^{Aa}	62.88 (36.94) ^{Aa}	97.41 (57.41) ^{Aa}
G3: MOD inc. - NCCL	57.87 (34.21) ^{Ab}	58.30 (21.28) ^{Aa}	116.17 (31,21) ^{Ab}
G4: MOD bulk - NCCL	37.77 (28.15) ^{Aa}	59.91 (28.74) ^{Aa}	97.69 (25.28) ^{Aa}

Different superscript letters indicate significant difference from the Two Way ANOVA ($p < 0.05$).
Different capital letters indicate significant difference in the restorative sequence.
Different lowercase letters indicate significant difference in the MOD technique.

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ANEXO 1

Vestibular

	Incremental	Bulkfill
LCNC + MOD	106,25 ($\pm 59,98$) Ab	34,53 ($\pm 32,12$) Aa
MOD + LCNC	57,87 ($\pm 34,21$) Ab	37,77 ($\pm 28,15$) Aa

Letra maiúscula: sequencia operatória (vertical). (P = 0.087).

Letra minúscula: técnica de restauradora MOD (horizontal) (P = 0.001).

Não tem interação (P = 0.052)

Palatino

	Incremental	Bulkfill
LCNC + MOD	181,13 ($\pm 164,63$) Aa	69,60 ($\pm 42,61$) Aa
MOD + LCNC	72,22 ($\pm 74,36$) Aa	54,50 ($\pm 33,44$) Aa

Letra maiúscula: sequencia operatória (vertical). (P = 0.125).

Letra minúscula: técnica de restauradora MOD (horizontal) (P = 0.239).

Não tem interação (P = 0.192)

SOMA

	Incremental	Bulkfill
LCNC + MOD	200,16 ($\pm 99,89$) Ab	97,41 ($\pm 57,41$) Aa
MOD + LCNC	116,17 ($\pm 31,21$) Ab	97,69 ($\pm 25,28$) Aa

Letra maiúscula: sequencia operatória (vertical). (P = 0.153).

Letra minúscula: técnica de restauradora MOD (horizontal) (P = 0.006).

Não tem interação (P = 0.064)

Two Way Analysis of

terça-feira, junho 20, 2023, 13:01:11

Variance

Data source: Data 1 in Notebook2

Balanced Design

Dependent Variable: Col 3

Normality Test (Shapiro-Wilk) Passed (P = 0.347)

Equal Variance Test: Passed (P = 0.082)

Source of Variation	DF	SS	MS	F	P
Col 1	1	5090.890	5090.890	3.089	0.087
Col 2	1	21078.199	21078.199	12.790	0.001
Col 1 x Col 2	1	6661.561	6661.561	4.042	0.052
Residual	36	59327.288	1647.980		
Total	39	92157.937	2363.024		

The difference in the mean values among the different levels of Col 1 is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Col 2. There is not a statistically significant difference (P = 0.087).

The difference in the mean values among the different levels of Col 2 is greater than would be expected by chance after allowing for effects of differences in Col 1. There is a statistically significant difference (P = 0.001). To isolate which group(s) differ from the others use a multiple comparison procedure.

The effect of different levels of Col 1 does not depend on what level of Col 2 is present. There is not a statistically significant interaction between Col 1 and Col 2. (P = 0.052)

Power of performed test with alpha = 0.0500: for Col 1 : 0.275

Power of performed test with alpha = 0.0500: for Col 2 : 0.933

Power of performed test with alpha = 0.0500: for Col 1 x Col 2 : 0.382

Least square means for Col 1 :

Group Mean

LCNC+MOD70.386

MOD+LCNC47.823

Std Err of LS Mean = 9.077

Least square means for Col 2 :

Group Mean

Incremental82.061

Bulk 36.149

Std Err of LS Mean = 9.077

Least square means for Col 1 x Col 2 :

Group Mean

LCNC+MOD x Incremental106.247

LCNC+MOD x Bulk 34.526

MOD+LCNC x Incremental57.874

MOD+LCNC x Bulk 37.773

Std Err of LS Mean = 12.837

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Col 2**

Comparison	Diff of Means	p	q	P	P<0.050
Incremental vs. Bulk	45.911	25.058	0.001		Yes

Palatino

Two Way Analysis of Variance

terça-feira, junho 20, 2023, 13:30:02

Data source: Data 1 in Notebook2

Balanced Design

Dependent Variable: Col 7

Normality Test (Shapiro-Wilk) Passed (P = 0.444)

Equal Variance Test: Passed (P = 0.141)

Source of Variation	DF	SS	MS	F	P
Col 1	1	3722.970	3722.970	2.467	0.125
Col 2	1	2163.547	2163.547	1.434	0.239
Col 1 x Col 2	1	2665.056	2665.056	1.766	0.192
Residual	36	54323.094	1508.975		
Total	39	62874.667	1612.171		

The difference in the mean values among the different levels of Col 1 is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Col 2. There is not a statistically significant difference (P = 0.125).

The difference in the mean values among the different levels of Col 2 is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Col 1. There is not a statistically significant difference (P = 0.239).

The effect of different levels of Col 1 does not depend on what level of Col 2 is present. There is not a statistically significant interaction between Col 1 and Col 2. (P = 0.192)

Power of performed test with alpha = 0.0500: for Col 1 : 0.205

Power of performed test with alpha = 0.0500: for Col 2 : 0.0924

Power of performed test with alpha = 0.0500: for Col 1 x Col 2 : 0.128

Least square means for Col 1 :

Group Mean

LCNC+MOD78.400

MOD+LCNC59.105

Std Err of LS Mean = 8.686

Least square means for Col 2 :

Group Mean

Incremental76.107

Bulk 61.398

Std Err of LS Mean = 8.686

Least square means for Col 1 x Col 2 :

Group	Mean
LCNC+MOD x Incremental	93.917
LCNC+MOD x Bulk	62.883
MOD+LCNC x Incremental	58.297
MOD+LCNC x Bulk	59.913

Std Err of LS Mean = 12.284

SOMA

Two Way Analysis of Variance

terça-feira, junho 20, 2023, 13:33:02

Data source: Data 1 in Notebook2

Balanced Design

Dependent Variable: sqrt(col(8))

Normality Test (Shapiro-Wilk) Passed (P = 0.111)

Equal Variance Test: Passed (P = 0.073)

Source of Variation	DF	SS	MS	F	P
Col 1	1	16.116	16.116	2.129	0.153
Col 2	1	64.739	64.739	8.552	0.006
Col 1 x Col 2	1	27.619	27.619	3.648	0.064
Residual	36	272.525	7.570		
Total	39	380.999	9.769		

The difference in the mean values among the different levels of Col 1 is not great enough to exclude the possibility that the difference is just due to random sampling variability after allowing for the effects of differences in Col 2. There is not a statistically significant difference (P = 0.153).

The difference in the mean values among the different levels of Col 2 is greater than would be expected by chance after allowing for effects of differences in Col 1. There is a statistically significant difference (P = 0.006). To isolate which group(s) differ from the others use a multiple comparison procedure.

The effect of different levels of Col 1 does not depend on what level of Col 2 is present. There is not a statistically significant interaction between Col 1 and Col 2. (P = 0.064)

Power of performed test with alpha = 0.0500: for Col 1 : 0.167

Power of performed test with alpha = 0.0500: for Col 2 : 0.774

Power of performed test with alpha = 0.0500: for Col 1 x Col 2 : 0.338

Least square means for Col 1 :

Group	Mean
LCNC+MOD	11.513
MOD+LCNC	10.243

Std Err of LS Mean = 0.615

Least square means for Col 2 :

Group	Mean
Incremental	12.150
Bulk	9.606

Std Err of LS Mean = 0.615

Least square means for Col 1 x Col 2 :

Group	Mean
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LCNC+MOD x Incremental	13.616
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LCNC+MOD x Bulk	9.410
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MOD+LCNC x Incremental	10.685
------------------------	--------

MOD+LCNC x Bulk	9.802
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Std Err of LS Mean = 0.870

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor: **Col 2**

Comparison	Diff of Means	p	q	P	P<0.050
Incremental vs. Bulk	2.544	24.136	0.006		Yes

**PARECER CONSUBSTANCIADO DO CEP****DADOS DO PROJETO DE PESQUISA**

Título da Pesquisa: Influência do protocolo restaurador nas tensões de contração residual em dentes pré-molares com lesão cervical não cariosa e cavidade MOD

Pesquisador: Paulo César

Área Temática:

Versão: 1

CAAE: 57028622.7.0000.5152

Instituição Proponente: FACULDADE DE ODONTOLOGIA

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 5.412.661

Apresentação do Projeto:

De acordo com o(s) arquivo(s) "PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1899826.pdf", postado em 22/03/2022 10:18:30:

APRESENTACAO –

"As lesões cervicais não cariosas (LCNC) são caracterizadas pela perda de tecido duro na junção cimento-esmalte, sem envolvimento de bactérias. A prevalência mundial de LCNCs entre adultos é de 46,7%, sendo maior nas populações mais velhas do que nas mais jovens.² As LCNCs possuem caráter multifatorial e três fatores específicos, combinados ou isolados, irão atuar na origem e progressão da doença, são eles: tensão, fricção e biocorrosão."

"A perda de tecido dentário na região amelocementária é característica das lesões cervicais não cariosas (LCNC). As LCNCs estão comumente associadas na prática clínica com cavidades mésio-ocluso-distais (MOD) e o protocolo restaurador inadequado pode gerar maiores concentrações de tensões residuais."

"Espera-se que os resultados obtidos possam contribuir para o conhecimento dos clínicos sobre a sequência adequada e para o protocolo restaurador ideal nos casos em que há duas cavidades (MOD e LCNC) associadas em um mesmo elemento dentário."

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Continuação do Parecer: 5.412.661

METODOLOGIA

Após aprovação no Comitê de Ética em Pesquisa com Seres Humanos da Universidade Federal de Uberlândia, serão coletados 40 pré-molares superiores humanos hígidos com indicação prévia de exodontia. Os dentes serão coletados nas clínicas de cirurgia da Faculdade de Odontologia da Universidade Federal de Uberlândia e serão armazenados em água destilada.

Todos os dentes deverão ter indicação clínica de exodontia e consentimento prévio dos pacientes. Desta forma, todos os pacientes receberão informações detalhadas e, se concordarem em participar, farão a assinatura do termo de consentimento livre e esclarecido.

Serão incluídos apenas pacientes maiores de 18 anos. O paciente será livre para deixar a pesquisa a qualquer momento, sem qualquer prejuízo ou coação. Até o momento de divulgação dos resultados, o paciente poderá solicitar a retirada de seus dados da pesquisa.

(A) Pesquisa/Estudo – Experimental, em duas fases, com 4 grupos, com análises quantitativas.

(B) Tamanho da amostra – 40 dentes, com cálculo do numero amostral segundo os pesquisadores por meio do Software SigmaPlot e referência da literatura.

(C) Criterio de Inclusao – “O critério de inclusão para coleta dos dentes será: dentes pré-molares humanos hígidos superiores de pacientes acima de 18 anos de idade com indicação clínica de exodontia.”

(D) Criterio de Exclusao – “Os critérios de exclusão para coleta dos dentes serão: dentes humanos que não sejam pré-molares superiores; dentes pré-molares que apresentem fraturas, trincas e lesões de cáries; dentes de pacientes menores de 18 anos de idade.”

(E) Recrutamento e abordagem dos participantes – "Pacientes da clínica de cirurgia da FOUFU".

(F) Local e instrumento de coleta de dados / Experimento – "As metodologias serão realizadas no Centro de Pesquisa Odontológico Biomecânico, Biomateriais e Biologia Celular (CPBio), da Faculdade de Odontologia da UFU."

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(G) Metodologia de análise dos dados – “Os dados coletados de cada metodologia serão organizados em planilhas e, em seguida, as análises serão realizadas em programa estatístico Sigma Plot versão 12.0 (Systat Software, Inc., San Jose, CA, EUA). Em todos os objetivos, os dados das análises quantitativas serão analisados e, caso os valores apresentem requisitos que possibilite o emprego de análise paramétrica, será utilizada a Análise de variância (ANOVA) Two-Way medidas repetidas, em nível de 5% de probabilidade e, caso seja detectada diferença entre os grupos, será empregado em seguida o teste de Tukey ($p < 0,05$). Caso os dados não permitam uma análise paramétrica, será empregado teste não-paramétrico de Kruskal-Wallis.”

(H) Desfecho Primário – “Compreender se a sequência restauradora ou técnica utilizada possuem influência nas tensões de contração residual em dentes pré-molares com lesão cervical não cariosa e cavidade mésio-ocluso-distal. Com os resultados deste trabalho, os pesquisadores poderão se direcionar melhor para a realização de estudos clínicos, visando melhoras nos protocolos de restaurações de lesões cervicais não cariosas e cavidades MOD localizadas em um mesmo dente pré-molar.”

(I) CRONOGRAMA – “Coleta e seleção dos dentes 23/06/2022 26/09/2022”.

(J) ORÇAMENTO – “Financiamento próprio R\$ 2.123,10”.

Objetivo da Pesquisa:

Avaliar a influência do protocolo restaurador nas tensões de contração residual em dentes pré-molares com lesão cervical não cariosa e cavidade mésio-ocluso-distal.

Avaliação dos Riscos e Benefícios:

Riscos:

A coleta dos dentes será realizada pela mestranda Mariana Fernandes Pires, após os atendimentos dos pacientes nas clínicas de cirurgia da Faculdade de Odontologia, nas dependências do Hospital Odontológico da Universidade Federal de Uberlândia. O único risco é a identificação do sujeito de pesquisa ao realizar a coleta do dente, o que contraria a Resolução 466/12, mas a equipe de pesquisa se compromete em não revelar em nenhum momento da pesquisa a identidade dos pacientes e, portanto, serão utilizados códigos para minimizar este risco. Todos os dentes coletados terão indicação clínica de exodontia e, os pacientes que permitirem a doação destes

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Continuação do Parecer: 5.412.661

dentes, irão oficializá-la por meio da assinatura do termo de consentimento livre e esclarecido.

Benefícios:

Por meio deste trabalho, os pesquisadores poderão verificar in vitro a influência da técnica e sequência restauradora na geração de tensão de contração de dente pré-molares com LCNC e cavidade MOD. A partir dos resultados, os cirurgiões dentistas clínicos poderão ter acesso a informação de qual sequência e técnica geram melhores resultados, e assim, os benefícios passam a ser de forma indireta para os participantes da pesquisa e para a sociedade.

Comentários e Considerações sobre a Pesquisa:

A hipótese dos pesquisadores é que (1) a sequência restauradora (LNC ou MOD) e que (2) a técnica restauradora (incremental convencional ou bulkfill) da cavidade MOD possuem influência na geração de contração residual no elemento restaurado.

TRECHOS DO TCLE:

"Nesta pesquisa nós estamos buscando analisar qual técnica é mais benéfica que o cirurgião dentista pode utilizar para restaurar duas cavidades em um mesmo dente, e para isso, iremos utilizar dentes humanos para realizar os testes"

"Na sua participação, você doará um dente pré-molar superior, o qual será extraído por indicação clínica independente desta pesquisa, para melhoria de sua saúde. Você receberá todos os cuidados pré e pós-operatórios inerentes ao procedimento cirúrgico ao qual será submetido, conforme protocolo utilizado nas clínicas de cirurgia da Faculdade de Odontologia."

"Os riscos consistem na identificação do sujeito de pesquisa no momento da coleta do dente, o que contraria a Resolução 466/12, porém a equipe executora se compromete em não revelar em nenhum momento da pesquisa a identidade dos pacientes e assim, serão utilizados códigos para minimizar este risco."

Considerações sobre os Termos de apresentação obrigatória:

Foram apresentados:

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Continuação do Parecer: 5.412.661

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Projeto_de_pesquisa_Detalhado.pdf 22/03/2022 10:17:34

lattes.pdf 22/03/2022 10:17:07

TermoConsentimentoLivre_Esclarecido.pdf 19/03/2022 21:18:58

Calculo_amostrai.pdf 19/03/2022 20:49:20

Termo_Equipe_Executora.pdf 19/03/2022 20:42:32

FolhaDeRosto.pdf 19/03/2022 20:41:01

Conclusões ou Pendências e Lista de Inadequações:

De acordo com as atribuições definidas nas Resoluções CNS nº 466/12, CNS nº 510/16 e suas complementares, o CEP/UFU manifesta-se pela aprovação do protocolo de pesquisa.

O protocolo não apresenta problemas de ética nas condutas de pesquisa com seres humanos, nos limites da redação e da metodologia.

Prazo para a entrega do Relatório Final ao CEP/UFU: JULHO/2023*.

* Tolerância máxima de 01 mês para o atraso na entrega do relatório final.

Considerações Finais a critério do CEP:

O CEP/UFU LEMBRA QUE QUALQUER MUDANÇA NO PROTOCOLO DE PESQUISA DEVE SER INFORMADA, IMEDIATAMENTE, AO CEP PARA FINS DE ANÁLISE ÉTICA.

O CEP/UFU alerta que:

a) Segundo as Resoluções CNS nº 466/12 e nº 510/16, o pesquisador deve manter os dados da pesquisa em arquivo, físico ou digital, sob sua guarda e responsabilidade, por um período mínimo de 5 (cinco) anos após o término da pesquisa;

b) O CEP/UFU poderá, por escolha aleatória, visitar o pesquisador para conferência do relatório e documentação pertinente ao projeto;

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Continuação do Parecer: 5.412.661

c) A aprovação do protocolo de pesquisa pelo CEP/UFU dá-se em decorrência do atendimento às Resoluções CNS nº 466/12 e nº 510/16 e suas complementares, não implicando na qualidade científica da pesquisa.

ORIENTAÇÕES AO PESQUISADOR:

- O participante da pesquisa tem a liberdade de recusar-se a participar ou retirar seu consentimento em qualquer fase da pesquisa, sem penalização e sem prejuízo (Resoluções CNS nº 466/12 e nº 510/16) e deve receber uma via original do Termo de Consentimento Livre e Esclarecido – TCLE, na íntegra, por ele assinado.
- O pesquisador deve desenvolver a pesquisa conforme delineada no protocolo aprovado pelo CEP/UFU e descontinuar o estudo após a análise, pelo CEP que aprovou o protocolo (Resolução CNS nº 466/12), das razões e dos motivos para a descontinuidade, aguardando a emissão do parecer, exceto quando perceber risco ou dano não previsto ao participante ou quando constatar a superioridade de regime oferecido a um dos grupos da pesquisa que requeiram ação imediata.
- O CEP deve ser informado de todos os efeitos adversos ou fatos relevantes que alterem o curso normal do estudo (Resolução CNS nº 466/12). É papel do pesquisador assegurar medidas imediatas e adequadas frente a evento adverso grave ocorrido (mesmo que tenha sido em outro centro); e enviar a notificação ao CEP e à Agência Nacional de Vigilância Sanitária – ANVISA – apresentando o seu posicionamento.
- Eventuais modificações ou emendas ao protocolo devem ser apresentadas ao CEP de forma clara e sucinta, destacando a parte do protocolo a ser modificada e suas justificativas. No caso de projetos do Grupo I ou II, apresentados à ANVISA, o pesquisador ou patrocinador também deve informá-la, enviando o parecer aprobatório do CEP, para ser anexado ao protocolo inicial (Resolução nº 251/97, item III.2.e).

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Continuação do Parecer: 5.412.661

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1899826.pdf	22/03/2022 10:18:30		Aceito
Projeto Detalhado / Brochura Investigador	Projeto_de_pesquisa_Detalhado.pdf	22/03/2022 10:17:34	Paulo César	Aceito
Outros	lattes.pdf	22/03/2022 10:17:07	Paulo César	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TermoConsentimentoLivre_Esclarecido.pdf	19/03/2022 21:18:58	Paulo César	Aceito
Outros	Calculo_amostral.pdf	19/03/2022 20:49:20	Paulo César	Aceito
Declaração de Pesquisadores	Termo_Equipe_Executora.pdf	19/03/2022 20:42:32	Paulo César	Aceito
Folha de Rosto	FolhaDeRosto.pdf	19/03/2022 20:41:01	Paulo César	Aceito

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

UBERLÂNDIA, 17 de Maio de 2022

Assinado por:
ALEANDRA DA SILVA FIGUEIRA SAMPAIO
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