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Análise biomecânica de pinos de fibra de vidro em diferentes quantidades de remanescentes dentários: Estudo através do método de elementos finitos tridimensionais

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Resumo

Oliveira VG. **Análise biomecânica de pinos de fibra vidro em diferentes quantidades de remanescentes dentários. Estudo através do método de elementos finitos tridimensionais** [Dissertação](Mestrado). Araçatuba: UNESP — Univ. Estadual Paulista; 2022.

Este estudo analisou a distribuição de tensões gerada por cargas oclusais axiais e obliquas sobre próteses fixas unitárias com coroas metal free em zircônia sobre dentes despolpados, variando-se a quantidade de remanescente e o sistema de pino (convencional e Splendor-SAP® - Simple Adjustable Post), através da análise dos elementos finitos tridimensionais. Foram confeccionados 6 modelos 3D contendo um bloco da região de pré-maxila com presença do elemento 21, subdivididos em ossos cortical e trabecular, simulando osso tipo III. Os modelos gerados foram exportados para o software ANSYS 19 (Southpointe, PA, USA) para discretização. Para cada modelo, 3 análises de força de 178N foram executadas sendo aplicadas 2 mm abaixo da borda incisal a 0°, 30° e 60° em relação ao longo eixo dentário. Foram gerados mapas de deslocamento (mm), tensão de von Mises (MPa), e tensão máxima principal (MPa). Os mapas de deslocamento e de tensão de von Mises não apresentaram diferenças significativas. Os mapas de tensão máxima principal mostraram que os modelos com Splendor-SAP® concentraram menos tensão de tração na cervical da coroa protética, área crítica do modelo. Além disso, o comportamento biomecânico, para ângulos maiores, foi mais favorável nos modelos com pinos Splendor-SAP®, sendo mais crítico o remanescente nos dentes tratados com pinos convencionais. Foi possível concluir que pinos Splendor-SAP® quando indicados, reduzem a influência negativa da perda coronária para a confecção de coroas protéticas e favorecem a distribuição de tensões, comparados aos pinos convencionais.

Palavras chave: Técnica para retentor intrarradicular, análise de elementos finitos, fenômenos biomecânicos.

Abstract

Oliveira, VG. **Biomechanical analysis of glass fiber posts in different amounts of remnants. Study through the three-dimensional finite element method** [Dissertação](Mestrado). Araçatuba: UNESP ― Univ. Estadual Paulista; 2022.

This study analyzed the stress distribution generated by occlusal loads on single fixed prostheses with metal free zirconia crowns on pulpless teeth, varying the amount of remainder and the post system (conventional and Splendor-SAP® - Simple Adjustable Post), through the three-dimensional finite elements analysis. Six 3D models were made containing a block of the premaxilla region with the presence of element 21, simulating type III bone. The ANSYS 19 software (Southpointe, PA, USA) was used for discretization of the models. For each model, 3 force analyzes of 178N were performed being applied 2 mm below the incisal edge at 0°, 30° and 60° in relation to the long tooth axis. The von Mises stress and displacement maps did not show significant differences. The maximum principal stress maps showed that the models with Splendor-SAP® concentrated less tensile stress on the cervical of the prosthetic crown. In addition, the biomechanical behavior, for higher angles, was more favorable in models with Splendor-SAP® posts, with the remnant being more critical in teeth treated with conventional posts. Concluding that the Splendor-SAP®, when indicated, reduce the negative influence of coronary loss for the manufacture of prosthetic crowns and favor stress distribution, compared to conventional pins.

Keywords: intra-radicular retainers, finite element analysis, biomechanical phenomena.

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BIOMECHANICAL ANALYSIS OF GLASS FIBER POSTS IN DIFFERENT AMOUNTS OF REMNANTS: STUDY THROUGH THE THREE-DIMENSIONAL FINITE ELEMENT METHOD

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RUNNING TITLE: 3D-FEA OF SPLENDOR-SAP® FIBER POST SYSTEM

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Abstract

This study analyzed the stress distribution generated by occlusal loads on single fixed prostheses with metal free zirconia crowns on pulpless teeth, varying the amount of remainder and the post system (conventional and Splendor-SAP® - Simple Adjustable Post), through the three-dimensional finite elements analysis. Six 3D models were made containing a block of the premaxilla region with the presence of element 21, simulating type III bone. The ANSYS 19 software (Southpointe, PA, USA) was used for discretization of the models. For each model, 3 force analyzes of 178N were performed being applied 2 mm below the incisal edge at 0°, 30° and 60° in relation to the long tooth axis. The von Mises stress and displacement maps did not show significant differences. The maximum principal stress maps showed that the models with Splendor-SAP® concentrated less tensile stress on the cervical of the prosthetic crown. In addition, the biomechanical behavior, for higher angles, was more favorable in models with Splendor-SAP® posts, with the remnant being more critical in teeth treated with conventional posts. Concluding that the Splendor-SAP®, when indicated, reduce the negative influence of coronary loss for the manufacture of prosthetic crowns and favor stress distribution, compared to conventional pins.

Keywords: intra-radicular retainers, finite element analysis, biomechanical phenomena.

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INTRODUCTION

Endodontic treatment is a routine dental procedure in which the dental pulp is removed and replaced with a root canal filling. Usually, it is indicated when there is inflammation or irreversible necrosis of the dental pulp, resulting from caries or trauma [1-3]. A tooth that requires endodontic treatment is usually a tooth that has lost a large volume of dental tissue and needs large areas of restoration and is therefore more inclined to fractures [4-6].

The susceptibility to fracture of a tooth is directly linked to its external and internal morphology, and the internal morphology can be changed through endodontic instrumentation. Highlighting the value of preserving root dentin in order to maintain the structural integrity of endodontically treated teeth [6-7]. Root canal preparation must preserve the canal path and eliminate microorganisms from the entire system [7-8].

Less invasive and rounded root canal preparations are expected to eliminate regions of stress concentration, leading to a lower incidence of microcrack formation [7, 9]. In general, when the remaining tooth structure is not considered adequate to retain a restoration, intracanal posts are used. The literature suggests that greater amounts of remaining coronal structure, also called a ferrule, would improve the biomechanical behavior of the restoration, even with the use of intracanal posts [10-12].

Intraradicular post systems have been used to rehabilitate endodontically treated teeth with partial or total destruction of dental crowns [13-16]. Fiberglass posts are relatively easy to use and, as they have an elastic modulus similar to that of human dentin, stress distribution along the root axis is favored [17-21], in addition to providing greater retention of coronal restorations [22-24]. To improve stress distribution in situations that present a large area of coronary loss, a greater amount of glassfiber can improve force dissipation, improving biomechanical behavior [19-21]. It is also worth mentioning that prefabricated fiber posts can provide a reduction in treatment time, as they can be cemented on the day of canal preparation [10, 12, 14].

However, a failure rate of up to 7% is still reported for treatments with these intracanal retainers. Dentin has a complex microstructure and the simulation of its biomechanical properties remains a challenge [20]. Some failures in fiberglass post-treatment were observed mainly due to adhesive failures, leading to loss of bond strength to dentin and, consequently, to subsequent loosening. Adhesive failures can have several causes, including the shape of the root canal and the difficulty in accessing the middle and apical root thirds, in addition to the different anatomical structures of dentin (number and direction of dentinal tubules) and the difficulty of

photopolymerization also in the middle thirds. and apical in addition to more critical cementation techniques [17-18, 25].

As the mechanical properties of natural teeth are different from those presented by restorative materials, the interface between these components represents the critical area for stress concentration. Determining stress distributions in endodontically treated teeth restored with intracanal posts is challenging due to the small size and complex structure of the posts [26].

In this sense, format and composition alternatives for these pins have been presented. The Splendor-SAP® (Simple Adjustable Post, Angelus®, Londrina, PR, Brazil) aims to overcome the shortcomings of current products and facilitate their use by the dental surgeon through the use of a single post adjustable to the canal, that is, a universal size for narrow, medium or wide canals, allowing the introduction of a greater amount of fiberglass in the rehabilitated tooth [27]. Under these conditions, studies that evaluate the biomechanical behavior of the stress distribution of different materials and models used in the manufacture of intraradicular posts, aiming to reduce the existing overload on the tooth structure, become extremely important for dentistry to establish treatment protocols in clinical practice [26-28].

Finite element analysis (FEA) has become an important tool in stress analysis and has been used in dental biomechanics in the last two decades [21], it was created based on a numerical method to evaluate complex structures through a digital model made from a real model [28]. It is an analytically powerful tool that provides detailed quantitative data at all locations within a mathematical model that simulates the mechanical behavior of the system [29]. This method has been used to investigate the process of stress dissipation in teeth restored in different ways [26, 30] and has increased the interest of researchers in situations involving the use of posts in restorations [31-33], it is essential for analyzes involving a comparison between the biomechanical behavior of different models.

The aim of this study was to analyze the distribution of stresses generated by axial and oblique occlusal loads on single fixed prostheses with metal-free zirconia crowns on pulped teeth, varying the tooth remnant (without coronal loss, with 2mm ferrule, and with total coronary artery) and the pin system (conventional and Splendor-SAP®), using the three-dimensional finite element methodology (FEM). The hypothesis tested in this study is that there are no differences in the transmission of masticatory forces to the supporting tissues when altering the remaining tooth between total loss, 2mm splint, or without coronal loss, and when using conventional fiberglass posts and those of the Splendor-SAP® type.

MATERIAL AND METHODS

For this study, 6 three-dimensional models were made containing a block of the premaxilla region with the presence of element 21 and subdivided into cortical and trabecular bones, simulating type III bone. For each model, 3 force applications were performed, which will be described below. Thus, this study simulated 18 different clinical situations. The specifications of each model are shown in Table 1 [34-37].

Elaboration of models

The models were elaborated with the aid of 3D graphic modeling, using the software InVesalius 3.0.0 (CTI, São Paulo, Brazil) and Rhinoceros 3D 4.0 (NURBS Modeling for Windows, USA), in a high-performance Workstation. Figure 1 illustrates the models made for this study.

Obtaining the bone block, tooth structure and simulated crown

The bone block was obtained from the recomposition of computed tomography (CT) scan of a transverse section of the premaxilla region, with the aid of the InVesalius software. This initial recomposition was exported to the Rhinoceros 3D program, for conversion into a format compatible with 3D modeling, editing of surfaces and contacts, and final modeling for the execution of finite element analysis, following the methodology of previous works [35].

The tooth structure was created by a direct three-dimensional drawing of an extracted central incisor, maintaining the proportions (crown/root). Thus, this tooth was designed to receive the application of occlusal, axial and oblique forces, simulating the articulation with the antagonist tooth. The tooth was simulated as a solid structure, without separation from the root cementum, keeping the pulp proportions to simulate the tested preparations.

The ceramic crown was made similarly to a previous work [35], simulated in zirconia, cemented over the remnant, remaining at least an average thickness of 1 mm on the buccal, lingual, mesial and distal surfaces and 2 mm on the incisal region. The cementation line was simulated with a thickness of 200 micrometers [38], both for the crown and for the cementation lines of the posts.

The root canals were simulated with preparation for making a conventional glass post, without excessive wear on the internal walls of the canal, with a length of 2/3 of the root length, leaving 4 mm of endodontic filling. For the Splendor-SAP® models, no changes were made to this preparation, therefore, a different post was only adapted for the same situation. Modeling of the Splendor-SAP® was performed by measurements directly on the original Splendor-SAP® (Angelus®, Londrina-PR).

Development of finite element models

The previously generated models were exported to the ANSYS 19 software (Southpointe, PA, USA) for discretization. The mechanical properties were incorporated, such as the elastic modulus and Poisson's coefficient of each constituent material of the study (Table 2), as well as the meshes elaboration of the various structures.

All materials involved in the study were considered homogeneous (the material properties are the same at any point of the structural element), isotropic (the material properties are the same in all directions at the same point of the structural element) and linear (the structure deformations are directly proportional to the applied forces), with the application of linear load. Load application in the axial (0º) and oblique (30º and 60º) direction of 178N was simulated following the long tooth axis [35]. The application point was 2 mm below the incisal edge, close to the contact point of its antagonist.

The model was fixed in its lateral bases, in the cortical and trabecular bone, in the x, y, z directions, not allowing movement of the sides, simulating fixation to the viscerocranium and the contact interfaces between the materials were simulated symmetrically bonded together. Thus, the efforts generated by load applications were distributed internally in the simulated structures.

After the final elaboration of the finite element models, incorporation of loading and restriction of movements, they were solved by the solver of ANSYS 19.2 and maps of displacement (mm), von Mises (MPa), and maximum principal stress (MPa) for viewing the results. The von Mises maps were used to analyze the biomechanical behavior of the system. The displacement maps were used to visualize movement tendency in the structure and the maximum principal stress maps to analyze the tensile (positive values) and compression (negative values) stresses distributed in the system.

RESULTS

Displacement

The displacement maps were very similar between the studied models and are illustrated in figure 2. The maximum values were close to 0.3 mm in the models under the application of 60 degrees of force inclination. It was possible to observe a tendency for the tooth to rotate close to the middle region of the root in the buccal area, mainly in the 60-degree applications, which reached values approximately 6 times greater than the vertical applications. It was not possible to verify differences between the studied models, neither regarding the configuration of the remaining tooth nor regarding the type of post used.

Von Mises

The von Mises maps are illustrated in figure 3. The analysis of the coronary remnant showed no visible differences between the studied models. The more inclined forces tended to a greater concentration of tensions, mainly in the dentin region and in the fiber post. The analysis of different types of posts showed that there was a stress concentration in the Splendor-SAP® type in the coronary region, the internal area of the crown, with values close to 10-13MPa, mainly for the oblique application of the load, which was not observed in the models with the conventional post.

Maximum principal stress

The maximum principal stress maps are illustrated in figures 4 and 5. In figure 4 a general section of the model was performed and in figure 5 an enlargement of the coronary area was performed to show the differences in the cervical area. The 60 degree applications showed higher values of tensile and compression than the other inclinations. Analyzing the general maps, the differences are very small; however, in the 60-degree analysis, it was possible to observe a higher concentration of tensile stress in the cervical region of the crown, mainly in the lingual region, when the conventional post was used. This is observed in small reddish dots. For a better visualization, the crown was cut in figure 5 for each model and showed that in the cervical region, both lingual and buccal, the models behaved slightly differently. Analyzing the behavior of conventional posts, the smaller the remnant, the greater the stress concentrations in the cervical region, especially under oblique loads. This can be noticed by the coloring of this area close to 100MPa. This concentration value is lower in models with Splendor-SAP® (SPTL, SPWF, SPNL) even under 60 degree load application. Comparing the posts, there were lower tensile stress concentrations in this region in the Splendor-SAP® post models and a slightly higher concentration in the post sleeve region in these models.

DISCUSSION

This study carried out a biomechanical comparison between conventional fiberglass posts and Splendor-SAP® and had its hypothesis partially denied, because although the displacement and von Mises analyses did not indicate differences between the studied models, the analysis of maximum principal stress indicated that the fiberglass Splendor-SAP® were superior for stress transmission, mainly tensile, including being very positive even in situations with large variations in coronary remnants.

It is important to emphasize that the findings of this study are based on a tooth that theoretically only was endodontically treated, without major intraradicular wear, that is, despite the need for posts for reconstruction to reduce the tendency to fracture [4-5], it would be the ideal situation with a minimum of internal loss of the remaining root structure [6-7]. Thus, despite the situations tested and the literature emphasizing that the existence of remnant coronary structure favors reconstruction with fiberglass posts [10-12], this study presents ideal conditions, in the aspect that internally to the root, the tooth was minimally worn. Even so, comparisons between systems are under identical conditions and do not invalidate this study.

Some studies suggest that fiberglass posts are safer because their biomechanical behavior is closer to dentin [19-21]. The fiberglass posts used in this study had material characteristics about 2.5 times more resistant than root dentin, but still far below the characteristics of a metallic post, that present, according to de Ona et al. [39], elastic modulus of 188GPa for Ni-Cr alloys, implying a greater tendency to irreparable fractures [10-11, 16, 39]. No model presented high stress values close to the dentine failure point when compared to laboratory fracture values [16]. Theoretically, therefore, still more favorable than metallic posts for stress distribution to the tooth root [12, 15-16].

Among the analyses carried out, only the maximum principal stress showed a difference between the studied systems. This analysis considers tensile stresses and compressive stresses, which are known to be more critical for friable materials such as human dentin [35]. Under this analysis, it was shown that conventional fiberglass posts have a behavior that worsens as the amount of coronary remnant decreases, mainly under oblique load applications, which is in agreement with many works [10-12, 31]. The use of fiberglass Splendor-SAP® showed, however, a better result for this stress distribution, not being significantly different in relation to the amount of remnant found. It is noteworthy that, in the comparative analysis with conventional fiberglass posts, the cervical region was relieved in tensile stress concentrations, and this area plays a critical role in the survival of the cemented crown when the integrity of the cementation is disrupted [33]. Thus, it is expected that Splendor-SAP® will present better biomechanical characteristics that will allow it to restore teeth with greater longevity.

The finite element methodology has its limitations like any other methodology and, in this sense, it is critical mainly to obtain values of the structures involved in the study. Still, because it is a comparative methodology, it is very effective as a method of analysis. To corroborate these findings, it is imperative that clinical studies be conducted for an adequate selection of the type of fiberglass post for particular clinical situations.

Based on the results and limitations of the study, it was possible to conclude that the Splendor-SAP® system, when indicated, reduces the negative influence of coronary loss for the manufacture of prosthetic crowns and is more favorable to stress distribution than conventional posts.

Clinical relevance: Splendor-SAP system was created to improve adjust of post on prepared endodontic canal and can be ideal for restoration of endodontic treated tooth improving mechanical characteristics for stress distribution.

Conflicts of Interest: There are no conflicts of interest.

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References

1 Sequeira-Byron P, Fedorowicz Z, Carter B, Nasser M, Alrowaili EF. Single crowns versus conventional fillings for the restoration of root-filled teeth. Cochrane Database Syst Rev. 2015;2015(9):CD009109. Published 2015 Sep 25. doi:10.1002/14651858.CD009109.pub3

2 De Carlo Bello M, Pillar R, Mastella Lang P, Michelon C, Abreu da Rosa R, Souza Bier CA. Incidence of Dentinal Defects and Vertical Root Fractures after Endodontic Retreatment and Mechanical Cycling. Iran Endod J. 2017;12(4):502-507. doi:10.22037/iej.v12i4.16587

3 Khoshbin E, Donyavi Z, Abbasi Atibeh E, Roshanaei G, Amani F. The Effect of Canal Preparation with Four Different Rotary Systems on Formation of Dentinal Cracks: An In Vitro Evaluation. Iran Endod J. 2018;13(2):163-168. doi:10.22037/iej.v13i2.16416

4 Mannocci F, Cowie J. Restoration of endodontically treated teeth. Br Dent J. 2014;216(6):341-346. doi:10.1038/sj.bdj.2014.198

5 Tabassum S, Khan FR. Failure of endodontic treatment: The usual suspects. Eur J Dent. 2016;10(1):144-147. doi:10.4103/1305-7456.175682

6 Shiraguppi VL, B S H, G S C, Desai N, Azad A. Comparative evaluation of fracture resistance of root obturated with resilon and gutta-percha using two different techniques: an in vitro study. J Clin Diagn Res. 2015;9(3):ZC15-ZC18. doi:10.7860/JCDR/2015/11134.5646

7 Munari LS, Bowles WR, Fok ASL. Relationship between Canal Enlargement and Fracture Load of Root Dentin Sections. Dent Mater. 2019;35(5):818-824. doi:10.1016/j.dental.2019.02.015

8 Arslan H, Barutcigil C, Karatas E, et al. Effect of citric acid irrigation on the fracture resistance of endodontically treated roots. Eur J Dent. 2014;8(1):74-78. doi:10.4103/1305-7456.126248

9 Rippe MP, Santini MF, Bier CA, Baldissara P, Valandro LF. Effect of root canal preparation, type of endodontic post and mechanical cycling on root fracture strength. J Appl Oral Sci. 2014;22(3):165-173. doi:10.1590/1678-775720130051

10 Al-Omiri MK, Mahmoud AA, Rayyan MR, Abu-Hammad O. Fracture resistance of teeth restored with post-retained restorations: an overview. J Endod. 2010;36(9):1439-1449. doi:10.1016/j.joen.2010.06.005

11 Maroli A, Hoelcher KAL, Reginato VF, Spazzin AO, Caldas RA, Bacchi A. Biomechanical behavior of teeth without remaining coronal structure restored with different post designs and materials. Mater Sci Eng C Mater Biol Appl. 2017;76:839-844. doi:10.1016/j.msec.2017.03.152

12 Bacchi A, Caldas RA, Schmidt D, et al. Fracture Strength and Stress Distribution in Premolars Restored with Cast Post-and-Cores or Glass-Fiber Posts Considering the Influence of Ferule. Biomed Res Int. 2019;2019:2196519. Published 2019 Jan 3. doi:10.1155/2019/2196519

13 Juloski J, Radovic I, Goracci C, Vulicevic ZR, Ferrari M. Ferrule effect: A literature review. J Endod 2012;38:11-9.

14 Bacchi A, Dos Santos MB, Pimentel MJ, Caetano CR, Sinhoreti MA, Consani RL. Influence of post-thickness and material on the fracture strength of teeth with reduced coronal structure. J Conserv Dent. 2013;16(2):139-143. doi:10.4103/0972-0707.108196

15 Pereira JR, do Valle AL, Shiratori FK, Ghizoni JS, Bonfante EA. The effect of post material on the characteristic strength of fatigued endodontically treated teeth. J Prosthet Dent. 2014;112(5):1225-1230. doi:10.1016/j.prosdent.2014.03.014

16 Barcellos RR, Correia DP, Farina AP, Mesquita MF, Ferraz CC, Cecchin D. Fracture resistance of endodontically treated teeth restored with intra-radicular post: the effects of post system and dentine thickness. J Biomech 2013;46:2572-7.

17 Sicuro SLM, Gabardo MC, Castiglia Gonzaga C, et al. Bond Strength of Self-adhesive Resin Cement to Different Root Perforation Materials. J Endod. 2016;42(12):1819-1821. doi:10.1016/j.joen.2016.08.019

18 Freitas TL, Vitti RP, Miranda ME, Brandt WC. Effect of Glass Fiber Post Adaptation on Push-Out Bond Strength to Root Dentin. Braz Dent J. 2019;30(4):350-355. Published 2019 Jul 22. doi:10.1590/0103-6440201902491

19 Santos-Filho PC, Veríssimo C, Soares PV, Saltarelo RC, Soares CJ, Marcondes Martins LR. Influence of ferrule, post system, and legth on biomechanical behavior of endodontically treated anterior teeth. J Endod 2014;40:119-23.

20 Diana HH, Oliveira JS, Ferro MC, Silva-Sousa YT, Gomes ÉA. Stress Distribution in Roots Restored with Fiber Posts and An Experimental Dentin Post: 3D-FEA. Braz Dent J. 2016;27(2):223-227. doi:10.1590/0103-6440201600666

21 Taneja S, Kumar P, Gupta N, Khan R. Influence of type of cement and their thickness on stress distribution at dentin-cement interface of computer-aided designed glass fiber post: A three-dimensional finite element analysis. J Conserv Dent. 2019;22(3):228-232. doi:10.4103/JCD.JCD_457_18

22 Cecchin D, de Almeida JF, Gomes BP, Zaia AA, Ferraz CC. Effect of chlorhexidine and ethanol on the durability of the adhesion of the fiber post relined with resin composite to the root canal. J Endod. 2011;37(5):678-683. doi:10.1016/j.joen.2011.01.007

23 Costa Dantas MC, do Prado M, Costa VS, Gaiotte MG, Simão RA, Bastian FL. Comparison between the effect of plasma and chemical treatments on fiber post surface. J Endod. 2012;38(2):215-218. doi:10.1016/j.joen.2011.10.020

24 Lorenzetti CC, Bortolatto JF, Ramos ATPR, Shinohara AL, Saad JRC, Kuga MC. The effectiveness of glass ionomer cement as a fiber post cementation system in endodontically treated teeth. Microsc Res Tech. 2019;82(7):1191-1197. doi:10.1002/jemt.23268

25 Amarnath GS, Swetha MU, Muddugangadhar BC, Sonika R, Garg A, Rao TR. Effect of Post Material and Length on Fracture Resistance of Endodontically Treated Premolars: An In-Vitro Study. J Int Oral Health. 2015;7(7):22-28.

26 Madfa AA, Al-Hamzi MA, Al-Sanabani FA, Al-Qudaimi NH, Yue XG. 3D FEA of cemented glass fiber and cast posts with various dental cements in a maxillary central incisor. Springerplus. 2015;4:598. Published 2015 Oct 13. doi:10.1186/s40064-015-1345-4

27 Guimarães MS, Bueno CEDS, Martin AS, Fontana CE, Pelegrine RA, Pinheiro SL, Pedro Rocha DG. In Vitro Evaluation of Bond Strength to Dentin of Two Post Systems: Computer-aided Design and Computer-aided Manufacturing Fiber Posts vs Splendor Single Adjustable Post. J Contemp Dent Pract. 2022 Apr 1;23(4):388-392. PMID: 35945830.

28 Oliveira JS, Chaves CAL, Silva-Sousa YTC, Gomes EA. The finite element methods on oral rehabilitation: New trend for endodontically treated teeth. Braz Dent Sci 2014;17:11-18.

29 Marghalani TY, Hamed MT, Awad MA, Naguib GH, Elragi AF. Three-dimension finite element analysis of custommade ceramic dowel made using CAD/CAM technology. J Prosthodont. 2012;21(6):440-50.

30 Madfa AA, Kadir MR, Kashani J, et al. Stress distributions in maxillary central incisors restored with various types of post materials and designs. Med Eng Phys. 2014;36(7):962-967. doi:10.1016/j.medengphy.2014.03.018

31 Watanabe MU, Anchieta RB, Rocha EP, Kina S, Almeida EO, Freitas AC Jr, Basting RT. Influence of crown ferrule heights and dowel material selection on the mechanical behavior of root-filled teeth: a finite element analysis. J Prosthodont. 2012 Jun;21(4):304-11. doi: 10.1111/j.1532-849X.2011.00832.x. Epub 2012 Feb 28.

32 Lazari PC, Oliveira RC, Anchieta RB, Almeida EO, Freitas Junior AC, Kina S, Rocha EP. Stress distribution on dentin-cement-post interface varying root canal and glass fiber post diameters. A three-dimensional finite element analysis based on micro-CT data. J Appl Oral Sci. 2013 Nov-Dec;21(6):511-7.

33 Kainose K, Nakajima M, Foxton R, Wakabayashi N, Tgami J. Stress distribution in root filled teeth restored with various post and core techniques: Effect of post length and crown height. Int Endod J. 2014 Oct 14. doi: 10.1111/iej.12397. [Epub ahead of print]

34 Veríssimo C, Simamoto Júnior PC, Soares CJ, Noritomi PY, Santos-Filho PC. Effect of the crown, post, and remaining coronal dentin on the biomechanical behavior of endodontically treated maxillary central incisors. J Prosthet Dent. 2014 Mar;111(3):234-46.

35 Verri FR, Okumura MHT, Lemos CAA, et al. Three-dimensional finite element analysis of glass fiber and cast metal posts with different alloys for reconstruction of teeth without ferrule. J Med Eng Technol. 2017;41(8):644-651. doi:10.1080/03091902.2017.1385655

36 González-Lluch C, Rodríguez-Cervantes PJ, Forner L, Barjau A. Inclusion of the periodontal ligament in studies on the biomechanical behavior of fiber post-retained restorations: An in vitro study and three-dimensional finite element analysis. Proc Inst Mech Eng H. 2016 Mar;230(3):230-8. doi: 10.1177/0954411916630006. PMID: 26893228.

37 Peng W, Zhou X, Gao Y, Xu X. Effect of Access Cavity Preparation on Dentin Preservation, Biomechanical Property, and Instrumentation Efficacy: A Micro-Computed Tomographic Study. J Endod. 2022 May;48(5):659-668. doi: 10.1016/j.joen.2021.12.012. Epub 2022 Feb 26. PMID: 35227729.

38 Ha SR. Biomechanical three-dimensional finite element analysis of monolithic zirconia crown with different cement type. J Adv Prosthodont. 2015;7(6):475-483. doi:10.4047/jap.2015.7.6.475

39 Ona M, Wakabayashi N, Yamazaki T, Takaichi A, Igarashi Y. The influence of elastic modulus mismatch between tooth and post and core restorations on root fracture. Int Endod J. 2013 Jan;46(1):47-52. doi: 10.1111/j.1365-2591.2012.02092.x. Epub 2012 Jul 7. PMID: 22775227.

Table legends

TABLE 1 - Specifications of the simulations that were performed for the study.

TABLE 2 - Mechanical properties of the materials that were simulated in the study**.**

Figure legends

FIGURE 1 - Modeling of the structures carried out for this study (cortical bone, trabecular bone, ligament, dentin with variations of remnants without crown loss, with 2mm ferrule and with total coronal loss, gutta percha, post system with variations of conventional post and Splendor- SAP®, post cements for each situation tested, crown cement and prosthetic crown)**.**

FIGURE 2 - Sections of all model displacement maps analyzed (CFTL – loss, conventional; CFWF – 2mm, conventional; CFNL – no loss, conventional; SPTL – loss, Splendor-SAP; SPWF – 2mm, Splendor-SAP; SPNL – no loss, Splendor-SAP) – Unit mm.

FIGURE 3 - Sections of all model von Mises maps analyzed (CFTL – loss, conventional; CFWF – 2mm, conventional; CFNL – no loss, conventional; SPTL – loss, Splendor-SAP; SPWF – 2mm, Splendor-SAP; SPNL – no loss, Splendor-SAP) – Unit MPa.

FIGURE 4 - Sections of all model maximum principal stress maps analyzed (CFTL – loss, conventional; CFWF – 2mm, conventional; CFNL – no loss, conventional; SPTL – loss, Splendor-SAP; SPWF – 2mm, Splendor-SAP; SPNL – no loss, Splendor-SAP) – Unit MPa.

FIGURE 5 - Sections of the main maximum stress maps and crown zoom of all analyzed models (CFTL – loss, conventional; CFWF – 2mm, conventional; CFNL – no loss, conventional; SPTL – loss, Splendor-SAP; SPWF – 2mm, Splendor-SAP; SPNL – no loss, Splendor-SAP) – Unit MPa.

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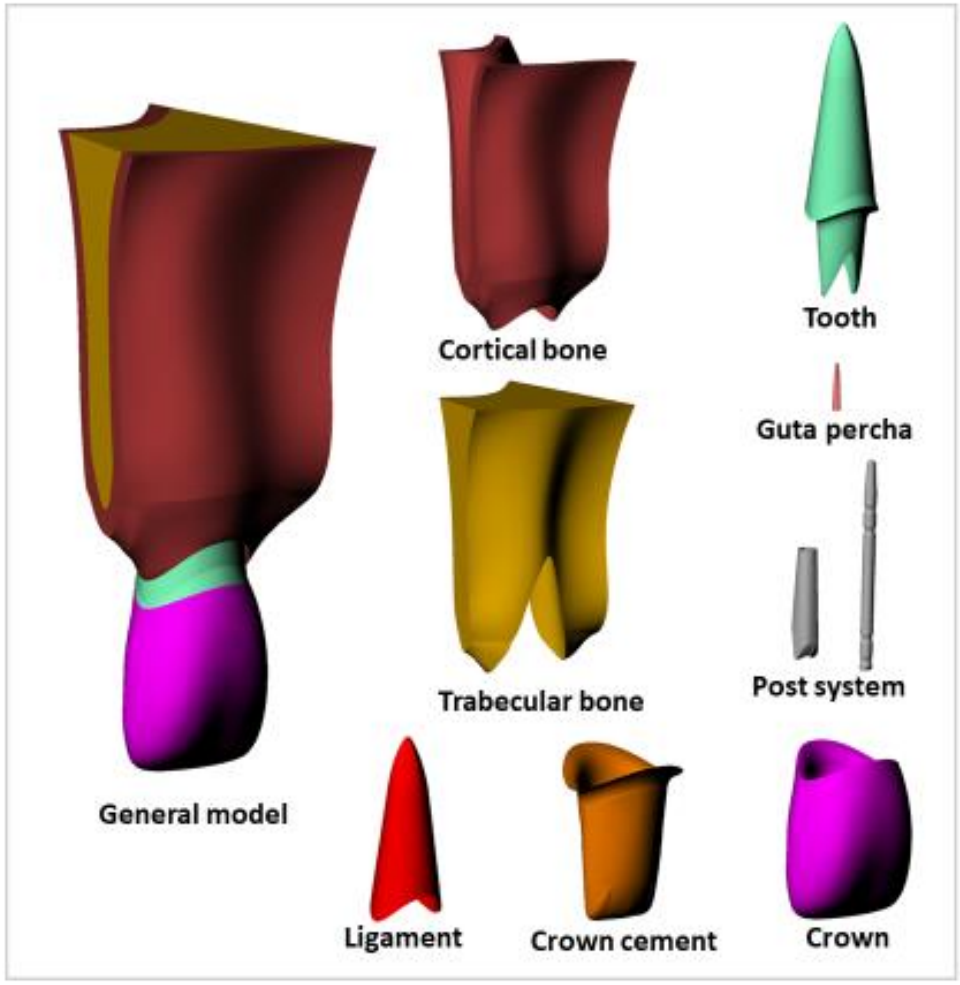

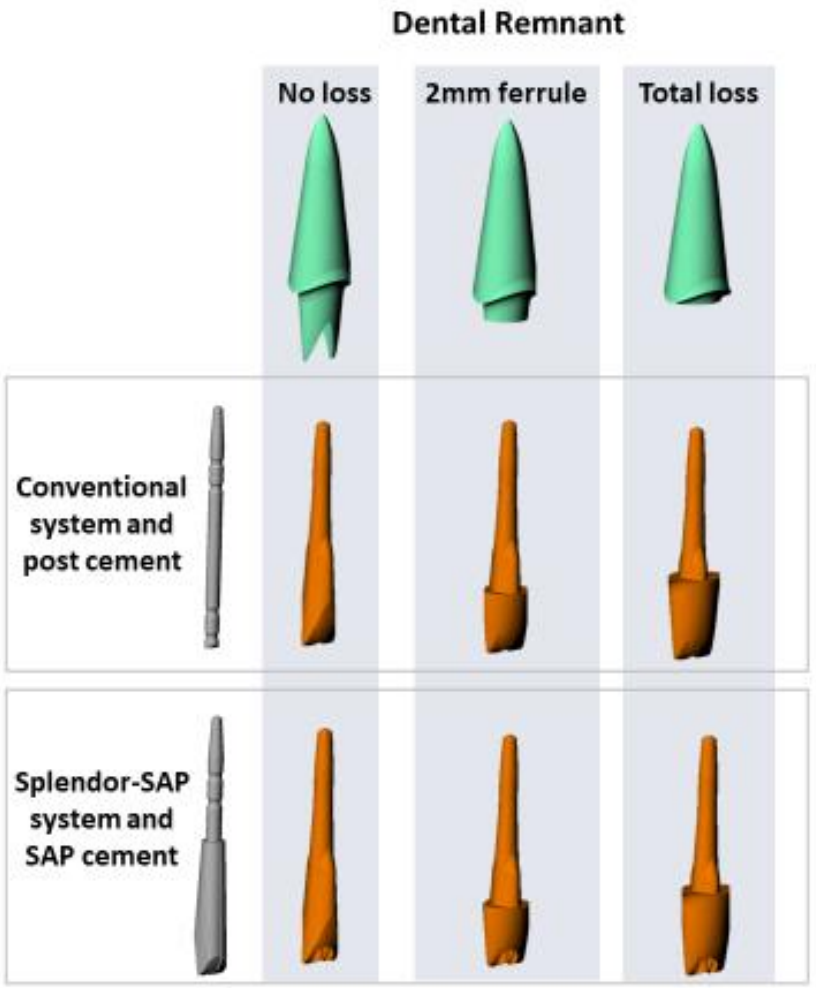

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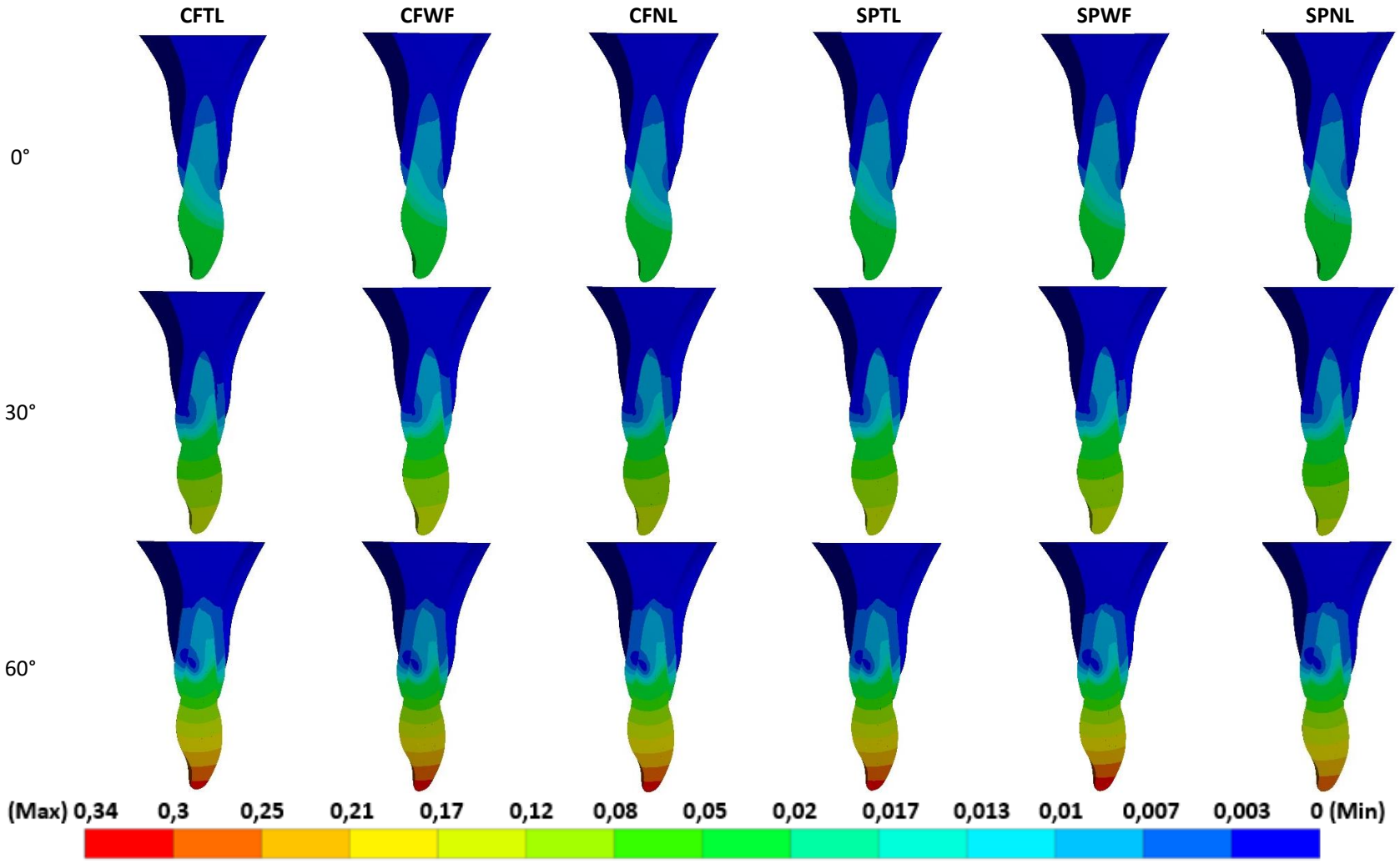

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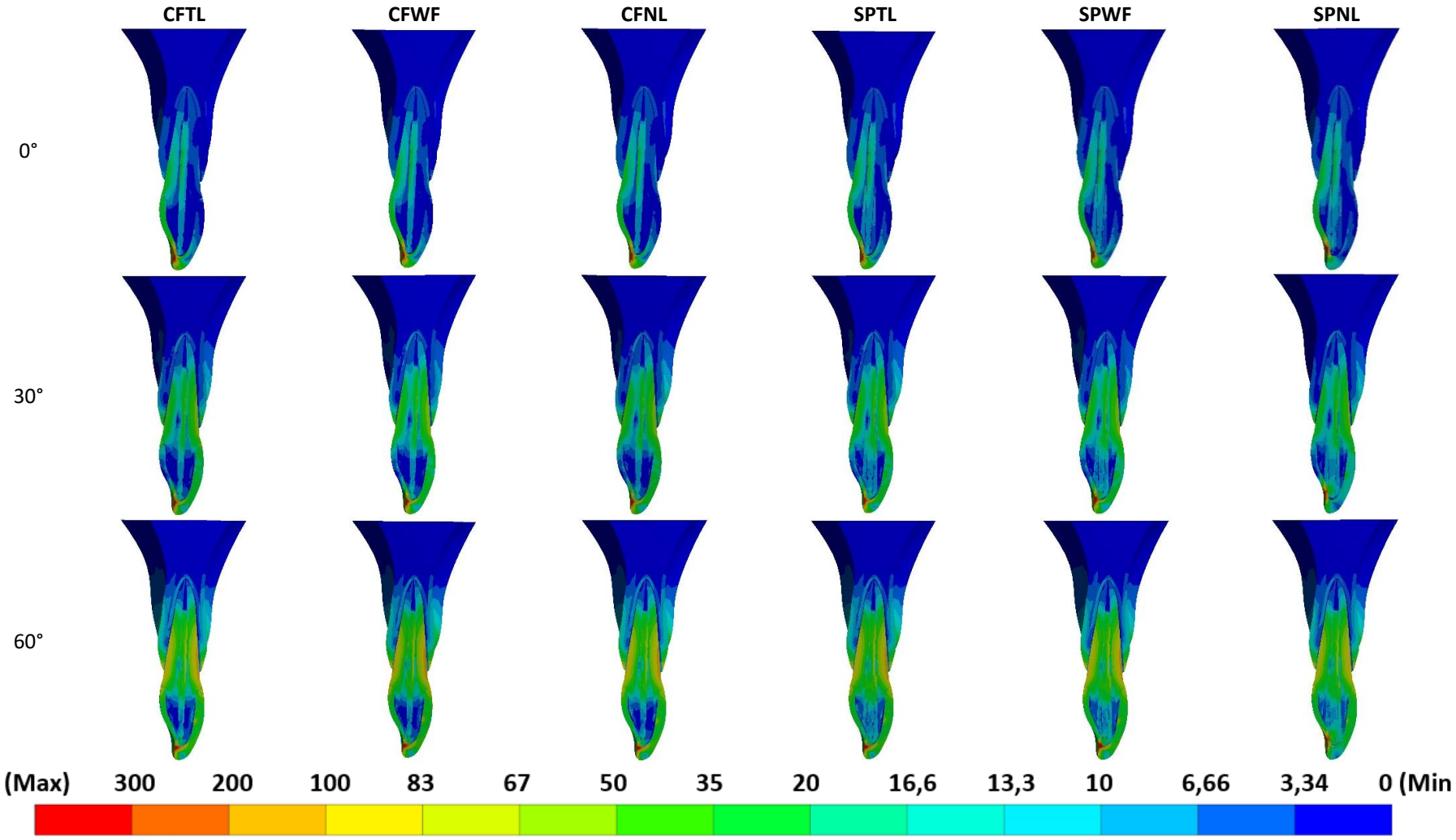

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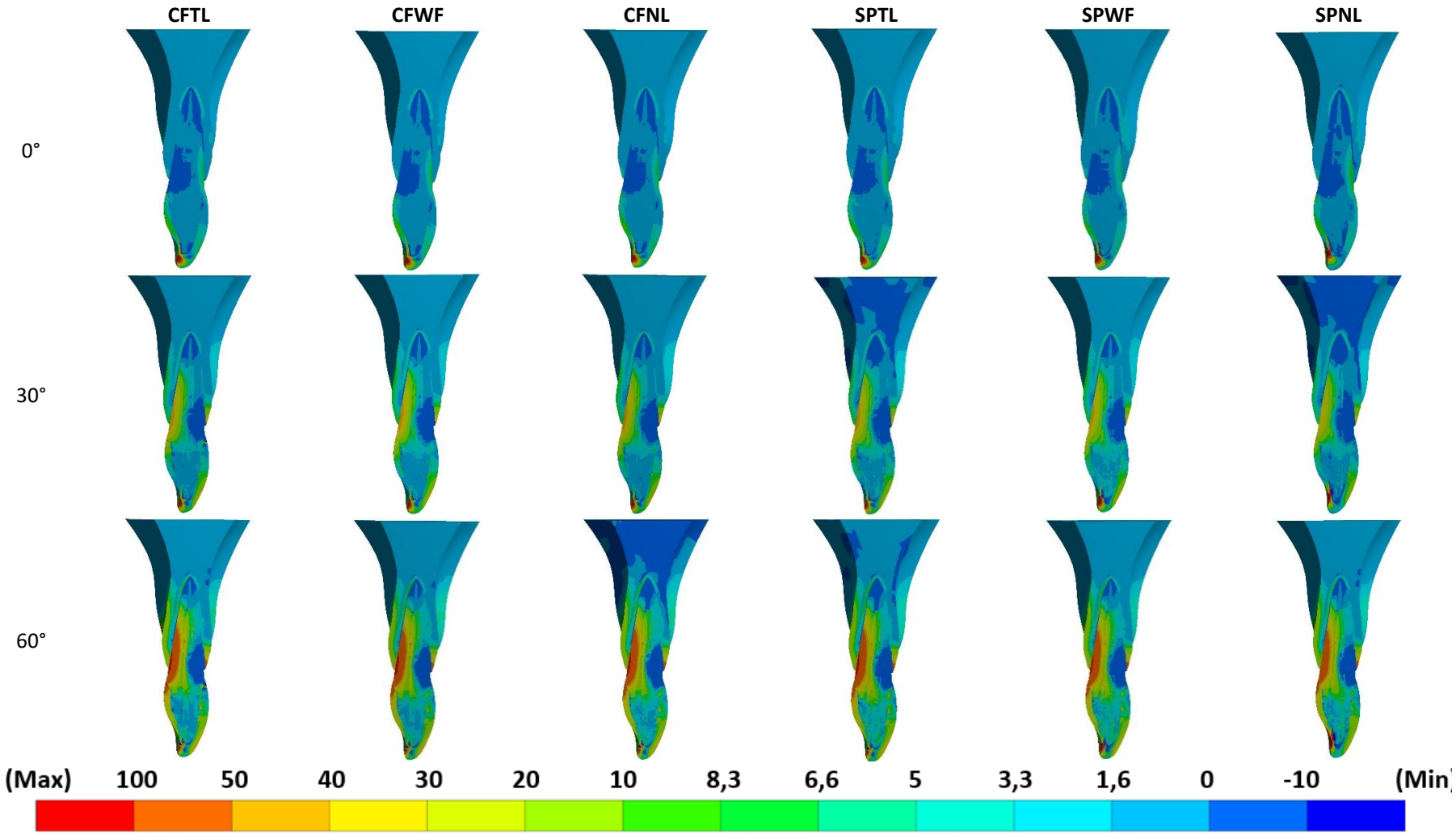

Figure 5 – Sections of the main maximum stress maps and crown zoom of all analyzed models (CFTL – loss, conventional; CFWF – 2mm, conventional; CFNL – no loss, conventional; SPTL – loss, Splendor-SAP; SPWF – 2mm, Splendor-SAP; SPNL – no loss, Splendor-SAP) – Unit MPa.

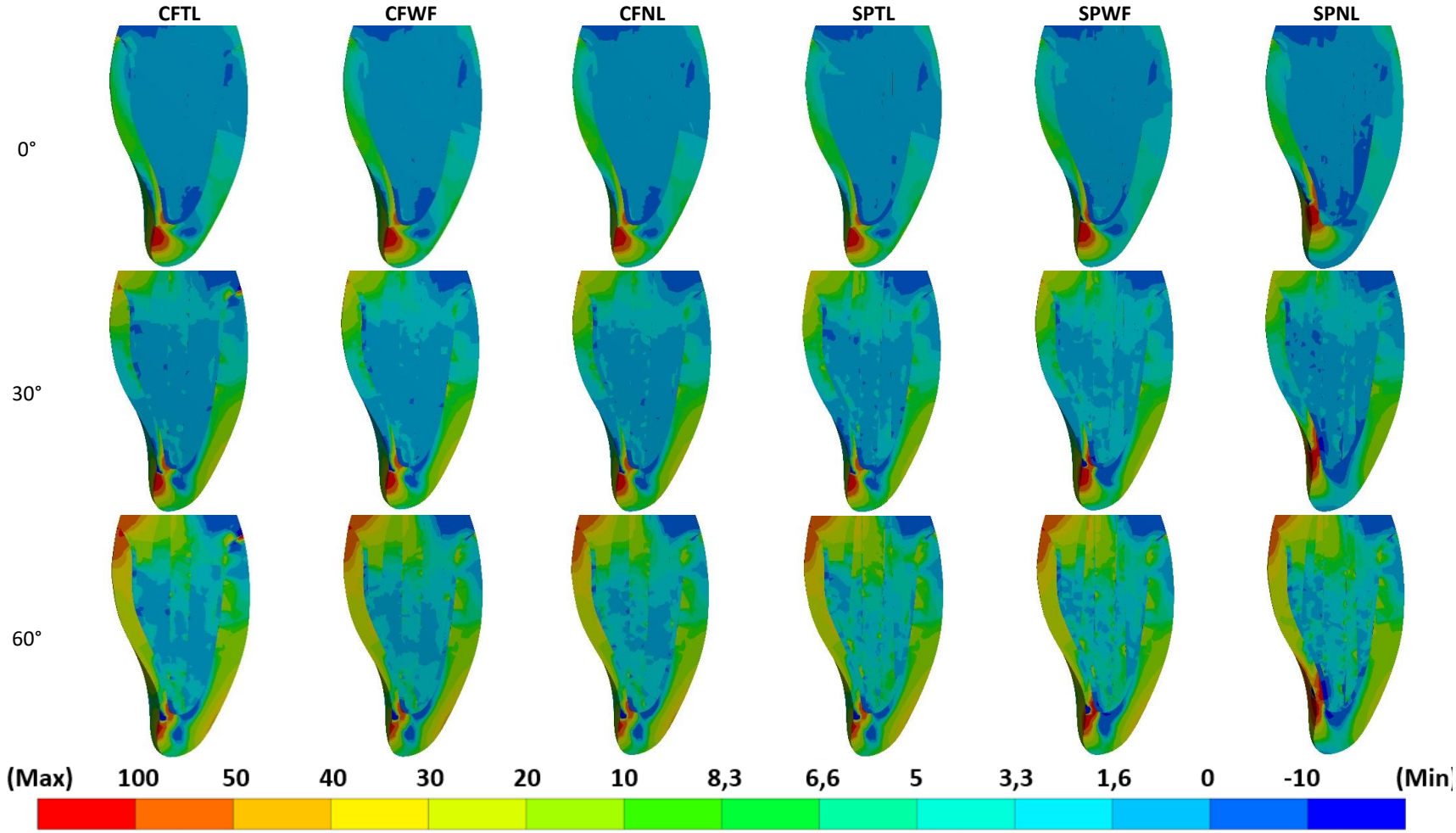

Table 1 - Specifications of the simulations that were performed for the study.

Model	Force	Description
CFTL	0º 30º 60º	Root canal-treated tooth, reconstructed with **conventional fiber post**, endodontic preparation compatible with post thickness, without ferrule, restored with metal-free zirconia crown.
CFWF	0º 30º 60º	Root canal-treated tooth, reconstructed with **conventional fiber post**, endodontic preparation compatible with post thickness, with 2mm ferrule, restored with metal-free zirconia crown.
CFNL	0º 30º 60º	Root canal-treated tooth, reconstructed with **conventional fiber post**, endodontic preparation compatible with post thickness, without coronal loss, restored with metal-free zirconia crown.
SPTL	0º 30º 60º	Root canal-treated tooth, reconstructed with **SPLENDOR-SAP® fiber post**, endodontic preparation compatible with post thickness, without ferrule, restored with metal-free zirconia crown.
SPWF	0º 30º 60º	Root canal-treated tooth, reconstructed with **SPLENDOR-SAP® fiber post**, endodontic preparation compatible with post thickness, with 2mm ferrule, restored with metal-free zirconia crown.
SPNL	0º 30º 60º	Root canal-treated tooth, reconstructed with **SPLENDOR-SAP® fiber post**, endodontic preparation compatible with post thickness, without coronal loss, restored with metal-free zirconia crown.

Table 2 – Mechanical properties of the materials that were simulated in the study**.**

Structure	Elastic modulus (E) (GPa)	Poisson's ratio (V)	References
Dentin	18,6	0,31	González-Lluch et al., 2016
Pulp	2×10^{-3}	0,45	Peng et al., 2022
Periodontal Ligament	$68,9 \times 10^{-3}$	0,45	Verri et al. 2017
Cortical bone	13,7	0,30	Verri et al. 2017
Trabecular bone	1,37	0,30	Verri et al. 2017
Guta percha	$6,9 \times 10^{-3}$	0,45	Peng et al., 2022
Resin cement	8	0,33	Ha et al., 2015
Zircônia (e-max zircad)	210	0,26	Verri et al. 2015
Fiberglass posts	45	0,26	Manufacturer's catalog

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  Smith JJ. The world of science. Am J Sci. 1999;36:234–5.

  Article in supplement or special issue:
  Frumin AM, Nussbaum J, Esposito M. Functional asplenia: demonstration of

splenic activity by bone marrow scan. Blood 1979;59 (Suppl 1):263–2.

Corporate (collective) author:
Who Collaborating Centre For Oral Precancerous Lesions. Definition of leukoplakia and related lesions: an aid to studies on oral precancer. Oral Surg Oral Med Oral Pathol 1978;46:518–39.

Unpublished article:
O'Mahony S, Rose SL, Chilvers AJ, Ballinger JR, Solanki CK, Barber RW, et al. Finding an optimal method for imaging lymphatic vessels of the upper limb. Eur J Nucl Med Mol Imaging. 2004. doi:10.1007/s00259-003-1399-3.

Example - Books and other monographs:
Personal author(s):
Blenkinsopp A, Paxton P. Symptoms in the pharmacy: a guide to the management of common illness. 3rd ed. Oxford: Blackwell Science; 1998.

Chapter in book:
Wyllie AH, Kerr JFR, Currie AR. Cell death: the significance of apoptosis. In: Bourne GH, Danielli JF, Jeon KW, editors. International review of cytology. London: Academic; 1980. p. 251–306.

No author given:
International statistical classification of diseases and related health problems (ICD-10). 10th revision, Vol 1. Geneva: World Health Organization, 2013; 868.

Example - Online page:
Website:
ISSN International Centre: The ISSN register. http://www.issn.org (2006). Accessed 20 Feb 2007.

Online database:
Healthwise Knowledgebase. US Pharmacopeia, Rockville. 1998. http://www.healthwise.org. Accessed 21 Sept 1998

FTP site:
Doe, J.: Trivial HTTP, RFC2169. ftp://ftp.isi.edu/in-notes/rfc2169.txt (1999). Accessed 12 Nov 1999.

- Figure Legends
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