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INFLUÊNCIA DO PREPARO CERVICAL E PREPARO DO CANAL RADICULAR NA RESISTÊNCIA À FRATURA DE DENTES ENDODONTICAMENTE TRATADOS: UM ESTUDO MICRO CT

Porto Alegre

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Trabalho de Conclusão do Curso de Especialização em Endodontia do Programa de Pós-Graduação de Odontologia da Universidade Federal do Rio Grande do Sul, como requisito parcial para obtenção do título de Endodontista

Orientador: Prof. Dr. Marcus Vinícius Reis Só

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Este trabalho foi submetido ao processo de avaliação por banca examinadora do Curso de Odontologia da Universidade Federal do Rio Grande do Sul – UFRGS, como requisito para a obtenção do título de Endodontista

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RESUMO

DUARTE, Simone Feretti. **Influência do preparo cervical e preparo do canal radiular na resistência a fratura de dentes endodonticamente tratados: um estudo micro ct**. 2018. 32 f. Trabalho de conclusão(especialização) – Faculdade de Odontologia, Universidade Federal do Rio Grande do Sul, Porto Alegre, 2018.

O objetivo deste estudo foi: (1) avaliar a resistência à fratura de dentes tratados endodonticamente após o preparo cervical e preparo do canal radicular e (2) avaliar o volume do canal radicular e a quantidade de dentina radicular remanescente antes e após o preparo cervical. Quarenta e quatro incisivos inferiores foram selecionados e submetidos a análise em micro tomografia computadorizada e distribuídos em 4 grupos (n = 11) de acordo com o instrumento utilizado no preparo cervical: Grupo controle - sem preparo cervical; Gattes Glidden - brocas tamanho # 2 e # 3; WXN – instrumento 25.07 e ProDesign S – instrumento 25.08. A abertura coronária foi realizada e os canais foram preparados com o Wave One Gold Primary. Os canais foram preenchidos com um cimento à base de resina epóxi e cones de guta-percha, restaurados com resina composta e nova análise em micro tomografia foi realizada. Todas as imagens foram reconstruídas e avaliadas quanto à espessura da dentina radicular mesial e distal antes e após a preparação e para o volume da porção cervical do canal após preparação. A resistência à fratura também foi avaliada. Os dados foram analisados usando ANOVA e teste de Tukey (P = 0,05). O preparo cervical e preparo do canal reduziu a espessura da dentina em todos os grupos (P > 0,05) e aumentou o volume do canal (P>0, 05). O preparo cervical com brocas Gates Gliden reduziu a resistência à fratura dentes tratados endodonticamente (P < 0,05). Todos os instrumentos reduziram a espessura de dentina e aumentaram o volume do canal no terço cervical em 5 mm. A broca Gattes Glidden tornou os incisivos mandibulares mais suscetíveis a fratura quando submetidos ao preparo cervical.

Palavras-chave: instrumentos NiTi, preparo cervical, micro-CT, resistência à fratura

ABSTRACT

DUARTE, Simone Feretti**. Influence of Preflaring and Root Canal Preparation on the Fracture Resistance of Endodontically treated teeth: a microCT study**. 2018. 32 f. Final paper(specialization) – Faculdade de Odontologia, Universidade Federal do Rio Grande d Sul, Porto Alegre, 2018.

The aim of this study were: (1) to evaluate the fracture resistance of endodontically treated teeth after cervical preflaring and root canal preparation and (2) to assess the volume of the root canal and the amount of remaining root dentin before and after cervical preflaring. Forty-four mandibular incisors were selected using micro- CT scanning and distributed into 4 groups (n = 11) according to the instrument used for cervical preflaring: Control group - no cervical preflaring; Gates Glidden – burs size #2 and #3; WXN – 25.07 Navigator instrument; and Easy – 25.08 ProDesign S instrument. Coronal opening was performed, and the canals were prepared with Wave One Gold Primary. Canals were filled with an epoxy-resin based sealer and gutta-percha cones, nrestored with composite resin and a new micro-CT scans were performed. All images were reconstructed and assessed for the thickness of mesial and distal root dentin before and after preparation and for the volume of cervical portion of the canal after preparation. Fracture resistance was also evaluated. The data were analyzed using ANOVA and Tukey's test (P=0,05). Cervical preflaring and canal preparation reduced the dentin thickness in all groups (P>0,05) and increased the canal volume (P>0,05). Cervical preflaring with Gates Gliden burs reduced the fracture resistance of endodontically treated teeth (P<0,05). All instruments reduced the dentin thickness and increased the canal volume in the cervical first 5 mm. Gates Glidden weakened mandibular incisors submitted to cervical preflaring.

Key Words: NiTi instruments, Cervical preflaring, micro-CT, fracture resistance.

SUMÁRIO

1 INTRODUÇÃO

A realização do tratamento endodôntico tem como principal objetivo o controle da infecção microbiana no interior dos canais radiculares e a modelagem do canal principal, propiciando uma obturação tridimensional e hermética, permitindo assim, a manutenção do dente em função na cavidade oral.

Embora os princípios gerais da endodontia permaneçam semelhantes desde 1826 (GROSSMAN, 1976), houveram grandes avanços em relação aos instrumentos, materiais e técnicas, com o objetivo de melhorar a qualidade do tratamento endodôntico. Recentemente, o preparo químico-mecânico dos canais radiculares é realizado com o uso de instrumentos a base de níquel-titânio, utilizados acoplados em motores elétricos, que funcionam tanto em movimento de rotação contínua, como em movimento reciprocante. A utilização desses sistemas tem aumentado significativamente a qualidade da modelagem do canal radicular, principalmente na instrumentação de canais curvos e atrésicos (JODWAY, HULSMANN, 2006), devido ao design, flexibilidade e memória elástica desses instrumentos (JODWAY, HULSMANN, 2006; KIM et al., 2010; STEWART et al., 2010).

Apesar dos avanços tecnológicos, algumas etapas do tratamento seguem sendo essenciais para a correta realização da terapia endodôntica. Independentemente do tipo de sistema utilizado para o preparo químico-mecânico, o preparo do terço cervical e médio dos canais radiculares deve ser realizado. Através desse procedimento, projeções de dentina são removidas da embocadura do canal radicular, permitindo assim, um acesso livre e reto aos canais radiculares, o que diminui a tensão dos instrumentos (CONSTANTE et al, 2007) e consequentemente, o risco de fratura e desvios durante o preparo do canal radicular. Além disso, o pré-alargamento também tem como objetivos criar um espaço suficiente para atuar como reservatório de substância irrigadora, remover a camada superficial da dentina infectada e modelar o canal de forma que facilite o selamento (PÉCORA et al, 2005).

Outra grande importância da realização do preparo cervical consiste na correta determinação do diâmetro anatômico da porção apical, o qual é tradicionalmente estabelecido de acordo com o calibre da primeira lima que se ajusta na região apical no comprimento de trabalho, através da sensibilidade tátil do cirurgião-dentista. Tan & Messer (2002) relataram que a realização do preparo do terço cervical e médio do canal radicular permitiu uma avaliação mais precisa do correto diâmetro apical, o que vai de acordo com outros autores

(LEEB et al, 1983; CONTRERAS, ZINMAN, KAPLAN, 2001; PÉCORA et al, 2005). No estudo de SCHIMITZ et al. (2008), em comparação com os grupos experimentais em que foram realizados o preparo cervical, o grupo que não recebeu o pré-alargamento apresentou maiores discrepâncias entre o tamanho real do canal e o diâmetro da lima apical inicial no comprimento de trabalho. Esses resultados são consistentes com estudos anteriores (CONTRERAS, ZINMAN, KAPLAN, 2001; TAN, MESSER, 2002; VANNI et al, 2005; PÉCORA et al, 2005; BARROSO et al, 2005).

Porém, autores citam que um desgaste excessivo da região cervical poderia reduzir a espessura da dentina para valores criticamente baixos e, dessa forma, aumentar a probabilidade de fraturas radiculares verticais (SORENSON, MARTINOFF, 1984; SEDGLEY, MESSER, 1992; PILO, CORCINO, TAMSE, 1998; PILO, TAMSE, 2000). Entretanto, estudos já foram realizados a fim de investigar a espessura da dentina residual após o preparo do terço cervical e ficou estabelecido que o diâmetro do canal, após o desgaste, não deve exceder um terço da largura da raiz, minimizando assim a deterioração das propriedades mecânicas da raiz (STERN, HIRSHFELD, 1973; TILK, LOMMEL, GERSTEIN, 1979; JOHNSON, SCHWARTZ, BLACKWELL, 1976; HUNTER, FEIGLIN, WILLIAMS, 1989).

Existem no mercado diversos instrumentos indicados para a realização do pré-alargamento do terço cervical e médio dos canais radiculares e muitos deles já foram avaliados em estudos. Em 2003, Zuckermann et al. concluíram que o preparo cervical realizado com a broca Gates-Glidden nº 2 em canais radiculares de molares inferiores não provocou um desgaste excessivo na raiz, preservando assim a sua integridade mecânica. Mais recentemente em 2014, Flores et al. concluíram que as brocas Gates-Glidden nº3, Largo nº 2, LA-Axxess nº 1 e CPdrill forneceram um preparo cervical adequado do canais radiculares, o que vai de encontro com demais estudos (DUARTE et al, 2011; PINTO et al, 2016). Além disso, enfatizaram que a análise da anatomia do canal radicular e dos instrumentos disponíveis no mercado quanto à sua forma, capacidade de corte e uso, é importante para selecionar o instrumento adequado para a realização do preparo cervical dos canais.

Apesar de um grande estudo epidemiológico apresentar uma taxa de 97,1% de sobrevivência a longo prazo de dentes tratados endodonticamente (SALEHRABI; ROTSTEIN, 2004), as fraturas radiculares continuam a ser importantes causas de extrações de dentes tratados endodonticamente (ZADIK et al, 2008; TOURÉ et al, 2011). Embora possam ocorrer de forma repentina, decorrentes de traumas dentais mais severos, as fraturas

radiculares também tem sido associadas à tratamentos endodônticos prévios. A redução da estrutura dentária e o efeito da desidratação sobre os túbulos dentinários há muito tempo tem sido considerados como as principais razões associadas a maior fraqueza e fragilidade de dentes tratados endodonticamente (HEIFER; MELNICK; SCHILDER, 1972; TIDMARSH, 1976).

Sendo assim, devido à escassez de estudos que comprovem a relação entre o preparo do terço cervical e médio dos canais com a ocorrência de fraturas verticais, o objetivo desse estudo é avaliar a influência da realização do preparo cervical na resistência à fratura de dentes tratados endodonticamente.

2 ARTIGO CIENTÍFICO

Introduction

All the current advances in Endodontics aimed to improve the quality of the root canal treatment and the clinical success rates. Nickel-titanium rotary and reciprocating instruments enabled better canal shaping, especially in curve and narrow root canals, because their design and flexibility (1).

Independently of the rotary or reciprocating system used for root canal preparation, the cervical preflaring has been performed. Cervical preflaring assumes particular importance because it minimizes the occurrence of operative accidents (2), reduces apical extrusion of debris (3), removes dentin interferences and allows free and straight access to the instrument along the working length (4). For consequence, the risk of fracture of the file and apical deviations are minimized (5,6). Furthermore, after cervical preflaring, the working length and the apical diameter can be established more accurately (7,8).

Root fractures can be originated after dental trauma or endodontic procedures such as chemomechanical preparation, filling techniques or retreatment procedures (9). Excessive cervical preflaring will reduce the dentin thickness leading to a higher risk of root fracture (10). Endodontically treated teeth can present a survival rate of 97.1% (11) but root fractures are the main causes of extraction (12). Some studies have assessed the influence of the thickness of dentinal walls after cervical preflaring and established that canal diameter at the cervical third must not exceed one third of the root width (5).

Several instruments are available in the market to perform the cervical preflaring. Traditionally, Gates Glidden, Largo, and LA Axxess burs have been employed for this purpose. A recent study associated Gates Gliden burs to higher incidence of dentin cracks in comparison with some NiTi systems used for cervical preparation (9). Thus, some authors did

not recommend cervical preflaring with these burs, once several NiTi instruments have been used in a crown-down approach (13).

Therefore, the aims of this study were: (1) to evaluate the fracture resistance of endodontically treated teeth submitted to cervical preflaring using different instruments and (2) to assess the volume of the root canal and the amount of remaining root dentin in the 3 mm and 5 mm below the enamel-cement junction after cervical preflaring and canal preparation. The null hypothesis was that there would be no difference regarding the volumes of the root canals, amount of remaining dentin and fracture resistance among the groups.

Materials and Methods

Sample selection and ethical aspects

This study was submitted and approved by Research Ethics Committee of Federal University of Rio Grande do Sul, Porto Alegre, Brazil (#68322017.8.0000.5347).

Forty-four human mandibular incisors were selected and stored in distilled water at room temperature until their use in this study. Digital radiographs were performed to evaluate if all teeth met the inclusion criteria. Teeth with complete root formation, absence of root curvature or dentin cracks/fractures, only one canal, no previous endodontic treatment or root resorption were included.

A baseline micro-CT scan was performed using a desktop X-ray microfocus CT scanner (SkyScan 1174v2; Bruker-microCT, Kontich, Belgium). The scanning procedures were performed using the following parameters: 50 kV X-ray tube voltages, 800 μA anode current and voxel size of 14.4 μA. Only one specimen was scanned at a time. Scans with 1304x1024 pixels were obtained with acquisition intervals of 1° over a total of 360° rotation.

Thus, data were recorded, and the sequences of scans were reconstructed using the NReconv1.6.4.8 (NRecon v.1.6.3; Bruker-microCT) software.

Root canal preparation and filling

Coronal opening was performed as usual using #1014 diamond burs (Fava Metalúrgica, São Paulo, Brazil) under water cooling. Next, the canals were negotiated with #10 and #15 K-files (Dentsply Maillefer, Ballaigues, Switzerland) until their tips were visualized at the apical foramen. These measures were recorded, and the working lengths (WL) were established as being 1mm shorter of this measure.

All teeth were randomly divided into four groups (n=11) according to the instrument used for cervical preflaring: Control group - canals were prepared but with no cervical preflaring; Gates Glidden group – burs size #2 and #3 (Dentsply Maillefer, Ballaigues, Switzerland); WXN group – 25.07 instrument (Navigator; MEDIN, Nové Město na Moravě, Czech Republic); and Easy group – 25.08 instrument (ProDesign S; Easy Instrumentos Odontológicos, Belo Horizonte, Brazil).

Gates Glidden burs were installed on a low-speed handpiece operating at 12.000 rpm, and a straight up-and-down motion was used up to 5 mm from the canal opening. WXN and Easy instruments were mounted on an electric device operated at 350 rpm and torque of 2 N.cm. These instruments were used in an in-and-out motion.

After cervical preflaring, the canals were prepared with Wave One Gold Primary instruments (25.07) (Dentsply Maillefer, Ballaigues, Switzerland) in a reciprocating motion, using the speed and torque recommended by the manufacturer. Each instrument was used in five teeth. During canal preparation, the canals were irrigated with 5 mL of 2.5% of sodium hypochlorite (NaOCl) (Biodinâmica, Ibiporã, PR, Brazil) delivered with a syringe and 30-

gauge needle (NaviTip, Ultradent, South Jordan, UT, USA). The needle was inserted 3 mm shorter of the WL.

After the completion of preparation, the root canals were irrigated with 5 mL of 17% EDTA (Biodinâmica) for 3 minutes and 3 mL of 2.5% NaOCl. Next, the canals were dried using paper points. Root canal filling was performed using Tagger's Hybrid technique. Root canal filling was performed using Wave One Primary and FM gutta-percha cones (Dentsply Maillefer, Ballaigues, Switzerland).

The Wave One Primary gutta-percha cones were inserted into the canals to verify if they reach the WL and if they fit at the apical third. Subsequently, an epoxy-resin based sealer (Sealer Plus; MK Life, Porto Alegre, RS, Brazil) was mixed according to the manufacturer's instructions and placed in the canal using a lentulo spiral. Finally, the gutta-percha cone was slowly inserted into the canal until it reached WL. Next, Three FM gutta-percha cones were inserted passively. Finally, a McSpadden compactor #50 (Dentsply Maillefer, Ballaigues, Switzerland) was coupled to a low-speed contra-angle and introduced passively into the root canal 4 mm short of the WL with forward-backward movements.

The excess of gutta-percha was removed with a heated plugger, and the coronal opening was cleaned with ethanol (Biodinâmica). Next, the coronal opening was etched with 37% phosphoric acid for 30 seconds, rinsed with 2 mL of distilled water for 30 seconds and restored using adhesive system (Scotchbond; 3M ESPE, Saint Paul, MN, USA) and nanoparticulated composite resin (Filtek™ Z-350; 3M ESPE). The restorative procedures were performed using the incremental filling technique. Each increment was light-cured for 40 seconds using a LED light source (Radii-cal, SDI, Bayswater, VC, Australia) with a power of 1200mW/cm^2.

All instrumentation and root canal filling procedures were performed by one single experienced operator and trained to use the instruments.

Analysis of root canal enlargement and dentin thickness

A new micro-CT scan was performed as described before and the reconstructed images obtained pre and post-preparation were geometrically co-registered with the preoperative data sets using the DataViewer software v.1.5.2 (Bruker-microCT), allowing quantitative comparison of the morphological parameter before and after preparation. For this step, the CTan v.1.12 software was used to evaluate the root canal volume and the dentin thickness pre and post root canal preparation in the cervical portion. The dentin thickness (mm) was evaluated at 3 mm and 5 mm from the cement-enamel junction and the canal volume (mm^3) only in the first 5 mm.

Fracture resistance test

After restoration, the simulation of periodontal ligament was performed by teeth immersing in melted wax (Horus; Herpo ProdutosDentários, Petrópolis, RJ, Brazil) up to 1 mm below to the cementoenamel junction (14). After cooling, a 0.2 mm + 01 mm thick wax layer was obtained by coating the roots. Next, the specimens from all of the groups were embedded in plastic cylinders (16.5 mm inner diameter X 20 mm high) filled with a chemically cured acrylic resin (Dencrilay, Dencril, SP, Brazil) using the following steps: a) the specimen was fixed on a parallelometer, with the long axes of the teeth and cylinder parallel to each other and perpendicular to the ground, and b) the acrylic resin was prepared and poured inside the cylinder up to 1 mm below the cementoenamel junction.

After resin polymerization, the wax was removed from the root surface and the resin cylinder ‘sockets’ by using warm water for 2 seconds. The resin cylinders were filled with a polyether impression material (ImpregumTM Soft, 3M ESPE) using a molding syringe. The teeth were re-inserted into their respective cylinder ‘sockets’, and any excess impression material was removed with a number 12 scalpel blade.

Fracture resistance tests were performed 48h after removal of impression material. During this period, the specimens were kept in distilled water at 37°C. Compressive loads were applied using a universal testing machine (EMIC DL 2000/700; São José dos Pinhais, PR, Brazil) at a crosshead speed of 0.5 mm/min, applied on the palatal aspect of specimens at 135° along the long axis of the tooth.

Statistical Analysis

The normality of the data was assessed by Shapiro Wilk Test. The two-dimensional and three-dimensional parameters were compared between and within groups using ANOVA and Tukey’s test ($P < .05$). The fracture resistance values were subjected to 1-way ANOVA and Tukey post-hoc tests. Statistical analysis was performed at a significance level of 5%.

Results

Table 1 shows the means and standard deviations of dentin thickness, volume of root canal (mm^3) of the first 5 mm below the cement-enamel and fracture resistance.

The dentin thickness presented at baseline was similar in all groups at 3 mm and 5 mm, both for the mesial and distal portion in the cervical third ($P > .05$). Root canal

preparation reduced the dentin thickness at 3 mm and 5 mm both in the mesial and distal portion of the root canal ($P < .05$).

The canal volume, up to the fourth millimeter below the enamel-cement junction, at baseline was similar in all groups ($P > .05$). Canal preparation with a 25.07 instrument significantly enlarged the canal space up to the fourth millimeter below the enamel-cement junction ($P < .05$) but with no differences among the groups.

The Gates Glidden group presented the lower fracture resistance values ($P < .05$). WXN, Easy, and Control groups showed similar fracture resistance ($P > .05$).

Discussion

Traditional endodontics therapy makes the controlled removal of tooth structure beyond getting access to the root canal to facilitate cleaning, shaping, root canal filling and to prevent procedural complications (15). The access of pulp chamber, along the chamber walls, and around canal orifices, may weaken the resistance of the tooth to fracture under functional loads (16). Micro-CT scanning was used for sample selection, dentin thickness evaluation, and cervical canal volume. This non-invasive method is considered gold-standard for these outcomes once it permits analyses before and after treatment, reconstruction in two and three dimensions and high level of accuracy and detailing (17).

Cervical preflaring previously to the root canal preparation consists in a controversial subject. De Deus et al. (18) assess the frequency in which the Reciproc instrument reaches the full working length of mandibular molar canals without a glide path or cervical preflaring. The R25 Reciproc instrument was able to reach the WL of straight- and moderate-curved mandibular molar canals without a glide path in a significant proportion of

cases. On the other hand, previous studies confirmed that better apical diameter (7,19,20) and WL determination (21,22) are achieved when cervical preflaring is performed.

This study used mandibular incisors because they present mesiodistal flattening which may lead to thin dentin layers after cervical preflaring and canal preparation. And as a consequence, lower fracture resistance values would be obtained. Three instruments were used for cervical preflaring: Gates Glidden, WXN 25.07 and Easy 25.08. The use of Gates-Glidden burs sizes #2 and #3 with a 0.7 mm and 0.9mm diameter, respectively, was determined based on previous studies that have also used these diameters to promote cervical preparation (24,25). WXN (25.07) and Easy (25.08) NiTi instruments were used in continuous rotary motion to prepare the cervical third of the root canals. WXN is one of the files from a six-instrument blister which has a triangular section and an inactive tip. This system provides constant taper throughout the sequence of instruments used. Easy Pro Design S instruments present triple helix and thermal treatment to optimize their mechanical properties and also to promote controlled-memory (1).

The mean dentin thickness observed before cervical preflaring was 1.45 mm, 1.31 mm, 1.41 mm and 1.32 mm in the third and five millimeters of the distal and mesial portion, respectively. After cervical preflaring and root canal preparation, there was no difference in canal volume and in remaining mesial and distal root dentin between the groups ($P > .05$). Thus, the first null hypothesis was confirmed. These results occurred due to the dimensions of instruments/bur used in each group, which promoted similar wear in the inner part of the canal.

Root canal anatomy and instrument features must be taken into account when cervical preflaring will be performed (24). The Gates Glidden #2 did not significantly decrease the residual dentin thickness in the coronal third of mandibular molars, preserving their

mechanical integrity (25). Recently, Flores et al. (23) concluded that Gates Glidden #3 provided adequate cervical preparation of the root canals. All these findings are in accordance with other studies which also evaluated remaining dentin thickness/walls after cervical preflaring (24).

However, none of these studies evaluated the impact of cervical preflaring or the instrument used for this purpose on the fracture of resistance of endodontically treated teeth. The present study assessed this outcome and rejected the null hypothesis. The fracture resistance of teeth submitted to cervical preflaring using Gates Glidden #2 and #3 was lower than those prepared WXN 25.07, Easy 25.08 or with no cervical preparation (control group) ($P < .05$). Instead, the tapered and continuous format of NiTi instruments, Gates Glidden burs have an hourglass format which may explain these unfavorable results because they did not enable uniform load distribution along the root canal walls. More finite element analysis (FEA) studies must be performed to confirm the relationship between the hourglass format promoted by Gates Gliden burs and the stress distribution along the canal walls of preflared teeth. Until now, FEA studies indicate that the access cavity preparation had the greatest influence on tooth strength whilst canal enlargement did not contribute to this process substantially (26,27).

Conclusion

Based on the results, it can be concluded that NiTi instruments did not weakened mandibular incisors when used for cervical preflaring, but Gates Gliden burs did. All instruments promoted similar reduction of dentin thickness and increasing in the canal volume at the cervical first 5 mm.

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Table 1 – Mean and standard deviation (mean ± SD) of dentin thickness measured before and after cervical preparation in each group (mm) at 3 mm and 5 mm below the cement enamel junction, volume of root canal (mm^3) of the first 5 mm below the dentine enamel-dentin junction before and after root canal preparation and fracture resistance.

	3 mm Distal		3 mm Mesial		5 mm Distal		5 mm Mesial		Volume		Fracture resistance
	Before	After	Before	After	Before	After	Before	After	Before	After	
Control	1.39 ^{a} (±0.15)	1.09 ^{b} (±0.17)	1.32 ^{a} (±0.18)	1.12 ^{b} (±0.14)	1.32 ^{a} (±0.14)	1.06 ^{b} (±0.16)	1.32 ^{a} (±0.16)	1.07 ^{b} (±0.13)	1.37 ^{a} (±1.11)	3.11 ^{b} (±1.08)	581.12 N ^{A} (±117.13)
Gates	1.39 ^{a} (±0.22)	1.17 ^{b} (±0.18)	1.36 ^{a} (±0.17)	1.16 ^{b} (±0.22)	1.24 ^{a} (±0.19)	1.06 ^{b} (±0.21)	1.21 ^{a} (±0.14)	1.02 ^{b} (±0.14)	1.34 ^{a} (±0.41)	2.61 ^{b} (±0.56)	404.59 N ^{B} (±54.46)
WXN	1.45 ^{a} (±0.21)	1.24 ^{b} (±0.29)	1.51 ^{a} (±0.25)	1.25 ^{b} (±0.31)	1.31 ^{a} (±0.15)	1.11 ^{b} (±0.18)	1.37 ^{a} (±0.22)	1.15 ^{b} (±0.27)	1.90 ^{a} (±0.70)	3.16 ^{b} (±0.94)	551.47 N ^{A} (±112.83)
Easy	1.57 ^{a} (±0.15)	1.23 ^{b} (±0.17)	1.46 ^{a} (±0.13)	1.09 ^{b} (±0.12)	1.39 ^{a} (±0.18)	1.07 ^{b} (±0.13)	1.39 ^{a} (±0.22)	1.03 ^{b} (±0.15)	1.65 ^{a} (±0.51)	3.01 ^{b} (±0.58)	521.44 N ^{A} (±86.37)

Footnote: Different small letters denote differences in pre- and post- microCT images and after fracture resistance test (α = 0.05%). Capital letters compare the groups after fracture resistance test (One-way NOVA and Tukey test). The significance level was set at 5%.

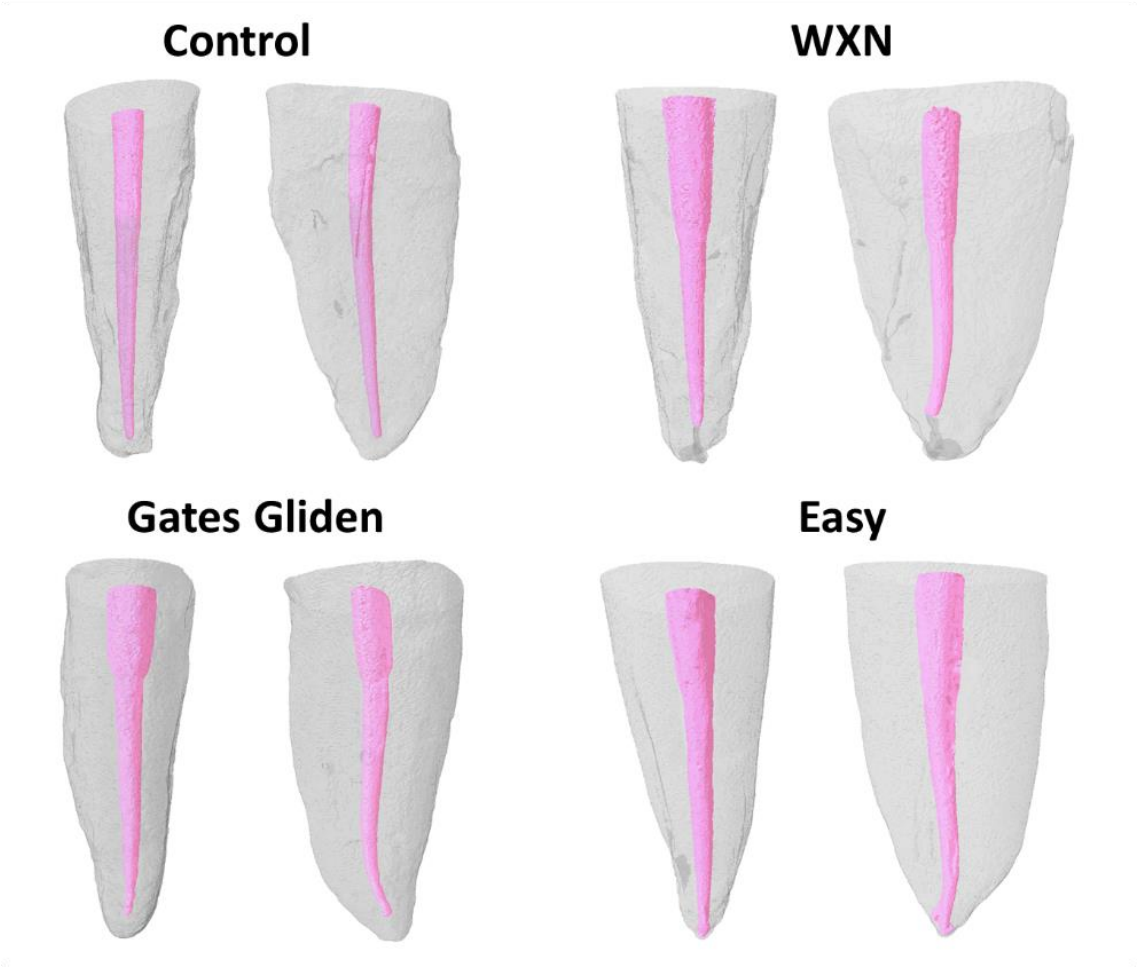

Fig. 1 – Micro-CT scans after cervical preflaring and root canal preparation. Note the hourglass format of the canal in the cervical third of Gates Gliden group.

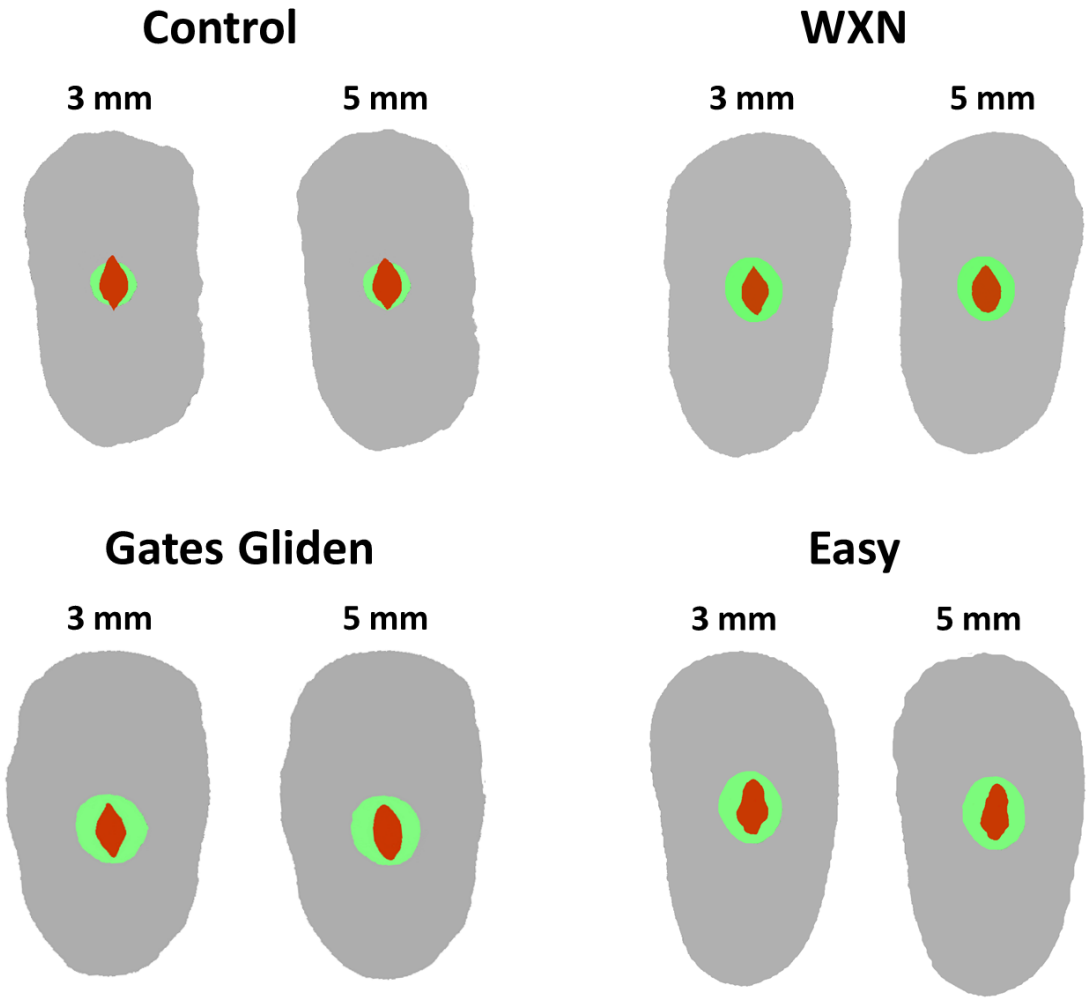

Fig. 2 Illustrative micro-CT scans of preparations produced by the tested instruments in 3 mm and 5 mm from the cement-enamel junction.

3 CONSIDERAÇÕES FINAIS

A fratura radicular vertical é um evento indesejável e que frequentemente acomete os dentes tratados endodonticamente. A etiologia das fraturas radiculares verticais está associada a aspectos multifatoriais entre os quais podemos destacar: forças oclusais, bruxismo, perdas de estruturas dentárias (cristas marginais), extensos preparos cavitários e desgastes excessivos do terço cervical das raízes, principalmente relacionados a procedimentos protéticos.

Diversos instrumentos são utilizados para a realização da etapa do preparo cervical, antecedendo ao preparo do canal, dentre eles destacam-se instrumentos acionados por micromotor tais como brocas especiais (Gates-glidden, Largo, LA Axxess) e outros por motor elétrico como os instrumentos de Ni-Ti (Orifice shapers)

O preparo do terço cervical dos canais radiculares é fundamental durante o processo do tratamento endodôntico. Entretanto, acredita-se que um desgaste excessivo da região cervical poder reduzir tanto a espessura da dentina e, dessa forma, favorecer o aparecimento de fraturas radiculares verticais. Contudo, não existe evidências científicas que apontem em que grupos dentais e com que instrumentos tal fato poderia acontecer.

Com base nos resultados obtidos neste estudo, foi possível concluir que os instrumentos de NiTi utilizados para o preparo do terço cervical, não enfraqueceram os incisivos inferiores tratados endodonticamente. Em contrapartida, os dentes submetidos ao preparo cervical com as brocas Gates Glidden reduziram a resistência à fratura. Uma possível explicação seria o formato de ampulheta proporcionado pelas brocas Gates-Glidden, não permitindo uma distribuição uniforme de carga ao longo das paredes do canal radicular.

Os resultados deste estudo não põe fim as respostas necessárias para elucidação do tema, mas descortina um amplo campo de pesquisa, o qual oportunizará estudar os demais grupos dentais, e o cruzamento de outras variáveis capazes de influenciar os resultados.

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ANEXO A- PARECER SUBSTANCIADO DO CEP

UFRGS - PRÓ-REITORIA DE PESQUISA DA UNIVERSIDADE FEDERAL DO RIO GRANDE DO

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Influência do preparo cervical na resistência à fratura de dentes monorradiculares tratados endodonticamente

Pesquisador: Marcus Vinicius Reis Só

Área Temática:

Versão: 2

CAAE: 68322017.8.0000.5347

Instituição Proponente: Universidade Federal do Rio Grande do Sul

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 2.107.215

Apresentação do Projeto:

O projeto "Influência do preparo cervical na resistência à fratura de dentes monorradiculares tratados endodonticamente" é coordenado pelo Prof Marcus Vinícius Reis Só, da Universidade Federal do Rio Grande do Sul, e conta com a participação de Paula Barcellos da Silva.

Objetivo da Pesquisa:

Analisar, in vitro, a influência da realização do preparo cervical na resistência à fratura de dentes monorradiculares tratados endodonticamente.

Avaliação dos Riscos e Benefícios:

Riscos: De acordo com os autores, o risco associado ao estudo é a perda do sigilo e confidencialidade dos participantes doadores dos dentes, porém isso será evitado através do Termo de Consentimento Livre e Esclarecido, que ficará retido sobre responsabilidade do pesquisador responsável por um período de cinco anos. O risco da extração dentária dos dentes doados à pesquisa não está associado ao estudo, visto que os dentes foram indicados para a extração por outros motivos e não pela própria pesquisa a ser desenvolvida.

Benefícios: De acordo com os pesquisadores, o presente estudo não apresenta benefícios diretos aos participantes, o benefício ocorrerá de forma indireta através dos conhecimentos gerados acerca do desempenho e influência de instrumentos utilizados no preparo dos canais radiculares

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na resistência à fratura de dentes tratados endodonticamente.

Comentários e Considerações sobre a Pesquisa:

a) Delineamento: estudo experimental, in vitro, randomizado e controlado.

b) Procedimentos experimentais: descritos de forma detalhada, e serão realizados nos dentes após a sua extração.

c) Análise de dados: foi apresentada.

d) Critérios de inclusão: dentes incisivos inferiores extraídos de pacientes com idade entre 18 e 60 anos.

e) Critérios de exclusão: dentes com formação radicular incompleta, dilaceração radicular, tratamento endodôntico prévio, reabsorções dentárias externas e internas e presença de fraturas ou trincas radiculares,e extensa calcificação no canal radicular serão excluídos.

f) Tamanho amostral: justificado por meio de cálculo estatístico.

g) Número de participantes: 40. Serão obtidos 40 incisivos inferiores humanos que serão divididos em 4 grupos (Controle, Gattes Glidden, LA Axxess e K3).

h) Orçamento: Presente.

i) Cronograma: Início 09/05/2017 e fim em 28/02/2018. Data prevista para início dos experimentos é 10/07/2017.

Considerações sobre os Termos de apresentação obrigatória:

a) Termo de Consentimento Livre e Esclarecido – ver pendências.

b) Termo de doação de dentes – adequado.

c) Orçamento - ver pendências

Conclusões ou Pendências e Lista de Inadequações:

Os pesquisadores responderam aos questionamentos encaminhados em diligência anterior.

a) Os pesquisadores devem indicar qual o critério de inclusão relativo aos indivíduos que poderão ser recrutados e que, em concordando, realizarão a doação dos dentes (por exemplo: idade dos pacientes): pacientes com idade entre 18 a 60 anos, que tiverem dentes indicados para extração, conforme descrito no plano de tratamento odontológico.

b) Os pesquisadores indicaram que os pacientes serão recrutados nas Clínicas Odontológicas da Faculdade de Odontologia, após a extração dental.

c) O montante de recursos a ser empregado no projeto foi compatibilizado nos diferentes documentos.

d) Os pesquisadores indicaram que não haverá armazenamento de dentes ou de parte do dente em

banco, para a realização de pesquisas futuras.

Os pesquisadores não incluíram a nova descrição dos critérios de seleção no Formulário da Plataforma Brasil. Consideraram-se para aprovação do projeto os critérios de seleção presentes no corpo do projeto.

Considerações Finais a critério do CEP:

Aprovado.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_917559.pdf	02/06/2017 11:00:19		Aceito
Outros	CARTA_RESPOSTA_AO_CEP.pdf	02/06/2017 10:59:29	Marcus Vinicius Reis Só	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.pdf	02/06/2017 10:59:06	Marcus Vinicius Reis Só	Aceito
Projeto Detalhado / Brochura Investigador	PROJETO.pdf	02/06/2017 10:58:56	Marcus Vinicius Reis Só	Aceito
Orçamento	ORCAMENTO.pdf	12/05/2017 09:46:40	Marcus Vinicius Reis Só	Aceito
Cronograma	CRONOGRAMA.pdf	12/05/2017 09:43:55	Marcus Vinicius Reis Só	Aceito
Folha de Rosto	folha_de_rosto.pdf	12/05/2017 09:42:38	Marcus Vinicius Reis Só	Aceito

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

PORTO ALEGRE, 08 de Junho de 2017

Assinado por:
MARIA DA GRAÇA CORSO DA MOTTA
(Coordenador)