UNIVERSIDADE FEDERAL DE PELOTAS

Faculdade de Odontologia

Programa de Pós-Graduação em Odontologia

Dissertação

Influência do material lubrificante e limpeza ou não do conduto radicular na resistência de união de pinos anatomizados

César Blaas Knabach

Pelotas, 2014

César Blaas Knabach

Influência do material lubrificante e limpeza ou não do conduto radicular na resistência de união de pinos anatomizados

Dissertação apresentada ao Programa de Pós-Graduação em Odontologia da Faculdade de Odontologia da Universidade Federal de Pelotas, como requisito parcial à obtenção do título de Mestre em Odontologia, área de concentração, Prótese Dentária.

Orientador: Prof. Dr. Rogério de Castilho Jacinto.
Co-orientadora: Profª. Drª. Tatiana Pereira-Cenci.

Pelotas, 2014

Universidade Federal de Pelotas / Sistema de Bibliotecas
Catalogação na Publicação

K67i Knabach, César Blaas

Influência do material lubrificante e limpeza ou não do conduto radicular na resistência de união de pinos anatomizados / César Blaas Knabach ; Rogério de Castilho Jacinto, orientador ; Tatiana Pereira Cenci, coorientadora. — Pelotas, 2014.

29 f.

Dissertação (Mestrado) — Programa de Pós-Graduação em Prótese Dentária, Faculdade de Odontologia, Universidade Federal de Pelotas, 2014.

1. Técnica para retentor intrarradicular. 2. Materiais dentários. 3. Cimentos de resina. I. Jacinto, Rogério de Castilho, orient. II. Cenci, Tatiana Pereira, coorient. III. Título.

Black : D3

Elaborada por Fabiano Domingues Malheiro CRB: 10/1955

César blaas Knabach

Influência do material lubrificante e limpeza ou não do conduto radicular na resistência de união de pinos anatomizados

Dissertação aprovada, como requisito parcial, para obtenção do grau de Mestre em prótese dentária, ao Programa de Pós-Graduação em Odontologia, Faculdade de Odontologia, Universidade Federal de Pelotas.

Data da Defesa: 07.07.2014

Banca examinadora:

Prof. Dr. Rogério de Castilho Jacinto (Orientador)
Doutor em Odontologia pela Universidade Estadual de Campinas.

Profª. Drª Noéli Boscatto
Doutora em Clínica Odontologia pela Universidade Estadual de Campinas.

Prof. Dr. Francisco Montagner
Doutor em Clínica Odontológica pela Universidade Estadual de Campinas.

Profª. Drª. Francine Madruga (suplente)

Resumo

KNABACH, César Blaas**. Influência do material lubrificante e limpeza ou não do conduto radicular na resistência de união de pinos anatomizados.** 2014. 29f. Dissertação (mestrado em Odontologia, área de concentração, Prótese Dentária) - Programa de Pós-graduação em Odontologia, Faculdade de Odontologia, Universidade Federal de Pelotas, Pelotas, 2014.

Pinos anatomizados são normalmente indicados para dentes com canais amplos e paredes fragilizadas, os quais necessitam de pinos intrarradiculares como auxiliares na retenção do material restaurador. Para confecção dos pinos anatomizados a utilização de um isolante no canal radicular é necessária. Por isso, o objetivo deste estudo foi avaliar a influencia do material lubrificante utilizado no canal para a preparação do pino e da limpeza ou não do canal previamente a cimentação, na força de adesão de pinos anatomizados cimentados com cimento resinoso. Oitenta incisivos bovinos foram obturados, o espaço para o pino foi confeccionado e então os dentes foram divididos em quatro grupos (n=20) dependendo do protocolo usado para o isolamento e limpeza do canal durante a preparação do pino anatomizado: Vaselina sólida sem limpeza (VS); Vaselina sólida e limpeza com cones de papel (VSL); Gel hidrossolúvel sem limpeza (GH); e Gel hidrossolúvel e irrigação com água destilada e secagem com cones de papel (GHL). Os pinos anatomizados com resina composta foram cimentados com um cimento resinoso convencional. Cada raiz foi cortada transversalmente produzindo fatias de 1,5mm de espessura, então o teste push-out para força de adesão foi feito. Os dados foram analisados estatisticamente pelos testes one-way ANOVA e Tukey post-hoc (α=0,05). Diferenças estatisticamente significantes foram observadas entre os materiais usados para o isolamento do canal ($p<0,001$), o uso do gel hidrossolúvel mostrou maiores valores de força de adesão (GH: 4,068 ± 0,720; GHL: 4,426 ± 0,877) que a vaselina sólida (VS: 2,922 ± 0,431; VSL: 3,250 ± 0,751) independentemente da limpeza ou não após o preparo do pino e previamente a cimentação. Diferenças não foram encontradas entre limpar ou não o conduto quando o mesmo lubrificante foi utilizado. O material lubrificante influenciou na força de adesão de pinos anatomizados, enquanto a remoção do lubrificante previamente a cimentação dos pinos anatomizados parece não afetar na força de adesão.

Palavras chave: técnica para retentor intrarradicular; materiais dentários; cimentos de resina

Abstract

KNABACH, César Blaas. Influence of lubricant material and cleaning or not the root canal in the bond strength of anatomized posts. 2014. 29f. Dissertation (Master degree in Dental Prosthesis) – Programa de Pós-graduação em Odontologia, Faculdade de Odontologia, Universidade Federal de Pelotas, Pelotas, 2014.

Anatomized posts are currently indicated for teeth with wide canals and thin walls, which requires intraradicular posts as retention auxiliary for the restorative material. For the anatomized posts confection a lubricant of the canals walls is needed. Therefore, the aim of this study was to evaluate the influence of the lubricant material used in the root canal preparation and cleaning or not previously cementation on the bond strength of anatomized posts cemented with resin-based cement. Eighty bovine incisors were obturated, post spaces were prepared and the teeth were divided into four groups depending on the protocol used for lubrication of the canal during anatomized post preparation: petrolatum gel without cleaning (PG); petrolatum gel followed by cleaning with paper points (PGC); hydrosoluble gel without cleaning (HG); and hydrosoluble gel followed by cleaning with water irrigation and drying with paper points (HGC). Anatomized posts relined with composite resin were luted with conventional resin cement. Each root was sectioned transversally producing1.5mm thick slices, and the push-out bond strength test was performed. Data were analyzed by one-way ANOVA followed by Tukey post-hoc test (α=0.05). Statistically significant differences were observed between the materials used for lubrication of the canal ($p<0.001$), the use of hydrosoluble gel showing higher bond strength (HG: 4.068 ± 0.720; HGC: 4.426 ± 0.877) than petrolatum gel (PG: 2.922 ± 0.431; PGC: 3.250 ± 0.751) regardless of cleaning the canal after lubrication and prior to the post cementation. Differences did not found between cleaning or no, when the same lubricant was used. The lubricating technique affected the bond strength of anatomized posts, while the removal of the lubricant prior to the anatomized post cementation does not seem to affect the bond strength.

Keywords: post and core technique; dental cements; lubricants

Sumário

1 Introdução

Dentes com amplas destruições coronárias geralmente levam à necessidade do uso de retentores intrarradiculares como auxiliares na retenção do material restaurador, seja ele direto ou indireto (Skupien, 2014). Diferentes tipos de pinos podem ser empregados como retentores intraradiculares, dentre eles os mais estudados são os pinos metálicos fundidos e os pinos pré-fabricados de fibra de vidro (Zhou e Wang, 2013).

Os pinos de fibra de vidro possuem maior estética (Giachetti et al., 2009), menor custo e exigem menor número de consultas clínicas quando comparado aos pinos metálicos fundidos, o que possibilita a redução do tempo de tratamento. Adicionalmente, possuem módulo de elasticidade similar à dentina, o que proporciona dissipação de forças sob o stress da carga mastigatória (Silva et al.,2009). Além disso, quando o caso em questão são dentes com canais amplos e/ou paredes fragilizadas, a utilização de pinos de fibra de vidro parecem ser melhor indicados (Wandscher et al., 2014), uma vez que as falhas, quando ocorrem, geralmente são mais facilmente reparáveis (Santos-Filho et al., 2014). Porém, há a dificuldade dos pinos de fibra de vidro ficarem bem adaptados em canais amplos, o que resulta em uma linha de cimentação muito ampla, reduzindo a força de adesão do conjunto pino/cimento (Gomes et al., 2014). Portanto, para esses casos a indicação de pinos anatomizados, seja com resina composta somente ou associado a pinos acessórios parece ser a melhor opção (Da Silva et al., 2008).

A cimentação segue sendo uma preocupação, pois ainda é a principal causa de falhas em pinos intraradiculares (Rasimick et al., 2010), principalmente em cimentação resinosa. Diversos fatores podem interferir na adesão desses cimentos às paredes do canal, como a utilização de cimentos endodônticos à base de óxido de zinco e eugenol (Demiryürek et al., 2010) irrigantes endodônticos como o hipoclorito de sódio (Renovato et al., 2013) durante o tratamento endodôntico. Adicionalmente a técnica de confecção dos pinos anatomizados requer a utilização de um material isolante no conduto radicular para que esse possa ser removido do interior do canal, fotopolimerizado e posteriormente cimentado. Dentre os lubrificantes conhecidos, os mais utilizados são a vaselina sólida (Marchi et al.,

2008) e o gel hidrossolúvel (Wandscher, 2014; Iglesia-Puig, 2004; Zogheib, 2011). Entretanto, até o momento não há trabalhos avaliando a influência desses materiais isolantes na resistência de união de pinos anatomizados cimentados com cimento resinoso.

1.1 Objetivos

Avaliar a influência do material isolante utilizado no preparo de pinos anatomizados na força de adesão desses pinos quando cimentados com cimento resinoso.

Avaliar a influência do método de limpeza do canal radicular após confecção dos pinos anatomizados na força de adesão desses pinos quando cimentados com cimento resinoso.

1.2 Hipótese

A hipótese nula a ser testada é que o material lubrificante utilizado na confecção dos pinos anatomizados e a limpeza do conduto radicular previamente a cimentação desses pinos influenciarão na força de adesão.

2 Projeto de pesquisa

2.1 Aquisição dos espécimes

Para este estudo in vitro serão utilizados 80 incisivos centrais superiores humanos obtidos através do banco de dentes do PET-odonto da Faculdade de Odontologia da UFPEL (FO-UFPEL) mediante termo de doação estabelecido pela mesma. Estes dentes foram submetidos à extração devido a diversos fatores não conhecidos e não relacionados a presente pesquisa e armazenados em Timol a 2% até o início do estudo. Dentes com raízes curvas, canais atrésicos, ápices abertos, fraturas radiculares ou tratamentos endodônticos prévios não serão incluídos no estudo.

2.2 Preparo dos espécimes

Os remanescentes de tecidos moles serão demovidos das raízes com auxílio de instrumentos manuais (SS White, Duflex, Rio de Janeiro, Brasil) e irrigação com água destilada. A porção coronária será removida 16 mm acima do ápice radicular usando um disco diamantado dupla face (KG Sorensen, Barueri, Brasil) e o comprimento de trabalho (CT) será estabelecido a 1 mm do ápice. Todos os canais serão instrumentados manualmente utilizando limas tipo K(Dentsply/Maillefer, Ballaigues, Suíça) pela técnica coroa-ápice até o diâmetro #40 no CT. Brocas largo 4 e 3 (Dentsplymaillefer, Petrópolis, Rio de Janeiro, Brasil), gates-glidden 4-2 (Dentsplymaillefer, Petrópolis, Rio de Janeiro, Brasil) serão utilizadas para o preparo do terços cervicais e médio. Durante a instrumentação, os canais serão irrigados com hipoclorito de sódio a 2,5% (ASFER, São Caetano do Sul, São Paulo, Brasil). A irrigação final será feita com 3ml de solução de EDTA 17% (Biodinâmica, Ibiporã, Paraná, Brasil) por 3 minutos seguido por irrigação com 5ml de água destilada.

Os canais serão secos com cones de papel absorvente (Tanari, Manacapuru, Amazonas, Brasil) e então obturados usando cimento endodôntico a base de hidróxido de cálcio (Sealer 26; Dentsply, Konstanz, Germany) e condensação lateral dos cones de guta-percha (Dentsply maillefer, Petrópolis, Rio de Janeiro, Brasil). As raízes serão então armazenadas a 37°C com 100% de umidade por 1 semana. Os dentes já obturados serão inseridos em tubos de PVC de 18 mm de diâmetro por 15 mm de altura, preenchidos com resina autopolimerizável (Clássico Artigos Odontológicos, São Paulo, São Paulo, Brasil). Após, a guta-percha será removida utilizando brocas largo 2 (Dentsplymaillefer, Petrópolis, Rio de Janeiro, Brasil) e o espaço para o pino será padronizado utilizando a broca n°3 do kit de pinos (Exacto, Angelus, Londrina, PR, Brasil) para criar um espaço circular padrão em todos os espécimes, sendo de 11 mm de profundidade e 1,7 mm de diâmetro na embocadura. Após a preparação, o espaço do pino será irrigado com água destilada e seco com cones de papel absorvente.

2.3 Confecção dos pinos anatomizados

A confecção do pino anatomizado iniciará pela limpeza do pino de fibra de vidro com álcool 70°, secagem com jatos de ar, aplicação de silano (dentsply, Petrópolis, RJ, Brasil) com auxílio de microbrush Aplik (Angelus, Londrina, PR, Brasil), evaporação com jatos de ar, aplicação de adesivo de dois passos (adper single bond 2, 3MESPE, Sumaré, SP, Brasil), remoção dos excessos e evaporação do solvente com jatos de ar e fotopolimerização por 40 segundos.

As raízes serão então divididas aleatoriamente em quatro grupos de 20 cada de acordo com o material isolante e a técnica de limpeza do canal. O primeiro grupo será aplicado vaselina sólida como isolante e não será utilizado nenhum método de limpeza do canal após a confecção do pino anatomizado (Grupo VSSL); O segundo grupo utilizará vaselina sólida e limpeza com cones de papel (Grupo VSCP); no terceiro grupo será utilizado gel hidrossolúvel como isolante e não será realizado nenhum método de limpeza (Grupo GHSL) e no último grupo será utilizado gel hidrossolúvel e enxague com soro fisiológico como método de limpeza e secagem com cones de papel (Grupo GHSF).

Após o isolamento dos condutos será feita a inserção de resina composta Z350 XT (3MESPE, St Paul MN, EUA) até o preenchimento total do canal e posterior inserção do pino de fibra de vidro n°2 já preparado (Exacto, Angelus, Londrina, PR, Brasil), remoção do conjunto pino/resina composta do interior do canal e fotoativação do conjunto por 60 s. Será testada, então, a adaptação do pino anatomizado. Em seguida será feita limpeza ou não do canal radicular de acordo com o grupo testado.

Todos os pinos anatomizados serão limpos com álcool 70° anteriormente a cimentação.

2.4 Cimentação dos pinos anatomizados

Para cimentação será utilizado cimento resinoso Relyx ARC (3M ESPE, St Paul, MN, EUA). O protocolo de cimentação será iniciado pelo condicionamento ácido do pino anatomizado e do canal radicular por 30s e 15s, respectivamente. Logo, o sistema adesivo Single Bond (3MESPE, Sumaré, SP, Brasil) será aplicado no pino e no canal, seguido de jato de ar e remoção dos excessos de adesivo do interior do canal com cones de papel e fotopolimerização por 10s em ambos. O cimento será manipulado conforme indicações do fabricante e inserido no canal com seringa Centrix (DFL, Rio de Janeiro, Brasil). Após, o pino será mantido em posição por 5 min sobre pressão digital e por fim fotopolimerizado por 40 s em cada face.

2.5 Ensaio mecânico

Antes do teste mecânico todos os espécimes serão submetidos à termociclagem (5.000ciclos de 30 segundos a 5 e 55°C)(MCT2-AMM, Instrumental Ltda, São Paulo, SP, Brasil). A força de adesão será testada em uma Máquina de Ensaio Universal EMIC (modelo DL-1000, Equipamento e Sistemas Ltda., São José dos Pinhais, PR, Brasil) através do teste mecânico pull-out. O cilindro de PVC contendo o espécime será fixado à máquina de ensaios mecânicos, um mandril fixará a parte coronária do pino e exercerá um movimento no sentido oposto ao pino no seu longo eixo a uma velocidade constante de 0,5mm/min. A força máxima alcançada, a qual é necessária para deslocar o pino será anotada em Newton (N). Em seguida, a força de adesão será transformada para Mpa através da fórmula: F=R/A, onde F= força de deslocamento do pino (N), e A= área adesiva (mm2).

Para calcular a área, utiliza-se a fórmula A= π.g.(R1+R2) e π = 3.14, g =conicidade da raiz, R1 = raio da abertura radicular da face apical da raiz, R2 = raio da abertura radicular da face cervical da raiz. Para determinar a conicidade da raiz (g), utilizou-se a fórmula g=(h2 + (R2-R1)2)1/2, onde h= espessura da fatia21,1. As medidas de R1 e R2 serão obtidas a partir das fotografias e mensuradas no programa Image-J (Wayne Rasband; National Institute of Health, Bethesda, MA). A espessura das fatias (h) será medida com paquímetro digital. Um examinador cego quanto aos grupos executará o teste em uma máquina calibrada.

2.6 Análise estatística

Os resultados serão analisados estatisticamente conforme homogeneidade dos dados em programa de computador específico e utilizando-se nível de significância de 5%.

3 Relatório de campo

Diversas alterações metodológicas foram realizadas frente ao projeto de pesquisa previamente apresentado. Através de questionamentos realizados na qualificação do projeto pode-se focar na literatura atual e realizar as mudanças necessárias. Além disso, intercorrências durante a realização da pesquisa levaram a novas modificações na metodologia.

Em relação ao substrato dentário, houve dificuldade de obtenção de dentes humanos que preenchessem os pré-requisitos de inclusão no trabalho, principalmente no fato de que deveriam ser raízes longas, retas e com canais amplos. Assim, o substrato bovino mostrou ser um excelente substituto, uma vez que a disponibilidade não é um problema aliado a preencherem satisfatoriamente os pré-requisitos anteriormente mencionados. (Reis, 2004)

A segunda modificação no projeto inicial foi a termociclagem, que deixou de existir no trabalho final. Após discussão na qualificação do projeto, fez-se uma busca mais focada nesse tema e observou-se que a termociclagem não era unanimidade entre os estudos. Além disso, em estudos que compararam a adesão de pinos de fibra com e sem termociclagem não encontraram diferença estatística na maioria dos cimentos testados (Mazzitelli et al., 2012) (Bitter et al., 2006).

A terceira e última modificação, a troca do teste pull-out pelo teste push-out, ocorreu durante a realização do trabalho, por uma intercorrência na metodologia. Um estudo piloto realizado com dentes humanos orientou a metodologia da pesquisa, no qual se obteve sucesso. Nesse estudo piloto, os corpos de prova alcançaram forças em torno de 200N. Após a modificação para dentes bovinos, a força de adesão chegou ao redor de 400N, sem a remoção do pino anatomizado. Nessa faixa de força o pino de fibra de vidro rompia-se no limite cervical. Como todos os corpos de prova estavam prontos para o ensaio mecânico, as modificações possíveis de serem feitas não levaram ao sucesso do teste pull-out. Assim, suportado pela literatura, o teste push-out mostra-se a melhor opção uma vez que pela secção das raízes, influencias anatômicas são diminuídas, sendo possível a obtenção de força de adesão em espécimes individuais e obter a partir desses, o valor médio.

4 Artigo

Influence of lubricant material and cleaning or not the root canal in the bond strength of anatomized posts.

Short title: Bond strength of anatomized posts.

César Blaas Knabach[a]

[a] MSc Student, Graduate Program in Dentistry, Federal University of Pelotas, Pelotas, Brazil. cesarblaas@hotmail.com

Rafael Sarkis Onofre[b]

[b] PhD Student, Graduate Program in Dentistry, Federal University of Pelotas, Pelotas, Brazil. rafaelonofre@terra.com.br

Tatiana Pereira-cenci[c]

[c] Professor, Graduate Program in Dentistry, Federal University of Pelotas, Pelotas, Brazil. Tatiana.dds@gmail.com.br

Rogério de Castilho Jacinto[c]

[c] Professor, Graduate Program in Dentistry, Federal University of Pelotas, Pelotas, Brazil. rogeriocastilho@hotmail.com

Corresponding author:

Rogério de Castilho Jacinto

R. Gonçalves Chaves 457

Pelotas, RS, Brazil 96015-560

e-mail: rogeriocastilho@hotmail.com

Tel/Fax: 32256741

§ Artigo formatado para revista Journal of Dentistry.

Abstract

Influence of lubricant material and cleaning or not the root canal in the bond strength of anatomized posts

Objective: The aim of this study was to evaluate the influence of the lubricant material used in the root canal preparation and cleaning or not previously cementation on the bond strength of anatomized posts cemented with resin-based cement.

Methods: Eighty bovine incisors were obturated, post spaces were prepared and the teeth were divided into four groups depending on the protocol used for lubrication of the canal during anatomized post preparation: petrolatum gel without cleaning; petrolatum gel followed by cleaning with paper points; hydrosoluble gel without cleaning; and hydrosoluble gel followed by cleaning with water irrigation and drying with paper points. Anatomized posts relined with composite resin were luted with conventional resin cement. Each root was sectioned transversally producing1.5mm thick slices, and the push-out bond strength test was performed. Data were analyzed by one-way ANOVA followed by Tukey post-hoc test (α=0.05).

Results: Statistically significant differences were observed between the materials used for lubrication of the canal ($p<0.001$), the use of hydrosoluble gel showing higher bond strength (HG: 4.068 ± 0.720; HGC: 4.426 ± 0.877) than petrolatum gel (PG: 2.922 ± 0.431; PGC: 3.250 ± 0.751) regardless of cleaning the canal after lubrication and prior to the post cementation. Differences did not found between cleaning or no, when the same lubricant was used.

Conclusion: The lubricating technique affected the bond strength of anatomized posts, while the removal of the lubricant prior to the anatomized post cementation does not seem to affect the bond strength.

Keywords: post and core technique; dental cements; lubricants

Clinical Relevance: A long survival time of wide canals restored with anatomized posts requires a right technique of confection. This study brings to clinicians details which make difference on the bond strength of this kind of posts.

Introduction

Glass fiber posts were introduced in restorative dentistry as an alternative to cast posts. The use of this kind of post has increased in recent years due to their translucency, which improves aesthetic results (1). Fiber posts have been considered to be more appropriate in regard of stress distribution in endodontic treated teeth, as they possess elastic modulus similar to dentin, and therefore, provide a more homogeneous dissipation of loading stresses to the tooth/cement/post structure compared to more rigid posts (2). Moreover, fiberglass posts tend to be more a conservative choice (3).

One problem related to fiber posts is their adaptation to wide canals, because the space between the post and the canal walls result in the need of a thicker layer of cement. In addition, loss of retention remains a major mode of failure of nonmetal posts luted by resin cements with a bonding agent (4). Therefore, anatomized posts have been proposed to combine the elastic modulus, the well adaptation, and the esthetic results of fiber posts, allowing a better fit to wide canals. Anatomized posts associate glass fiber post with compound resin, providing an effective method of improving fracture resistance, and enhancing the repair of failures in flared root canals (5). Also, the thinner resin cement layer result less gap formation, consequently, higher bond strength (6, 7).

Debonding has been considered the most common cause of failure in the prefabricated posts (4). Many studies have evaluated the fracture resistance and the stress distribution of anatomized posts (8), but to our knowledge there are no previous study analyzing the bond strength of these posts. Furthermore, the anatomized post technique requires the canal lubrication to remove the post from the canal to be light cured previously to cementation. Although there is not clearly described in literature, when the canal lubrication is needed, petrolatum and hydrosoluble gel are the most common substance used by clinicians (8-10). However, until now, there are no studies evaluating the influence of these substances in the bond strength of anatomized posts. Therefore, the objective of this study was to evaluate the influence of lubricant materials and cleaning protocols of the canals on the bond strength of anatomized posts.

Materials and methods

Tooth preparation

Eighty single canal mandibular bovine incisors were used in the study. Teeth with canal calcification, open apices and curve roots were excluded. The teeth were cleaned using with periodontal curettes (SS White, Duflex, Rio de Janeiro, Brazil) and stored in 10% formalin. The teeth were decoronated at 16mm from the apex using slow-speed diamond disc (KG Sorensen, Barueri, Brazil) under water cooling. All of the root canals were endodontically instrumented by a single operator to the working length, 1 mm from the apex using crown down technique with K-type hand files (Dentsply/Maillefer, Ballaigues, Switzerland), until size #80. Irrigation was performed with 1% sodium hypochlorite solution after every change of file, 17% EDTA at the finishing instrumentation and distillated water rinse. Root canal spaces were dried using absorbent paper points (Tanari, Manacapuru, Amazonas, Brazil) prior to obturation with gutta-percha and Calcium Hydroxide-based cement (Sealer 26; Dentsply, Konstanz, Germany) using the lateral condensation technique. The roots were prepared for post placement beginning by removing 11mm of the coronal portion of the gutta-percha using a low-speed drill (Largo n°2, Dentsply maillefer, Petrópolis, Rio de Janeiro, Brazil) and adjustment of the root walls using a low speed drill from the post kit n°3 (Exacto, Angelus, Londrina, PR, Brazil).

Anatomized post preparation

All posts were cleaned in ethanol for 30 s, followed by a silane coupling agent (dentsply, Petrópolis, RJ, Brazil) for 60 s using a disposable brush, air-dried for 5 s, treated with a single-bottle adhesive (Adper Single Bond 2, 3MESPE, Sumaré, SP, Brazil) and light-cured for 40s (radii-cal, SDI, São Paulo, Brazil).

The roots were randomly divided into four groups (n=20) according to the lubricating material and the canal walls cleaning protocol. The number of specimens was used according to previously literature (Daleprane, 2014; Mesquita, 2013). Petrolatum gel (Farmax, Divinópolis, MG, Brazil) was used as lubricant and no cleaning method was performed (PG);, Petrolatum gel and cleaning with paper points (PGC); Hydrosoluble gel (KY, Johnson & Johnson, São josé dos campos, SP, Brazil) without cleaning (HG); Hydrosoluble gel with water rinse and drying with paper points (HGC).

After the lubrication of the canals with the substance determined for each group, the anatomized posts were made by a modified technique of the literature (Zogheib, 2011). They were filled with composite resin (Z350 XT, 3MESPE, St Paul MN, USA) followed by the insertion of the previously prepared post. Each post + resin was removed from the canal without light cured and light cured outside the canal for 60 s with 1250mW/cm2 of light energy (radii-cal, SDI). The adaptation of the anatomized posts in the canals was tested, and they were cleaned with ethanol before cementation procedures. The cleaning protocol was applied in the canals as appropriate

Cementation procedures

For cementation procedures, resin-based cement was used in all groups (Relyx ARC, 3M ESPE, St Paul, MN, USA). The cementation protocol was performed by the manufacturer's instructions. Each root canal wall and the anatomized post were etched with 35% phosphoric acid, for 15 and 30s, respectively. The canal walls were water rinsed and dried with paper points and the anatomized posts were water rinsed and air-dried. A small layer of single-bottle adhesive was applied (Adper Single Bond 2, 3MESPE, Sumaré, SP, Brazil) into the canal and on the anatomized post surface, followed by soft air jets for 10s and light cure for 10 s (canal) and 40 s (anatomized post) with 1250 mW/cm2 light energy. The resin-based cement was manipulated and inserted into the canals with a probe (n°5, Duflex, Rio de Janeiro, Brazil). Then, the anatomized posts were seated and kept into the canals with digital pressure for 5 minutes and finally light cured for 60s. The roots were maintained under 100% of humidity during all study.

Push-out test

The roots with the anatomized post cemented were sectioned into 1.5 mm-thick slices under water cooling (Isomet, Buehler Ltd., Lake Bluff, IL, USA) from crown to apex. Four slices from each root were obtained and subjected to push-out bond strength testing. The push-out load was applied using cylindrical plungers attached to a universal testing machine (EMIC - modelo DL-1000, Equipamento e Sistemas Ltda., São José dos Pinhais – Brazil). The apical surface of each slice was positioned facing the punch tip, so that the loading force was applied in an apical-coronal direction with a crosshead speed of 0.5 mm/ min until failure, or the anatomized post was dislodged from the root slice. Push-out bond strength was converted into megapascals (MPa) by dividing the load at failure in Newtons by the bonded surface area (SL) in mm2, where SL was calculated at the lateral surface of a truncated cone using the formula: $SL=\pi(R+r)[h2 +(R - r)2]^{0.5}$, where ‘R’ was the coronal post radius, ‘r’ was the apical post radius, and ‘h’ was the thickness of the slice. The largest and smallest diameters of the anatomized post and the thickness of the slice was individually measured using a digital caliper (série 799, Starrett, Itu, São Paulo, Brazil). It was performed the bond strength mean of each root and after the mean of the group.

<u>Statistical analyses</u>

The mean of the Mpa values were analyzed by a statistical package (STATA 10, stata corp) using one-way ANOVA and Tukey post-hoc test ($\alpha=0.05$).

Results

Table 1 shows the mean and SD of push-out bond strength values for the tested groups. There were statistically significant differences among the tested groups. HG and HGC presented higher bond strength values compared to PG and PGC ($p<0.001$). HG was also higher than PG and PGC ($p<0.001$ and $p=0.004$, respectively). However, no differences were found between PGC and PG ($p=0.499$) and HGC and HG ($p=0.421$).

Discussion

Cementing glass fiber posts into root canals is a clinical challenge, due to the high level of technique sensitivity (11), and to the range of factors that might influence in the adhesion of posts, such as endodontic irrigating solutions (12), endodontic root canal sealers (13), post space preparation procedures and materials used for cementation. Debonding has been considered the main cause of failure of intraradicular posts (4). The results of the present study showed that another factor that can influence in the adhesion of posts, specifically in cases when anatomized posts are required, is the material used for post space lubrication during preparation of these posts. Hydrosoluble gel showed to be the most appropriate material for lubrication of the canal when preparing the anatomized post, and removing or not the lubricant of the canal previously to post cementation did not influence the results.

The bond strength of anatomized posts was evaluated using bovine teeth. The advantage was that with bovine teeth it was possible to standardize conditions such as size, age, and storage time. All samples were freshly extracted, straight rooted, and with the same diameter of the canal and thickness of dentine, which allowed the confection of anatomized posts with similar size and shapes. The literature has shown different results when comparing bovine with human teeth (14) (15). Reis et al 2004 (16) found that there were no statistically significant differences in micro Tensile bond strength between human and bovine teeth, and stated that bovine teeth proved to be possible substitute for human teeth in either dentin or enamel bond testing.

In vitro tests such as push-out (17), pull-out (18) and microtensile (19) have been used to evaluate bond strength of different kind of posts (20). The push-out bond strength method used in this study is more reliable for testing the bonding of fiber posts to radicular dentine, when compared to the other testing methods, such as microtensile (20). Both push-out and pull-out tests have found higher number of samples with adhesive failure than other tests (21). Pull-out tests permit the analysis of a large number of samples within an adequate time frame. In addition, the luting interfaces are not altered during the sample preparation, as is the case for push-out testing. However, in the present study forces of up to 400 N exerted by pull-out test were not enough to dislodge the anatomized post in the samples analyzed (data not shown). Therefore, push-out test was used, to avoid the influence of anatomical retentive factors, which was reduced by sectioning the bonded roots, measuring the bond strength of individual specimens and obtaining a mean value (20).

The substances tested in the study i.e. Petrolatum gel and Hydrosoluble gel were chosen since they are the most widely used substances in clinical practice when lubrication is necessary (9) (10) (8). To our knowledge there are no previous study analyzing the influence of these substances on the bond strength of anatomized posts. Moreover, it can be speculated that residues of the substances in the canal could affect the adhesion of the post, so a cleaning protocol was also evaluated. The cleaning methods used were water rinsing followed by drying with paper points when hydrosoluble gel was used. Petrolatum, however, is insoluble in water and only dissolved with products that cannot e used in the root canals such as ether, benzene, chloroform, carbon sulfide, benzene and essence of turpentine. Therefore, when petrolatum was used the cleaning protocol was removal of the excess of material with paper points without previous water rinsing. According to the results of the study, as far as bond strength is concerned, the cleaning protocol is not necessary and could be dismissed in order to reduce clinical time.

Nevertheless, the lubricating material interfered with the bond strength of anatomized posts. Petrolatum gel caused significant lower bond strength than Hydrosoluble gel. This could be explained by the fact the petrolatum cannot be eliminated by the etching required for cementing the anatomized post with the resinous cement used in this study. The hydrosoluble gel without the cleaning protocol also showed higher bond strength than petrolatum gel, with or without cleaning. The possible explanation is that even without the water rinsing protocol the hydrosoluble gel might be removed from the interior of the canal during the etching and washing steps for post cementation.

Conclusions

Although there are no reports in the literature of the use of petrolatum gel for canal lubrication during anatomized post preparation, this technique has been empirically used in clinical practice. The results of the present report showed that this substance should not be used in the canal lubrication as it could lead to failure of the prosthetic treatment of wide canals that require anatomized posts. In conclusion, the lubricating technique affected the bond strength of anatomized posts, while the cleaning protocol prior to the anatomized post cementation does not seem to affect the bond strength.

Acknowledgments

The authors thank the material support (Angelus, Londrina, PR, Brazil).

References

1. Giachetti L, Grandini S, Calamai P, Fantini G, Scaminaci Russo D. Translucent fiber post cementation using light- and dual-curing adhesive techniques and a self-adhesive material: push-out test. Journal of Dentistry. 2009;37(8):638-42.

2. Silva NR, Castro CG, Santos-Filho PC, Silva GR, Campos RE, Soares PV, et al. Influence of different post design and composition on stress distribution in maxillary central incisor: Finite element analysis. Indian Journal of Dent al Research. 2009;20(2):153-8.

3. Santos-Filho PC, Veríssimo C, Soares PV, Saltarelo RC, Soares CJ, Marcondes Martins LR. Influence of ferrule, post system, and length on biomechanical behavior of endodontically treated anterior teeth. Journal of Endodontics. 2014;40(1):119-23.

4. Rasimick BJ, Wan J, Musikant BL, Deutsch AS. A review of failure modes in teeth restored with adhesively luted endodontic dowels. Journal of Prosthodontics. 2010;19(8):639-46.

5. Silva GR, Santos-Filho PC, Simamoto-Júnior PC, Martins LR, Mota AS, Soares CJ. Effect of post type and restorative techniques on the strain and fracture resistance of flared incisor roots. Brazilian Dental Journal. 2011;22(3):230-7.

6. Schmage P, Pfeiffer P, Pinto E, Platzer U, Nergiz I. Influence of oversized dowel space preparation on the bond strengths of FRC posts. Operative Dentstry. 2009;34(1):93-101.

7. Gomes GM, Rezende EC, Gomes OM, Gomes JC, Loguercio AD, Reis A. Influence of the resin cement thickness on bond strength and gap formation of fiber posts bonded to root dentin. Journal Adhesive Dentistry. 2014;16(1):71-8.

8. Wandscher V, Bergoli C, Limberger I, Ardenghi T, Valandro L. Preliminary Results of the Survival and Fracture Load of Roots Restored With Intracanal Posts: Weakened vs Nonweakened Roots. Operative Dentistry. 2014. [epub ahead of print]

9. Iglesia-Puig MA, Arellano-Cabornero A. Fiber-reinforced post and core adapted to a previous metal ceramic crown. Journal of Prosthetic Dentistry. 2004;91(2):191-4.

10. Zogheib LV, Saavedra GeS, Cardoso PE, Valera MC, Araújo MA. Resistance to compression of weakened roots subjected to different root reconstruction protocols. Journal of Applied Oral Science. 2011;19(6):648-54.

11. Naumann M, Koelpin M, Beuer F, Meyer-Lueckel H. 10-year survival evaluation for glass-fiber-supported postendodontic restoration: a prospective observational clinical study. Journal of Endodontics. 2012;38(4):432-5.

12. Renovato SR, Santana FR, Ferreira JM, Souza JB, Soares CJ, Estrela C. Effect of calcium hydroxide and endodontic irrigants on fibre post bond strength to root canal dentine. International Endodontics Journal. 2013;46(8):738-46.

13. Demiryürek EO, Külünk S, Yüksel G, Saraç D, Bulucu B. Effects of three canal sealers on bond strength of a fiber post. Journal of Endodontics. 2010;36(3):497-501.

14. Retief DH, Mandras RS, Russell CM, Denys FR. Extracted human versus bovine teeth in laboratory studies. American Journal of Dentitry. 1990;3(6):253-8.

15. Schilke R, Lisson JA, Bauss O, Geurtsen W. Comparison of the number and diameter of dentinal tubules in human and bovine dentine by scanning electron microscopic investigation. Archives of Oral Biology. 2000;45(5):355-61.

16. Reis AF, Giannini M, Kavaguchi A, Soares CJ, Line SR. Comparison of microtensile bond strength to enamel and dentin of human, bovine, and porcine teeth. Journal of Adhesive Dentistry. 2004;6(2):117-21.

17. Ekambaram M, Yiu CK, Matinlinna JP, Chang JW, Tay FR, King NM. Effect of chlorhexidine and ethanol-wet bonding with a hydrophobic adhesive to intraradicular dentine. Journal of Destistry. 2014;42(7):872-82.

18. Binus S, Koch A, Petschelt A, Berthold C. Restoration of endodontically treated teeth with major hard tissue loss--bond strength of conventionally and adhesively luted fiber-reinforced composite posts. Dental Traumatology. 2013;29(5):339-54.

19. Braga NM, Souza-Gabriel AE, Messias DC, Rached-Junior FJ, Oliveira CF, Silva RG, et al. Flexural properties, morphology and bond strength of fiber-reinforced posts: influence of post pretreatment. Brazilian Dental Journal. 2012;23(6):679-85.

20. Soares CJ, Santana FR, Castro CG, Santos-Filho PC, Soares PV, Qian F, et al. Finite element analysis and bond strength of a glass post to intraradicular dentin: comparison between microtensile and push-out tests. Dental Materials. 2008;24(10):1405-11.

21. Castellan CS, Santos-Filho PC, Soares PV, Soares CJ, Cardoso PE. Measuring bond strength between fiber post and root dentin: a comparison of different tests. Journal of Adhesive Dentistry. 2010;12(6):477-85.

Table 1- Mean and standard deviations (MPa) of push-out bond strength values for the tested groups.

Groups	N	Missing	Mean	SD
PG	20	2	2.922 A	0.431
PGC	20	0	3.250 A	0.751
HG	20	1	4.068 B	0.720
HGC	20	1	4.426 B	0.877

Different upper letters show significant differences between groups ($p<0.001$).

5 Conclusões

Os resultados do presente estudo mostraram que o material de isolamento influenciou na força de adesão de pinos anatomizados, enquanto os métodos de limpeza previamente a cimentação desses pinos parece não influenciar na força de adesão.

Referências

BINUS, S. et al. Restoration of endodontically treated teeth with major hard tissue loss--bond strength of conventionally and adhesively luted fiber-reinforced composite posts. **Dental Traumatology**, v. 29, n. 5, p. 339-54, oct. 2013.

BITTER, K. et al. Effects of luting agent and thermocycling on bond strengths to root canal dentine. **International Endodontics Journal**, v. 39, n. 10, p. 809-18, oct. 2006.

BRAGA, N. M. et al. Flexural properties, morphology and bond strength of fiber reinforced posts: influence of post pretreatment. **Brazilian Dental Journal**, v. 23, n. 6, p. 679-85, dec 2012.

CASTELLAN, C. S. et al. Measuring bond strength between fiber post and root dentin: a comparison of different tests.**The Journal of Adhesive Dentistry**, v. 12, n. 6, p. 477-85, dec. 2010.

DA SILVA, L. M. et al. Influence of different adhesive systems on the pull-out bond strength of glass fiber posts. **Journal of Applied Oral Science**, v. 16, n. 3, p. 232-5, 2008 may-Jun. 2008.

DEMIRYÜREK, E. O. et al. Effects of three canal sealers on bond strength of a fiber post. **Journal of Endodontics**, v. 36, n. 3, p. 497-501, mar. 2010.

EKAMBARAM, M. et al. Effect of chlorhexidine and ethanol-wet bonding with a hydrophobic adhesive to intraradicular dentine. **Journal of Dentistry**, v. 42, n. 7, p. 872-82, jul. 2014.

GIACHETTI, L. et al. Translucent fiber post cementation using light- and dual-curing adhesive techniques and a self-adhesive material: push-out test. **Journal of Dentistry**, v. 37, n. 8, p. 638-42, aug. 2009.

GOMES, G. M. et al. Influence of the resin cement thickness on bond strength and gap formation of fiber posts bonded to root dentin. **The Journal of Adhesive Dentistry**, v. 16, n. 1, p. 71-8, feb. 2014.

IGLESIA-PUIG, M. A.; ARELLANO-CABORNERO, A. Fiber-reinforced post and core adapted to a previous metal ceramic crown. **The Journal of Prosthetic Dentistry**, v. 91, n. 2, p. 191-4, feb 2004.

MARCHI, GM; MITSUI, FH; CAVALCANTI, AN. Effect of remaining dentine structure and thermal-mechanical aging on the fracture resistance of bovine roots with different post and core systems. **International Endodontic Journal,** v.41, n.11, 969-76, nov. 2008.

MAZZITELLI, C. et al. Effect of thermal cycling on the bond strength of self-adhesive cements to fiber posts. **Clinical Oral Investigations**, v. 16, n. 3, p. 909-15, jun. 2012.

NAUMANN, M. et al. 10-year survival evaluation for glass-fiber-supported postendodontic restoration: a prospective observational clinical study. **Journal of Endodontics**, v. 38, n. 4, p. 432-5, apr. 2012.

RASIMICK, B. J. et al. A review of failure modes in teeth restored with adhesively luted endodontic dowels. **Journal of Prosthodontics**, v. 19, n. 8, p. 639-46, dec. 2010.

REIS, A. F. et al. Comparison of microtensile bond strength to enamel and dentin of human, bovine, and porcine teeth. **The Journal of Adhesive Dentistry**,, v. 6, n. 2, p. 117-21, summer 2004.

RENOVATO, S. R. et al. Effect of calcium hydroxide and endodontic irrigants on fibre post bond strength to root canal dentine**. International Endodontics Journal**, v. 46, n. 8, p. 738-46, aug. 2013.

RETIEF, D. H. et al. Extracted human versus bovine teeth in laboratory studies. **American Journal of Dentistry**, v. 3, n. 6, p. 253-8, dec. 1990.

SANTOS-FILHO, P. C. et al. Influence of ferrule, post system, and length on biomechanical behavior of endodontically treated anterior teeth. **Journal of Endodontics**, v. 40, n. 1, p. 119-23, jan. 2014.

SCHILKE, R. et al. Comparison of the number and diameter of dentinal tubules in human and bovine dentine by scanning electron microscopic investigation. **Archives of Oral Biology**, v. 45, n. 5, p. 355-61, may. 2000.

SCHMAGE, P. et al. Effect of surface conditioning on the retentive bond strengths of fiberreinforced composite posts. **The Journal of Prosthetic Dentistry**, v. 102, n. 6,

p. 368-77, dec. 2009.

SILVA, G. R. et al. Effect of post type and restorative techniques on the strain and fracture resistance of flared incisor roots. **Brazilian Dental Journal**, v. 22, n. 3, p. 230-7, apr 2011.

SILVA, N. R. et al. Influence of different post design and composition on stress distribution in maxillary central incisor: Finite element analysis. **Indian Journal of Dental Research,** v. 20, n. 2, p. 153-8, 2009 apr-jun. 2009.

SKUPIEN; JOVITO; ADIEL. **Pinos de fibra de vidro e resinas compostas: Implicações clínicas e laboratoriais.** Tese de Doutorado em Odontologia. Programa de Pós-graduação em Odontologia. Universidade Federal de Pelotas. mar 2014.

SOARES, C. J. et al. Finite element analysis and bond strength of a glass post to intraradicular dentin: comparison between microtensile and push-out tests. **Dental Materials**, v. 24, n. 10, p. 1405-11, oct. 2008.

WANDSCHER, V. et al. Preliminary Results of the Survival and Fracture Load of Roots Restored With Intracanal Posts: Weakened vs Nonweakened Roots. **Operative Dentistry**, feb. 2014.

ZHOU, L.; WANG, Q. Comparison of fracture resistance between cast posts and fiber posts: a meta-analysis of literature. **Journal of Endodontics**, v. 39, n. 1, p. 11-5, jan. 2013.

ZOGHEIB, L. V. et al. Resistance to compression of weakened roots subjected to different root reconstruction protocols. **Journal of Applied Oral Science**, v. 19, n. 6, p. 648-54, 2011 nov-dec. 2011.