UNIVERSIDADE FEDERAL DE JUIZ DE FORA
CAMPUS GOVERNADOR VALADARES
PROGRAMA DE PÓS-GRADUAÇÃO EM CIÊNCIAS APLICADAS À SAÚDE

Belizane das Graças Oliveira Maia

Resistência à fratura de raízes fragilizadas reabilitadas com pinos de fibra de vidro reembasados ou fresados

Governador Valadares
2021

Belizane das Graças Oliveira Maia

Resistência à fratura de raízes fragilizadas reabilitadas com pinos de fibra de vidro reembasados ou fresados

Dissertação apresentada ao Programa de Pós-Graduação em Ciências Aplicadas à Saúde, da Universidade Federal de Juiz de Fora, Campus Governador Valadares, como requisito parcial à obtenção do título de Mestra em Ciências Aplicadas à Saúde. Área de concentração: Biociências

Orientador: Prof. Dr. Rafael Binato Junqueira

Governador Valadares

2021

Ficha catalográfica elaborada através do programa de geração
automática da Biblioteca Universitária da UFJF,
com os dados fornecidos pelo(a) autor(a)

Maia, Belizane das Graças Oliveira.
Resistência à fratura de raízes fragilizadas reabilitadas com pinos de fibra de vidro reembasados ou fresados / Belizane das Graças Oliveira Maia. -- 2021.
64 p. : il.

Orientador: Rafael Binato Junqueira
Dissertação (mestrado acadêmico) - Universidade Federal de Juiz de Fora, Campus Avançado de Governador Valadares, Instituto de Ciências da Vida - ICV. Programa de Pós-Graduação em Ciências Aplicadas à Saúde, 2021.

1. CAD/CAM. 2. Força de Compressão. 3. Falhas de Restaurações Dentárias. 4. Teste de Materiais. 5. Técnica de Pino e Núcleo. I. Junqueira, Rafael Binato, orient. II. Título.

Belizane das Graças Oliveira Maia

Resistência à fratura de raízes fragilizadas reabilitadas com pinos de fibra de vidro reembasados ou fresados

Dissertação apresentada ao Programa de Pós-Graduação em Ciências Aplicadas à Saúde, da Universidade Federal de Juiz de Fora, Campus Governador Valadares, como requisito parcial à obtenção do título de Mestra em Ciências Aplicadas à Saúde. Área de concentração: Biociências.

Aprovada em 09 de novembro de 2021.

BANCA EXAMINADORA

Prof. Dr. Rafael Binato Junqueira – Orientador
Universidade Federal de Juiz de Fora – Campus Governador Valadares

Prof. Dr. Cláudio Antônio Talge Carvalho
Universidade Estadual Paulista – UNESP

Prof. Dr. Rodrigo Furtado de Carvalho
Universidade Federal de Juiz de Fora – Campus Governador Valadares

Dedico este trabalho aos meus pais, Maria do Socorro e José Maia (*in memorian*), ao meu marido, Geovane, ao meu filho Nícolas e a minhas irmãs. Todo o tempo dispendido nesta tarefa foi roubado de cada um deles.

AGRADECIMENTOS

Agradeço, em primeiro lugar, a Deus, por ter me dado forças e, até mesmo, carregado nos braços, durante esta jornada. Houve momentos em que tudo dava errado, não tinha tempo para nada, pensei em desistir, mas a força que vem da fé me sustentou. Obrigado, Senhor!

À Universidade Federal de Juiz de Fora – campus de Governador Valadares, meus sinceros agradecimentos pela oportunidade de cursar o mestrado, por todo o aprendizado adquirido e pelo crescimento pessoal e profissional alcançado.

Agradeço a cada um dos professores, por seu empenho e dedicação em me guiar por novos mundos do saber, por me desafiar a aprender a aprender, de forma competente e, ao mesmo tempo carinhosa. Ao professor Rafael Binato Junqueira, meu orientador e, hoje, um amigo que ganhei pelo caminho, não tenho palavras para agradecer por todos os domingos, feriados, horários inusitados que pedi ajuda e sempre recebi uma orientação, sugestões, uma resposta de incentivo, de apoio e, acima de tudo, com toda a paciência do universo.

Agradeço aos colegas de profissão e amigos, Mauro Rocha, pela disponibilidade demonstrada e pelo auxílio durante os procedimentos de fresagem dos pinos; Thaís Alves, por todo o suporte durante os ensaios mecânicos e análise microscópica dos padrões de falhas e à professora Francielle Verner pelas considerações durante a análise estatística.

Aos meus colegas do PPGCAS, por todas as dúvidas esclarecidas, pela troca de experiências que transformou nosso grupo de What's App, Mestrandos, em uma rede de apoio e terapia coletiva e me deu forças para continuar. E, sempre tem um vídeo educativo, uma notícia, algo divertido, um tutorial, memes, reclamações e soluções, tudo junto e misturado.

Aos amigos e companheiros da Univale, pelas trocas de horários, substituições, conselhos, apoio, incentivo, exemplos de vida e profissional, a cada um de vocês, meu agradecimento. Ao Cláudio, que fez de tudo que estava ao seu alcance para adequar meus horários ao mestrado, pela confiança em mim depositada, gratidão.

Agradeço à minha família, motivo de minhas lutas, por suportarem, com amor, todo o stress e falta de tempo, especialmente a Geovane, Nícolas e mamãe; à minha irmã, Tatiana (sem esquecer Jefferson, Otávio e Heitor) por me fazerem sentir em casa em Valadares; a Iêda, Danny, Alice e Ana, por todo o incentivo. Obrigado meu Deus, pela família maravilhosa que me deu de presente!

Eu sou aquela mulher
a quem o tempo
muito ensinou.
Ensinou a amar a vida.
Não desistir da luta.
Recomeçar na derrota.
Renunciar a palavras e pensamentos negativos.
Acreditar nos valores humanos.
Ser otimista.

(Cora Coralina, no livro "Vintém de cobre: meias confissões de Aninha". 6ª ed., São Paulo: Global Editora, 1997, p.145.)

RESUMO

O objetivo no presente estudo foi **c**omparar a resistência à fratura de raízes fragilizadas restauradas com pinos de fibra de vidro (PFV) fresados através da tecnologia CAD/CAM e pré-fabricados reembasados com diferentes resinas**.** Para este estudo experimental laboratorial *in vitro*, setenta incisivos bovinos foram tratados endodonticamente e divididos em sete grupos (n=10), de acordo com o protocolo de fragilização radicular (moderada: 1mm de dentina remanescente ao redor do canal radicular; ou severa: 0,5mm de dentina remanescente) e a técnica de anatomização do pino. No grupo controle, não houve fragilização e o PFV foi cimentado diretamente. Nos grupos FM-Z350 e FS-Z350, raízes com fragilização moderada (FM) ou severa (FS) receberam PFV reembasados com resina composta nanoparticulada convencional. Nos grupos FM-Bulk fill e FS-Bulk fill, raízes com FM ou FS, receberam PFV reembasados com resina do tipo Bulk fill. Nos grupos FM-Fresado e FS-Fresado, raízes com FM ou FS, receberam PFV fresados. Após ciclagem termomecânica (88 N, 3,8 Hz, 1.200.000 ciclos, equilíbrio térmico entre 5°C e 45°C) as raízes foram submetidas à compressão estática em uma máquina de ensaios universal até a fratura. O modo de falha foi analisado em estereomicroscópio (7,5x) e as frequências comparadas pelo teste qui-quadrado. Os grupos foram comparados por meio de ANOVA dois fatores, post hoc de Tukey e Teste T, com significância de 5%. O valor médio de resistência à fratura (Kgf) foi de 47,5 para o grupo controle. Nos grupos com fragilização moderada, os valores médios foram, 65.5 no grupo FM-Bulk fill, 63.4 no grupo FM-Z350 e 56.4 no grupo FM-F. Nos grupos com fragilização severa, 72.7 no grupo FS-Bulk fill, 65.7 no grupo FS-Z350 e 16,8 no grupo FS-F. O grupo FS-F obteve os menores valores, com diferença significante em relação a todos os grupos ($p < 0,001$) e o maior valor foi no grupo FS-Bulk fill, com diferença em relação a FM-F ($p = 0,037$) e FS-F ($p < 0,001$). Na comparação com o controle, FM-Bulk fill, FM-Z350, FS-Bulk fill e FS-Z350 apresentaram valores superiores de resistência à fratura; FS-F, valor inferior e FM-F sem diferença. No grupo controle, a frequência de fraturas reparáveis foi de 100%, e nos grupos com fragilização moderada e severa, foi de 87% e 63%, respectivamente. Concluiu-se que raízes com fragilização severa reabilitadas com pinos de fibra de vidro fresados apresentaram menores valores de resistência à fratura em relação ao grupo controle e aos reembasados. Entretanto, o padrão de falha apresentado em todos os grupos foi predominantemente do tipo reparável. A quantidade de estrutura dental remanescente foi determinante na sobrevivência do dente, uma vez que dentes com fragilização severa apresentaram frequência maior de falhas catastróficas.

Palavras-chave: CAD-CAM. Força de Compressão. Falhas de Restaurações Dentárias. Tecnologia Odontológica. Teste de Materiais. Técnica de Pino e Núcleo. Preparo do Canal Radicular.

ABSTRACT

The aim of the present study was to compare the fracture resistance of weakened roots restored with CAD/CAM milled GFPs to the prefabricated ones, relined with two different resins. For this experimental in vitro laboratory study, seventy bovine incisors were endodontically treated and divided into seven groups (n=10), according to the weakening protocol (medium: 1mm of remaining dentin around the root canal; or highly: 0.5mm of remaining dentin) and the post anatomization technique. The control group was non-weakened, and the GFP was directly luted. In groups MW-Z350 and HW-Z350, medium weakened (MW) or highly weakened (HW) roots were restored with a GFP relined with conventional nanoparticle composite resin. In MW-Bulk fill and HW-Bulk fill groups, MW or HW roots were restored with a GFP relined with Bulk fill resin. In MW-M and HW-M groups, MW or HW roots were restored with a milled GFP. After thermomechanical cycling (88 N, 3.8 Hz, 1,200,000 cycles, thermal equilibrium between 5°C and 45°C), the roots were submitted to compression in a universal testing machine until fracture. The failure mode was analyzed under a stereomicroscope (7.5x), and the frequencies were compared by the chi-square test. The groups were compared by two-factor ANOVA, Tukey's post hoc, and T-test at a 5% significance level. The mean value of fracture resistance (kgf) was 47.5for the control group. In the groups with medium weakening protocol, the values were 65.5in the MW-Bulk fill group, 63.4in the MW-Z350 group, and 56.4in the MW-M group. In the highly weakened groups, 72.7in the HW-Bulk fill group, 65.7in the HW-Z350 group, and 16.8in the HW-M group. The HW-M group obtained the lowest values, showing a significant difference compared to all groups ($p < 0.001$), and the highest value was HW-Bulk fill, with a significant difference compared to MW-M ($p = 0.037$) and HW-M ($p < 0.001$). Compared to control, MW-Bulk fill, MW-Z350, HW-Bulk fill, and HW-Z350 showed higher fracture resistance values; HW-M, lower value, and MW-M no difference. In the control group, the frequency of repairable fractures was 100%, and in the groups with moderate and highly weakening the frequency was 87% and 63%, respectively. It was concluded that the highly weakened roots rehabilitated with milled GFP showed lower fracture resistance values than control group and the relined ones. However, the failure pattern in all groups was predominantly repairable. The remaining tooth structure was determinant for dental survival since teeth with high weakened samples showed a higher frequency of catastrophic failures.

Keywords: CAD-CAM. Compressive strength. Dental restoration failures. dental technology; materials testing, post and core technique, prosthodontic tooth preparation; root canal preparation.

SUMÁRIO

1 INTRODUÇÃO

A utilização de retentores intrarradiculares em dentes tratados endodonticamente, com substancial perda coronária é uma abordagem bastante utilizada na reabilitação oral com o objetivo de proporcionar retenção ao núcleo de preenchimento e, consequentemente, à futura restauração (ATLAS, GRANDINI e MARTIGNONI, 2019).

Atualmente, a demanda por procedimentos odontológicos estéticos tem aumentado devido à influência exercida pelas mídias sociais, e a Odontologia está em constante evolução para satisfazer esta demanda do mercado (BINALRIMAL, 2019). A melhora das propriedades estéticas das restaurações livres de metal levou ao desenvolvimento de uma grande variedade de pinos intrarradiculares capazes de resolver problemas relacionados aos pinos metálicos (PARČINA et al., 2016).

Nesse contexto, surgiram os pinos de fibra de vidro (PFV), que apresentam bons índices de sobrevida e sucesso (GULDENER et al., 2017), boa relação custo/benefício e estética satisfatória. São de fácil manipulação na cimentação, com módulo de elasticidade semelhante à dentina e aderem-se quimicamente às resinas de uso odontológico (KULKARNI, et al., 2016). O baixo módulo de elasticidade permite um desempenho mecânico do dente restaurado semelhante ao de um dente natural, reduzindo o risco de fraturas radiculares não restauráveis (SCHMOLDT et al., 2011).

Os PFV apresentam uma distribuição relativamente uniforme do estresse ao longo da raiz e o módulo de elasticidade é similar à dentina. São associados a baixas taxas de fratura catastróficas quando comparados aos outros tipos de pinos e exibem picos de tensão inferiores e, portanto, superiores na análise de elementos finitos (ATLAS, GRANDINI e MARTIGNONI, 2019). Embora os PFV tenham se tornado bastante utilizados clinicamente, falhas das restaurações têm sido relatadas, predominantemente a descimentação, seguida por fratura do núcleo de preenchimento, sendo um modo de fratura favorável, passível de retratamento (FRANCO et al.,2014; KULKARNI, et al., 2016).

A preservação do máximo de estrutura natural é um fator decisivo para a restauração bem-sucedida do dente tratado endodonticamente, e o preparo do espaço para pino deve ser o mais conservador possível (ATLAS, GRANDINI e MARTIGNONI, 2019). Além disso, a adaptação do pino e núcleo ao espaço para pino pode influenciar significativamente a probabilidade de sobrevida a e durabilidade do tratamento realizado (SILVA et al., 2021).

Essa adaptação é prejudicada em dentes com canal radicular amplo, canais não circulares ou que apresentam variações anatômicas, uma vez que os pinos pré-fabricados apresentam um formato padronizado que não se adapta às suas paredes, propiciando uma linha de cimentação espessa, o que gera um alto estresse de polimerização do cimento, aumentando a possibilidade da ocorrência de falhas devido à perda de retenção do pino (MARCOS et al., 2016; SILVA et al., 2021). Nestes casos, pode-se lançar mão de técnicas para obtenção de pinos anatômicos, seja pela personalização de pinos pré-fabricados com resina composta, a qual preencherá os espaços entre o pino e as paredes do canal (LINS et al., 2019; SILVA et al., 2021) ou pela confecção de um PFV fresado pela tecnologia CAD/CAM, no qual o pino e o núcleo se constituirão em uma estrutura única (MARCOS et al., 2016; LIU et al., 2010).

Recentemente, a utilização de resinas tipo bulk fill com a finalidade de individualizar o PFV tem sido estudada devido à tensão de contração durante sua polimerização igual ou mais baixa que as resinas compostas convencionais, especialmente em incrementos maiores (LINS et al., 2019; RIZZANTE et al., 2019a; RIZZANTE et al., 2019b; SILVA et al., 2021). As resinas bulk-fill tiveram performance similar ou melhor que as resinas compostas convencionais (CIDREIRA BOARO et al., 2019), apresentando-se como uma alternativa viável para reembasamento de PFV (SILVA et al., 2021).

O uso da tecnologia CAD/CAM tem se mostrado uma opção promissora, especialmente quando se considera a possibilidade de se fresar ambos, pino e núcleo, em uma peça única, o que eliminaria a necessidade de utilização de uma resina composta para a construção de um núcleo, reduzindo o número de interfaces, que são áreas mais suscetíveis a falhas (SARY et al., 2019). Também é possível a fresagem em diferentes materiais, superando a limitação estética relacionada ao uso de núcleos metálicos fundidos em dentes anteriores. Além disso, o pino fresado, devido à sua excelente adaptação às paredes do canal gera uma linha de cimentação mais fina (GAMA et al., 2021; LIU et al., 2010; TSINTSADZE et al., 2018).

Para produzir um pino e núcleo através da tecnologia CAD/CAM são necessárias três etapas. A primeira é a obtenção dos dados do espaço para pino através do escaneamento direto ou indireto. A segunda etapa é o desenho virtual do pino e núcleo, em um programa de computador, com os dados obtidos no escaneamento. A terceira etapa é a fresagem de um bloco do material escolhido em uma fresadora (ALBUQUERQUE; SILVA; MORGAN, 2020).

Quando comparados aos PFV reembasados, os PFV fresados requerem uma sessão clínica mais longa, para escaneamento ou moldagem do canal radicular; uma fase laboratorial ou um sistema CAD/CAM no consultório (*chairside*) e uma segunda sessão clínica para sua cimentação, caso seja fresado em laboratório (TSINTSADZE et al., 2018).

Para a obtenção do modelo digital do pino que será fresado, pode-se realizar o escaneamento direto intracanal (LIBONATI et al., 2020, mas este procedimento exige um investimento inicial elevado. Um padrão do pino e núcleo, em resina acrílica ou em cera também pode ser escaneado, utilizando-se um *scanner* de laboratório para gerar o modelo digital através do qual serão confeccionados o pino e núcleo definitivos (GAMA et al., 2021; LEE, 2018). Este procedimento requer um tempo adicional e experiência na manipulação dos materiais (LEE, 2018).

Ao comparar os pinos fresados aos núcleos metálicos fundidos (NMF), uma vantagem dos pinos fresados é a minimização dos erros e desvantagens inerentes ao processo de fundição, como a formação de bolhas e irregularidades na superfície do metal (FALCÃO SPINA et al., 2018). Outra vantagem descrita na literatura é que a restauração com pinos e núcleos fresados aumentam significativamente a resistência à fratura de canais radiculares fragilizados quando comparados a PFV cimentados com uma espessa linha de cimento resinoso, aos PFV reembasados com resina composta e aos NMF (PANG et al., 2019; SARY et al., 2019).

Esta resistência do remanescente radicular à fratura influencia diretamente seu prognóstico a longo prazo e a presença de uma férula de 1,5 a 2 mm pode ter um efeito positivo na resistência à fratura de dentes tratados endodonticamente, ao passo que, em sua ausência, um desfecho clínico ruim é muito provável (JULOSKI et al., 2012; LAZARI et al., 2018). Na ausência de férula deve-se considerar a utilização de pinos e núcleos metálicos fundidos e na presença de uma férula de 1mm de espessura, o uso de pino de fibra de vidro parece ser a melhor decisão clínica (FONTANA et al., 2019).

Nos trabalhos que relacionaram a ausência de férula ao modo de falha do dente tratado endodonticamente, não foram avaliados os pinos fresados. Assim, a confecção de PFV fresados é uma técnica recente, que surgiu com a promessa de melhor retenção ao canal por se adaptar perfeitamente às paredes radiculares e ainda possuir propriedades semelhantes à dentina. Entretanto, observa-se uma escassez de estudos e falta de consenso na literatura. Algumas pesquisas relataram que pino e núcleo de fibra de vidro integrados, fabricados por CAD/CAM podem aumentar a resistência geral da raiz fragilizada à fratura (PANG et al., 2019; SARY et al. 2019).

Em contrapartida, outros estudos prévios (GAMA et al., 2021; GOMES et al., 2015; RUSCHEL et al., 2018) não encontraram resultados que incentivem o uso do CAD/CAM para fabricação dos PFV em relação aos pré-fabricados e aos reembasados. Portanto, o presente trabalho se justifica por testar os pinos fabricados por CAD/CAM, comparando-os às técnicas tradicionalmente estabelecidas, em relação à resistência à fratura de raízes fragilizadas em diferentes níveis. A hipótese nula é de que raízes dentárias fragilizadas reabilitadas com PFV, confeccionados por diferentes técnicas, apresentam valores de resistência à fratura semelhantes.

2 ARTIGO CIENTÍFICO

Artigo científico enviado para publicação no periódico *Journal of Prosthetic Dentistry*, qualis CAPES interdisciplinar B1. A estruturação do artigo baseou-se nas instruções aos autores preconizadas pelo periódico (ANEXO A).

Title page

Fracture resistance of weakened roots restored with relined or milled CAD-CAM glass fiber posts.

Belizane das Graças Oliveira Maia, DDS[a], Thais da S. Alves Santos, DDS, MSc[b], Cláudio Antonio Talge Carvalho, DDS, MSc, PhD[c], Francielle Silvestre Verner, DDS, MSc, PhD[d], Rafael Binato Junqueira, DDS, MSc, PhD[d].

Funding sources:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

[a]MSc student, Health Applied Sciences Master Program, Federal University of Juiz de Fora, Campus GV, Governador Valadares, Minas Gerais, Brazil. belizanemaia@hotmail.com

[b]PhD student, Department of Restorative Dentistry, Endodontic Division, São Paulo State University (Unesp), Institute of Science and Technology, São José dos Campos, Brazil. thais.s.alves@unesp.br

[c]PhD, Professor, Department of Restorative Dentistry, Endodontic Division, São Paulo State University (Unesp), Institute of Science and Technology, São José dos Campos, Brazil. claudio.talge@unesp.br

[d]PhD, Professor, Health Applied Sciences Program and Department of Dentistry, Federal University of Juiz de Fora, Campus GV, Governador Valadares, Minas Gerais, Brazil. francielle.verner@ufjf.br , rafael.binato@ufjf.br

Corresponding author:

Professor Rafael Binato Junqueira

Address: Av. Dr. Raimundo Monteiro Rezende 330, Sala 301, Centro, Governador Valadares, Minas Gerais, Brazil.

ZIP: 35.010-173

Phone: +55 32 991490663

E-mail: rafael.binato@ufjf.edu.br

Authorship Declaration:

All authors listed above certify that they have contributed significantly to this work, agree with the manuscript, and take public responsibility for the content, including participation in the manuscript's concept, design, analysis, writing, or review.

Conflict of interest:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Disclosure statement:

The authors do not have any financial interest in the companies whose materials are included in this article.

ABSTRACT

Statement of the problem. The type of post and core that favors the prognosis of weakened roots without a ferrule is challenging for dentists, and there is no consensus in the literature about the best rehabilitation technique.

Purpose. To compare the fracture resistance of weakened roots restored with milled glass fiber posts (GFPs) to the prefabricated ones, relined with two different resins.

Methodology: Seventy bovine incisors were endodontically treated and divided into seven groups (n=10), according to the weakening protocol (medium or highly) and the post anatomization technique (relined with Bulk fill or with conventional nanoparticle composite resins or milled). The control group was non-weakened, and the GFP was directly luted. After thermomechanical cycling (88 N, 3.8 Hz, 1,200,000 cycles, thermal equilibrium between 5°C and 45°C), the roots were submitted to compression in a universal testing machine until fracture. The failure mode was analyzed under a stereomicroscope (7.5x), and the frequencies were compared by the chi-square test. The groups were compared by two-factor ANOVA, Tukey's post hoc, and T-test at a 5% significance level.

Results. The mean value of fracture resistance (kgf) was 47.5for the control group. In the groups with medium weakening protocol, the values were 65.5in the MW-Bulk fill group, 63.4in the MW-Z350 group, and 56.4in the MW-M group. In the highly weakened groups, 72.7in the HW-Bulk fill group, 65.7in the HW-Z350 group, and 16.8in the HW-M group. The HW-M group obtained the lowest values, showing a significant difference compared to all groups ($p < 0.001$), and the highest value was HW-Bulk fill, with a significant difference compared to MW-M ($p = 0.037$) and HW-M ($p < 0.001$). Compared to control, MW-Bulk fill, MW-Z350, HW-Bulk fill, and HW-Z350 showed higher fracture resistance values; HW-M, lower value, and MW-M no difference. In the control group, the frequency of repairable

fractures was 100%, and in the groups with moderate and highly weakening the frequency was 87% and 63%, respectively.

Conclusions. Regardless of the weakening degree and the type of resin tested, the roots restored with relined GFP showed higher strength values and may be considered a suitable technique for weakened roots rehabilitation. Milled GFP showed lower fracture strength values and may be acknowledged as a promising technique that still requires further research. In general, highly weakened teeth showed a higher frequency of catastrophic failures. However, the failure pattern presented in all groups was predominantly repairable.

CLINICAL IMPLICATIONS

Rehabilitating weakened teeth is a challenging situation in which using a relined glass fiber post is a suitable technique for intraradicular retainer. Dentists should also consider milled glass fiber posts as a promising material. Even though roots rehabilitated with relined GFP presented higher fracture resistance values than milled ones, both techniques lead to reparable root fracture patterns.

INTRODUCTION

Intraradicular retainers in root-filled teeth with substantial coronary loss are widely used in oral rehabilitation to provide retention to the core build-up and future restoration.[1] Several factors can influence the survival of such teeth, including the amount of remaining dental structure, and the presence or absence of a ferrule.[2] The presence of a 1.5 to 2 mm ferrule has a positive effect on the fracture resistance of root-filled teeth, and, in its absence, a poor clinical outcome is more probable.[3,4] The selection of a retainer that improves the prognosis of a weakened root without a ferrule still is a dilemma for dentists.

With the evolution of the esthetic properties of metal-free restorations, there was a seek to develop intraradicular retainers to solve issues related to metallic posts.[5] In this context, glass fiber posts (GFP) emerged, with good survival and success rates,[6] a reasonable cost/benefit ratio, and excellent aesthetics. They are easy to handle in cementation[7] and chemically adhere to dental composites.[8] GFP are also associated with low catastrophic fracture rates compared to other types of posts[7] and exhibit lower stress peaks in finite element analysis.[1] Failures of these restorations have been reported[9], predominantly decementation, followed by fracture of the core build-up. However, they are favorable fracture types, amenable to retreatment.[7]

Post adaptation to the root canal significantly influences the probability of survival and durability of the treatment performed.[10,11] It is impaired in teeth with large, non-circular or those that present anatomical variations in the canal, since prefabricated posts have a standardized shape that does not fit to their walls, generating a thick cementation layer with high stress of cement polymerization, increasing the occurrence of failures due to the loss of post retention.[11] In these cases, anatomical posts can be obtained by relining prefabricated posts with composite resins[12] or by making a customized GFP milled by CAD/CAM technology.[13]

The use of bulk-fill resins to individualize GFP has been studied due to the equal or lower shrinkage stress during its polymerization than conventional composite resins, especially in larger increments.[4,11,13,14,15] To obtain customized GFP, the use of CAD/CAM technology is a promising option, especially when considering the possibility of milling post and core in a single piece.[13,16] This would eliminate the need to use a composite resin to construct a core, reducing the number of interfaces, which are more susceptible to failure.[13] Besides, the milled post provides excellent adaptation to the canal walls, leading to a thin cementation layer.[16]

Direct intracanal scanning can be performed to obtain a digital post model. However, this procedure requires a substantial financial investment[17]. In acrylic resin or wax, a pattern of the post and core can also be scanned using a laboratory scanner to create a digital model through which the definitive post and core will be obtained. This procedure requires additional time and experience in handling materials.[18] Milling GFP is a recent technique that emerged with the promises of better root canal retention and perfect adaptation to the root walls, with similar properties to dentin.[19]

There is a lack of studies and consensus in the literature about the best approach for weakened teeth rehabilitation. Some authors have reported that integrated GFP and core, manufactured by CAD/CAM, can increase the overall fracture resistance of weakened roots.[10,16] Otherwise, some previous studies[10,20,21] did not encourage CAD/CAM manufacturing GFP regarding prefabricated relined posts. Thus, the present work aimed to test posts made by CAD/CAM, comparing them to traditionally established techniques regarding fracture resistance of weakened roots. The null hypothesis is that weakened roots rehabilitated with GFP by different techniques have similar fracture resistance values.

MATERIALS AND METHODS

Seventy extracted bovine incisors were selected, with similar measurements, evaluated using a caliper (Starret 727; Starret). The crowns were removed with a double-faced diamond disk under irrigation, leaving a 16 mm length root. Roots whose canal had more than 2mm in diameter and those that did not have walls surrounding the canal with at least 2mm thick, or exceeded 2,5mm, were replaced by others meeting these criteria.

Endodontic treatment was performed using rotary instrumentation (ProTaper Universal, Dentsply Maillefer), irrigation with 5ml of 2.5% sodium hypochlorite, root filling with gutta-percha, and resin cement (AHPlus; Dentsply) using warm vertical compaction of gutta-percha, leaving an 11 mm post space. Then, the canal was sealed with a temporary eugenol-free filling cement (Villevie), and the roots were stored in distilled water at 37°C for 48 hours.

The roots were placed in a dental surveyor (B2; Bio-Art) attached to the vertical axis, perpendicular to the ground without any inclinations. In this position, each root was inserted for 3 seconds in a container with sculpting wax (Kota) melted between 60 and 70ºC, leaving a 2mm cervical collar exposed. They were then inserted into a PVC tube containing colorless self-curing acrylic resin (Jet, Classic Dental Products) in the plastic phase. After acrylic resin polymerization, the roots were immersed in water at 75°C for 1 minute to remove the wax layer. The root space in the acrylic resin was filled with an elastomeric polyether-based material (Impregum Soft; 3M/ESPE), and, before its polymerization, the root was reinserted. After polymerization of the polyether, the excess material was removed with a scalpel blade, exposing a cervical collar of 2mm.[2,22] The experimental groups were subjected to a root weakening protocol, as described by Junqueira et al.[9]

The samples were randomly divided into seven groups (n = 10), according to the weakening protocol used and the technique for GFP customization. The prefabricated GFP used was Exacto #2 (Angelus). Control group: prefabricated GFP cemented in non-weakened roots; MW-Bulk Fill Group: medium weakened roots, rehabilitated with GFP relined with Bulk Fill resin (Filtek One Bulk Fill; 3M); HW-Bulk Fill Group: highly weakened roots, rehabilitated with GFP relined with Bulk Fill resin; MW-Z350 Group: medium weakened roots, rehabilitated with GFP relined with conventional nanoparticle composite resin (Filtek Z350; 3M ESPE); HW-Z350 Group: highly weakened roots, rehabilitated with GFP relined with conventional nanoparticle composite resin; MW-M Group: medium weakened roots, rehabilitated with milled GFP (Fiber Cad – Post and Core; Angelus); HW-M group: highly weakened roots, rehabilitated with milled GFP (Fiber Cad – Post and Core; Angelus).

During the root weakening process, to assure the diamond tips would be inserted parallel to the long axis of the root canal, a bench drill support (model 860964; Worker) adapted to hold a dental electric micro motor (N3; Marathon) in a perpendicular position to the ground was used. The PVC cylinder containing the remaining tooth was fixed on the support base, with the canal centered regarding the diamond tip inserted in the straight handpiece, under constant irrigation.

Post spaces were lubricated with aqueous gel (K-Y, Semina) in MW-Bulk Fill, HW-Bulk Fill, MW-Z350, HW-Z350 groups. The GFP was cleaned with 37% phosphoric acid (Fusion Duralink; Angelus) for 1 minute, washed with water, dried, and silanized (Silano, Angelus). A layer of light-curing adhesive (Adper Single Bond, 3M ESPE) was applied, followed by light curing for 20 seconds. A portion of composite resin was applied on the surface of the post. Without light curing, this set was inserted into the post space, and 5-second photoactivation was performed.[11] This set was removed from the post space and photoactivated for 60 seconds. Adaptation to the root canal has been verified.

The post space was isolated with aqueous gel in groups MW-M and HW-M and molded by relining a prefabricated acrylic resin pin (Pinjet, Angelus) with self-curing acrylic resin (Pattern Resin Ls, GC America Inc.). The resin pattern thus obtained was scanned (Scanner S600 ARTI, Zirkonzahn), generating a digital model (CAD) which was milled (MC X5, Dentsply Sirona) from a prefabricated fiberglass block (Fiber Cad Post & Core, Angelus), obtaining a customized post and core.[21]

Before cementation, root canals and posts were cleaned with 92.8% alcohol. A layer of silane was applied to the posts, and according to the manufacturer's instructions, cementation was performed with dual self-etching resin cement (U200, 3M ESPE).

Full crowns of composite resin were made using an acetate matrix with the anatomy of an upper canine. All sample preparation was performed by a single operator, a specialist in dental prosthesis and endodontics.

The samples were placed in a thermomechanical cycler (model ER - 37000; Erios) and subjected to a load of 88 N with a frequency of 3.8 Hz, totaling 1 200 000 cycles. The loading piston with a 4 mm diameter spherical tip was placed on the lingual surface of the crowns 3 mm from the incisal edge.[9]

For the fracture resistance mechanical test, the samples were placed in a universal testing machine (DL 2000; EMIC), on a metal support with the long axis of the roots at an angle of 45° with the direction of application of the load, at a speed of 1mm/min until the occurrence of total sample fracture. A compressive force was applied to the lingual surface, 3 mm from the incisal edge, through a piston with a spherical tip measuring 4 mm in diameter. A 100Kgf load cell was used.[9] Values were recorded kilogram-force (kgf). The roots were analyzed under a stereomicroscope (7.5X; Discovery V20 – Zeiss), and the failure mode was classified as: type I: fracture/displacement of the crown and or post; type II: a fracture in the cervical third of the root; type III: a fracture in the middle third of the root; type IV: vertical root fracture. Types I and II were considered repairable, allowing restoration, while types III and IV were considered catastrophic fractures.[9]

The fracture resistance values were submitted to statistical analysis, using the Student's T-test to compare each group with the control group, the parametric test ANOVA (two-way), and Tukey's post hoc test to compare the experimental groups with each other. The frequency of failure types was compared using the chi-square test. The significance level considered was 5%.

RESULTS

The two-way ANOVA revealed a statistically significant difference ($p < 0.001$) between the experimental groups when comparing weakening protocol (medium or highly) and the post type (relined with Bulk fill or nanoparticle composite resin or milled). The mean and standard deviation values of the fracture resistance (kgf) as a function of the weakening protocol and the post type are described in table 1.

Tukey's test showed that the HW-M group had the lowest fracture resistance values, showing a significant difference compared to all other groups ($p < 0.001$). The highest mean value of fracture resistance was recorded by the HW Bulk Fill group, which presented a significant difference ($p = 0.037$) regarding MW-M and HW-M groups ($p < 0.001$).

The Student's T-test for independent samples showed a statistically significant difference when comparing each experimental group and the control (table 2). Only the MW-M group showed no significant difference from the control ($p = 0.161$).

Regarding the failure mode obtained after the fracture resistance essay, the Chi-square test showed an association between failure mode and the posts and weakening protocol ($p = 0.018$) (table 3). The control showed the highest frequency (100%) of types I and II fracture (favorable prognosis), while the HW-Bulk Fill group had the highest frequency (50%) of catastrophic failure (types III and IV). Types of each failure observed after the mechanical test are shown in figure 1.

DISCUSSION

Customization of GFP for the rehabilitation of weakened roots is indicated when its shape is not compatible with the width or extent of the root canal. A prefabricated GFP can be adapted to the root anatomy by relining it with Bulk fill or conventional composite resins.[1,11,12,14,15] Alternatively, a post and core can be milled in a single structure through direct or indirect scanning and subsequent milling of a glass fiber block using CAD/CAM technology.[13,16,17]

This study evaluated the fracture resistance of weakened roots restored with relined or milled GFP. The null hypothesis that weakened roots rehabilitated with GFP made by different techniques had similar fracture resistance values was rejected because there was a significant difference between the experimental groups ($p < 0.001$). Comparing the experimental groups individually to the control group (non-weakened roots rehabilitated with non-customized GFP), Student's t-test showed that groups relined with both types of resin, regardless of the weakening degree, showed an increase in fracture resistance, corroborating previous studies in which the presence of a GFP did not weaken the root[6] or even protect the tooth against root fracture.[1]

In roots restored with milled posts, the MW-M group did not differ from the control, and the HW-M group showed lower fracture resistance values, agreeing with Gama et al.[21], and Ruschel et al.[20] They demonstrated that milled GFP showed lower resistance and flexural modulus than prefabricated posts with and without relining, and these results did not encourage the use of CAD/CAM for manufacturing GFPs compared to prefabricated and relined ones.

The lower fracture strength values observed in the milled groups compared to the prefabricated relined GFP can be attributed to, according to Ruschel et al. (2018), the milling direction of the glass fiber disk. When milling occurs parallel to fibers, the mechanical properties are better than when posts are milled diagonally to the long axis of the fibers. Since all posts were milled simultaneously in one fiberglass disc, there is a possibility that fibers have been cut diagonally in some regions of the post or the core, reducing their fracture resistance.

Clinically, the resistance must be high enough to resist masticatory efforts and not so high that transfer excessive occlusal forces to the root, leading to its fracture. Before occurring a root fracture, for a good prognosis of the tooth, it is desirable that the post and/or core be fractured first.

The group with the highest mean values of fracture resistance (HW-Bulk fill) showed the highest frequency of catastrophic failures (those that lead to clinical tooth loss). The use of bulk-fill resin for GFP relining is due to its lower shrinkage stress during polymerization, generating, theoretically, a more faithful copy of the root canal. They are also more translucent, enabling greater light penetration, allowing polymerization through thicker increments when compared to conventional composite resins (LINS et al., 2019; SILVA et al., 2021; RIZZANTE et al., 2019b). On the other hand, Gama et al.[21] found a higher frequency of catastrophic failures in the milled GFPs, even though they showed significantly lower fracture strength values than relined ones.

Contradicting the results found in the present study, Pang et al.[16] concluded that the use of milled post and cores improved the biomechanics of the weakened root-filled tooth, showing fracture resistance values close to the metal cast post and core, presenting a low frequency of catastrophic failures. However, the difference in results can be attributed to discrepancies in methodologies. They compared the milled GFP, metal cast post and core, and the prefabricated PFV not relined, even though it was cemented on a weakened root. Only a composite resin core filling was made. Otherwise, in the present study, the milled posts were compared to relined GFP in weakened roots and prefabricated GFP with no relining, cemented into unweakened roots, displaying a thin cementation line.

Sary et al.[13] showed that using milled posts and cores improved the biomechanics of endodontically treated teeth by increasing the fracture resistance of weakened roots when compared to prefabricated GFP, with and without a composite resin relining. However, the material used for milling the posts was a polymer-infiltrated ceramic and not glass fiber. Although both materials have elasticity modulus close to dentin, the differences in the results can be attributed to intrinsic differences in the materials used for milling.

Regarding the failure mode, the repairable type predominated, and the control group, which was non-weakened, presented more favorable fracture patterns (90% type I and 10% type II) compared to the other groups, so 100% were considered repairable fractures. For the groups medium and highly weakened, this value was 87% and 63%, respectively. Thus, the less the remaining tooth structure, the higher the frequency of failures considered catastrophic. Therefore, the long-term prognosis of endodontically treated teeth may be directly related to the amount of remaining dental tissue.[1,3] These results contradict those obtained by GOMES et al.[10]. The authors found no differences in the magnitude and distribution of stress between the weakened and non-weakened roots, after different rehabilitation protocols using GFP with and without resin relining, through finite element analysis. The stress concentration, mainly in the buccolingual direction, would be responsible for vertical root fractures, considered catastrophic. Furthermore, Junqueira et al.[9] related no change in root fracture resistance when the dentin thickness factor was analyzed individually.

Teeth with no ferrule are less resistant to fracture, and when it occurs, they show more disadvantageous patterns,[2,3] and post cementation cannot compensate for the absence of a ferrule. Instead, the presence of a post can negatively affect the failure pattern.[4] Rehabilitation with GFP seems to present a better clinical indication when there is a ferrule of at least 1mm thickness, which is more critical than the type or design of the post used.[2] The teeth tested in this study had significant structural losses, including root dentin, with a total absence of a ferrule, a challenging clinical situation.[4] Under the conditions of this study, 78.6% of the failures occurred in the coronal portion or near the cement-enamel junction, being amenable to retreatment. These results are in accordance with Atlas, Grandini, Martignoni, [1] Guldener et al.,[6] and Pang et al.[16] who also reported that the presence of GFPs increased the chance of long-term tooth survival by distributing stress relatively evenly along the root and contradict Lazari et al.,[4] according to which the presence of any post negatively affects the fracture mode.

The specimens have received as final restoration full crowns of conventional nanoparticle composite resin. If an indirect full crown were cemented, the distribution of forces to core, post, and root could be different, resulting in fracture strength values or failure patterns other than those found in this study.

An elastomeric material was used to replace the periodontal ligament to simulate conditions in the oral cavity. Moreover, 1,200,000 cycles were performed in a thermomechanical cycler for the artificial aging of the sample.[2,9] All samples survived the thermomechanical cycling. For the mechanical fracture strength test, the samples were placed in a universal testing machine with the long axis of the roots at a 45° angle to the direction of load application since this is the closest loading angle found in canines.[9] However, the fracture resistance test uses a continuous loading until the fracture is recorded, and although relevant for *in vitro* essays, it becomes a limitation since it does not represent the natural conditions of the oral environment.[4] Further clinical and laboratory studies should be performed to evaluate the fracture resistance of weakened roots restored with different types of GFP, as well as the behavior of such materials against thermal, mechanical, chemical, and biological challenges of the oral environment, to extrapolate our results.

CONCLUSION

Regardless of the weakening degree and the type of resin tested, the roots restored with relined GFP showed higher strength values and may be considered a suitable technique for weakened roots rehabilitation. On the other hand, milled GFP showed lower fracture strength values and may be acknowledged as a promising technique that still requires further research. In general, highly weakened teeth showed a higher frequency of catastrophic failures. However, the failure pattern presented in all groups was predominantly repairable.

REFERENCES

1. Atlas A, Grandini S, Martignoni M. Evidence-based treatment planning for the restoration of endodontically treated single teeth: importance of coronal seal, post vs no post, and indirect vs direct restoration. Quintessence Int. 2019;50:772-81.

2. Fontana PE, Bohrer TC, Wandscher VF, Valandro LF, Limberger IF, Kaizer OB. Effect of ferrule thickness on fracture resistance of teeth restored with a glass fiber post or cast post. Oper Dent. 2019;44:E299-E308.

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

4. Lazari PC, de Carvalho MA, Del Bel Cury AA, Magne P. Survival of extensively damaged endodontically treated incisors restored with different types of posts-and-core foundation restoration material. J Prosthet Dent. 2018;119:769-76.

5. Parčina I, Amižić, Baraba A. Esthetic Intracanal Posts. Acta Stomatol Croat. 2016;50:143-50.

6. Guldener KA, Lanzrein CL, Siegrist Guldener BE, Lang NP, Ramseier CA, Salvi GE. Long-term Clinical Outcomes of Endodontically Treated Teeth Restored with or without Fiber Post-retained Single-unit Restorations. J Endod. 2017;43:188-93.

7. Lamichhane A, Xu C, Zhang FQ. Dental fiber-post resin base material: a review. J Adv Prosthodont. 2014;6:60-5.

8. Daneshkazemi A, Davari A, Askari N, Kaveh M. Effect of different fiber post surface treatments on microtensile bond strength to composite resin. J Prosthet Dent. 2016;116:896-901.

9. Junqueira RB, de Carvalho RF, Marinho CC, Valera MC, Carvalho CAT. Influence of glass fibre post length and remaining dentine thickness on the fracture resistance of root filled teeth. Int Endod J. 2017;50:569-77.

10. Gomes ÉA, Gueleri DB, da Silva SR, Ribeiro RF, Silva-Sousa YT. Three-dimensional finite element analysis of endodontically treated teeth with weakened radicular walls restored with different protocols. J Prosthet Dent. 2015;114:383-9.

11. Silva CF, Martins VM, Melo AP, Martins LC, Santos-Filho PCF. The Use of Bulk-Fill Flow in the Customization of Glass Fiber Post. Eur J Dent. 2021;15:139-44.

12. Lins RBE, Cordeiro JM, Rangel CP, Antunes TBM, Martins LRM. The effect of individualization of fiberglass posts using bulk-fill resin-based composites on cementation: an in vitro study. Restor Dent Endod. 2019;44:e37.

13. Sary SB, Samah MS, Walid AAZ. Effect of restoration technique on resistance to fracture of endodontically treated anterior teeth with flared root canals. J Biomed Res. 2019;33:131-38.

14. Rizzante FAP, Mondelli RFL, Furuse AY, Borges AFS, Mendonça G, Ishikiriama SK. Shrinkage stress and elastic modulus assessment of bulk-fill composites. J Appl Oral Sci. 2019;27:e20180132.

15. Rizzante FAP, Duque JA, Duarte MAH, Mondelli RFL, Mendonça G, Ishikiriama SK. Polymerization shrinkage, microhardness, and depth of cure of bulk fill resin composites. Dent Mater J. 2019;38:403-10.

16. Pang J, Feng C, Zhu X, Liu B, Deng T, Gao Y et al. Fracture behaviors of maxillary central incisors with flared root canals restored with CAD/CAM integrated glass fiber post-and-core. Dent Mater J. 2019;38:114-19.

17. Tsintsadze N, Juloski J, Carrabba M, Goracci C, Vichi A, Grandini S et al. Effects of scanning technique on in vitro performance of CAD/CAM-fabricated fiber posts. J Oral Sci. 2018;60:262-68.

18. Lee JH. Fabricating a custom zirconia post-and-core without a post-and-core pattern or a scan post. J Prosthet Dent. 2018;120:186-89.

19. de Andrade GS, Tribst JP, Dal Piva AO, Bottino MA, Borges AL, Valandro LF, Özcan M. A study on stress distribution to cement layer and root dentin for post and cores made of CAD/CAM materials with different elasticity modulus in the absence of ferrule. J Clin Exp Dent. 2019;11:e1-e8.

20. Ruschel GH, Gomes ÉA, Silva-Sousa YT, Pinelli RGP, Sousa-Neto MD, Pereira GKR et al. Mechanical properties and superficial characterization of a milled CAD-CAM glass fiber post. J Mech Behav Biomed Mater. 2018;82:187-192.

21. Gama M, Balbinot GS, Ferreira GC, Mota EG, Leitune V, Collares FM. CAD/CAM Milled Glass Fiber Posts: Adaptation and Mechanical Behavior in Flared Root Canals. Oper Dent. 2021. doi: 10.2341/20-198-L. Epub ahead of print. PMID: 34624118.

22. Adanir N, Belli S. Evaluation of different post lengths' effect on fracture resistance of a glass fiber post system. Eur J Dent. 2008;2:23-8.

TABLES

Table 1. Mean and standard deviation of the fracture resistance values (kgf) according to the weakening protocol and post type.

Weakening protocol	Post type	Fracture resistance
MW	GFP + Bulk fill	65.5 (15.3) BC
MW	GFP + Z350	63.4 (8.90) BC
MW	Milled GFP	56.4 (10.6) B
HW	GFP + Bulk fill	72.7 (8.80) C
HW	GFP + Z350	65.7 (15.9) BC
HW	Milled GFP	16.8 (3.36) A

MW: medium weakened; HW: highly weakened

Different letters indicate a significant difference between the values ($p < 0.05$) and the weakening protocol*post type interaction, using a 2-way ANOVA and Tukey post hoc test.

Table 2. Comparison of fracture strength values between control and experimental groups using Student's t-test for independent samples.

Weakening protocol	NW	MW			HW		
Post type	GFP	GFP + Bulk fill	GFP + Z350	Milled GFP	GFP + Bulk fill	GFP + Z350	Milled GFP
Fracture resistance (kgf) Mean (SD)	47,5 (14,2)	65.5 (15.3)	63.4 (8.90)	56.4 (10.6)	72.7 (8.80)	65.7 (15.9)	16.8 (3.36)
Control*Experimental		p=0.021	p=0.008	p=0.161	p<0.001	p=0.018	p<0.001

NW: Non-weakened; MW: medium weakened; HW: highly weakened; GFP: Glass fiber post

Table 3 Fracture type in each group (n = 10) concerning the factors post and weakening protocol and frequency of catastrophic failure.

Weakening protocol	Post type	Failure mode				Frequency of catastrophic	p value (Chi-square test)
		Favorable		Catastrophic			
Control	GFP	9	1	0	0	0%	0,018
MW	GFP + Bulk fill	7	2	1	0	10%	
	GFP + Z350	7	2	0	1	10%	
	Milled GFP	2	6	0	2	20%	
HW	GFP + Bulk fill	3	2	4	1	50%	
	GFP + Z350	3	4	3	0	30%	
	Milled GFP	0	7	1	2	30%	
Total		31	24	9	6	21.4%	

MW: medium weakened; HW: highly weakened

FIGURES

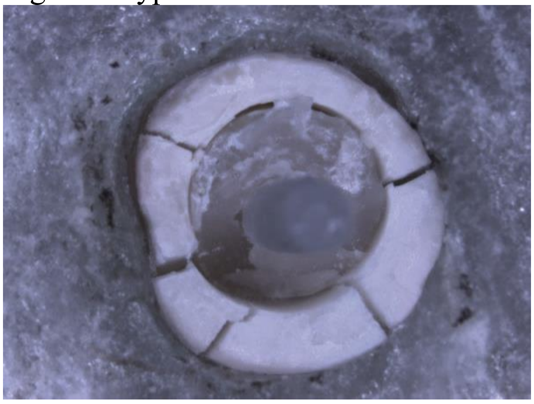
Fig. 1. Failure mode observed after fracture resistance mechanical test

Fig. 1A. Type I fracture

Fig. 1B. Type II fracture

Fig. 1C. Type III fracture

Fig. 1D. Type IV fracture



3 CONCLUSÃO

Independente do grau de fragilização e o tipo de resina testada, as raízes restauradas com PFV reembasado apresentaram valores de resistência superiores aos demais grupos, podendo-se considerar uma técnica adequada para a reabilitação de dentes fragilizados. Já os pinos de fibra de vidro fresados apresentaram menores valores de resistência à fratura, podendo ser considerados uma técnica promissora que ainda necessita de pesquisas adicionais, sobretudo clínicas. De forma geral, dentes com fragilização severa apresentaram frequência maior de falhas catastróficas. No entanto, o padrão de falha apresentado em todos os grupos foi predominantemente do tipo reparável.

REFERÊNCIAS

ADANIR, N.; BELLI, S. Evaluation of different post lengths' effect on fracture resistance of a glass fibre post system. **European Journal of Dentistry**, v. 2, p. 23-28, 2008.

ALBUQUERQUE, R.; SILVA, N.; MORGAN, L. **Pinos pré-fabricados:** do convencional ao digital. Nova Odessa: Napoleão, 2020.

ATLAS, A.; GRANDINI, S.; MARTIGNONI, M. Evidence-based treatment planning for the restoration of endodontically treated single teeth: importance of coronal seal, post vs no post, and indirect vs direct restoration. **Quintessence Int**, v. 50, n. 10, p. 772-781, 2019.

BATISTA, V. E. S.; BITENCOURT, S. B.; BASTOS, N. A.; PELLIZZER, E. P.; GOIATO, M. C.; DOS SANTOS, D. M. Influence of the ferrule effect on the failure of fiber-reinforced composite post-and-core restorations: A systematic review and meta-analysis. **J Prosthet Dent**, v. 123, n. 2, p. 239-245, fev. 2020.

BINALRIMAL, S. The effect of social media on the perception and demand of Aesthetic Dentistry. **J Adv Med Dent Scie Res**, v. 7, n. 5, p. 63-67, 2019.

BRASIL. Lei 11.794, de 8 de outubro de 2008. Regulamenta o inciso VII do § 1o do art. 225 da Constituição Federal, estabelecendo procedimentos para o uso científico de animais; revoga a Lei no 6.638, de 8 de maio de 1979; e dá outras providências. **Diário Oficial da União:** Seção 1, Brasília, DF, ano 145, n. 196, p. 1, 9 out. 2008.

CIDREIRA BOARO, L. C.; PEREIRA LOPES, D.; DE SOUZA, A. S. C.; LIE NAKANO, E.; AYALA PEREZ, M. D.; PFEIFER, C. S.; GONÇALVES, F. Clinical performance and chemical-physical properties of bulk fill composites resin -a systematic review and meta-analysis. **Dent Mater**, v. 35, n. 10, p. e249-e264, out. 2019.

FALCÃO SPINA, D. R.; DA COSTA, R. G.; CORRER, G. M.; RACHED, R. N. Scanning of root canal impression for the fabrication of a resin CAD-CAM-customized post-and-core. **J Prosthet Dent**, St. Louis, v. 120, n. 2, p. 242-245, ago. 2018.

FIGUEIREDO, F. E.; SANTOS, R. C.; SILVA, A. S.; VALDÍVIA, A. D.; OLIVEIRA-NETO, L. A.; GRIZA, S.; SOARES, C. J.; FARIA-E-SILVA, A. L. Ferrule design does not affect the biomechanical behavior of anterior teeth under mechanical fatigue: an in vitro evaluation. **Oper Dent**, v. 44, n. 3, p. 273-280, 2019.

FONTANA, P. E.; BOHRER, T. C.; WANDSCHER, V. F.; VALANDRO, L. F.; LIMBERGER, I. F.; KAIZER, O. B. Effect of ferrule thickness on fracture resistance of teeth restored with a glass fiber post or cast post. **Oper Dent**, v. 44, n. 6, p. e299-e308, 2019.

FRANCO, E. B.; LINS DO VALLE, A.; POMPÉIA FRAGA DE ALMEIDA, A. L.; RUBO, J. H.; PEREIRA, J. R. Fracture resistance of endodontically treated teeth restored with glass fiber post of different lengths. **J Prosthet Dent**, v. 111, n. 1, p. 30-34, jan. 2014.

GAMA, M.; BALBINOT, G. S.; FERREIRA, G. C.; MOTA, E. G.; LEITUNE, V.; COLLARES, F. M. CAD/CAM Milled Glass Fiber Posts: Adaptation and Mechanical

Behavior in Flared Root Canals. **Oper Dent**, out. 2021. doi: 10.2341/20-198-L. Epub ahead of print. PMID: 34624118.

GOMES, E. A.; GUELERI, D. B.; DA SILVA, S. R.; RIBEIRO, R. F.; SILVA-SOUSA, Y. T. Three-dimensional finite element analysis of endodontically treated teeth with weakened radicular walls restored with different protocols. **J Prosthet Dent**, v. 114, n. 3, p. 383-389, set. 2015.

GULDENER, K. A.; LANZREIN, C. L.; SIEGRIST GULDENER, B. E.; LANG, N. P.; RAMSEIER, C. A.; SALVI, G. E. Long-term clinical outcomes of endodontically treated teeth restored with or without fiber post-retained single-unit restorations. **J Endod**, v. 43, n. 2, p. 188-193, fev. 2017.

JULOSKI, J.; RADOVIC, I.; GORACCI, C.; VULICEVIC, Z. R.; FERRARI, M. Ferrule effect: a literature review. **J Endod**, v. 38, n. 1, p. 11-19, 2012.

JUNQUEIRA, R. B.; CARVALHO, R. F. de; MARINHO, C. C.; VALERA, M. C.; CARVALHO, C. A. T. Influence of glass fibre post length and remaining dentine thickness on the fracture resistance of root filled teeth. **Int Endod J**, v. 50, n. 6, p. 569-577, jun. 2017.

KULKARNI, K.; GODBOLE, S. R.; SATHE, S.; GOTOORKAR, S.; JAISWAL, P.; MUKHERJEE, P. Evaluation of the mode of failure of glass fiber posts: an in vitro study. **International Journal of Scientific Study**, v. 3, n. 12, p. 34-39, mar. 2016.

LEE, J. H. Fabricating a custom zirconia post-and-core without a post-and-core pattern or a scan post. **J Prosthet Dent**, v. 120, n. 2, p. 186-189, ago. 2018.

LIBONATI, A.; DI TARANTO, V.; GALLUSI, G.; MONTEMURRO, E.; CAMPANELLA, V. CAD/CAM customized glass fiber post and core with digital intraoral impression: a case report. **Clin Cosmet Investig Dent**, v. 10, n. 12, p. 17-24, fev. 2020.

LINS, R. B. E.; CORDEIRO, J. M.; RANGEL, C. P.; ANTUNES, T. B. M.; MARTINS, L. R. M. The effect of individualization of fiberglass posts using bulk-fill resin-based composites on cementation: an in vitro study. **Restor Dent Endod**, v. 44, n. 4, p. e-37, out. 2019.

LIU, P.; DENG, X. L.; WANG, X. Z. Use of a CAD/CAM-fabricated glass fiber post and core to restore fractured anterior teeth: a clinical report. **J Prosthet Dent**, v. 103, n. 6, p. 330-333, jun. 2010.

MARCOS, R. M.; KINDER, G. R.; ALFREDO, E.; QUARANTA, T.; CORRER, G. M.; CUNHA, L. F.; GONZAGA, C. C. Influence of the resin cement thickness on the push-out bond strength of glass fiber posts. **Brazilian Dental Journal**, v. 27, n. 5, p. 592-598, 2016.

PANG, J.; FENG, C.; ZHU, X.; LIU, B.; DENG, T.; GAO, Y.; LI, Y.; KE, J. Fracture behaviors of maxillary central incisors with flared root canals restored with CAD/CAM integrated glass fiber post-and-core. **Dent Mater J**, v. 38 n. 1, p. 114-119, 8 fev. 2019.

PARČINA, I.; AMIŽIĆ; BARABA, A. Esthetic intracanal posts. **Acta stomatologica Croatica**, v. 50, n. 2, p. 143-150, 2016.

[a]RIZZANTE, F. A. P.; MONDELLI, R. F. L.; FURUSE, A. Y.; BORGES, A. F. S.; MENDONÇA, G.; ISHIKIRIAMA, S. K. Shrinkage stress and elastic modulus assessment of bulk-fill composites. **J Appl Oral Sci**, v. 7, n. 27, jan. 2019. Disponível em: https://doi.org/10.1590/1678-7757-2018-0132 . Acesso em: 11 maio 2021.

[b]RIZZANTE, F. A. P.; DUQUE, J. A.; DUARTE, M. A. H.; MONDELLI, R. F. L.; MENDONÇA, G.; ISHIKIRIAMA, S. K. Polymerization shrinkage, microhardness, and depth of cure of bulk fill resin composites. **Dent Mater J**, v. 38, n. 3, p. 403-410, jun. 2019.

RUSCHEL, G. H.; GOMES, É. A.; SILVA-SOUSA, Y. T.; PINELLI, R. G. P.; SOUSA-NETO, M. D.; PEREIRA, G. K. R.; SPAZZIN, A. O. Mechanical properties and superficial characterization of a milled CAD-CAM glass fiber post. **Journal of the Mechanical Behavior of Biomedical Materials**, v. 82, p. 187–192, 2018.

SARY, S. B.; SAMAH, M. S.; WALID, A. A. Z. Effect of restoration technique on resistance to fracture of endodontically treated anterior teeth with flared root canals. **J Biomed Res**, v. 33, n. 2, p. 131-138, abr. 2019.

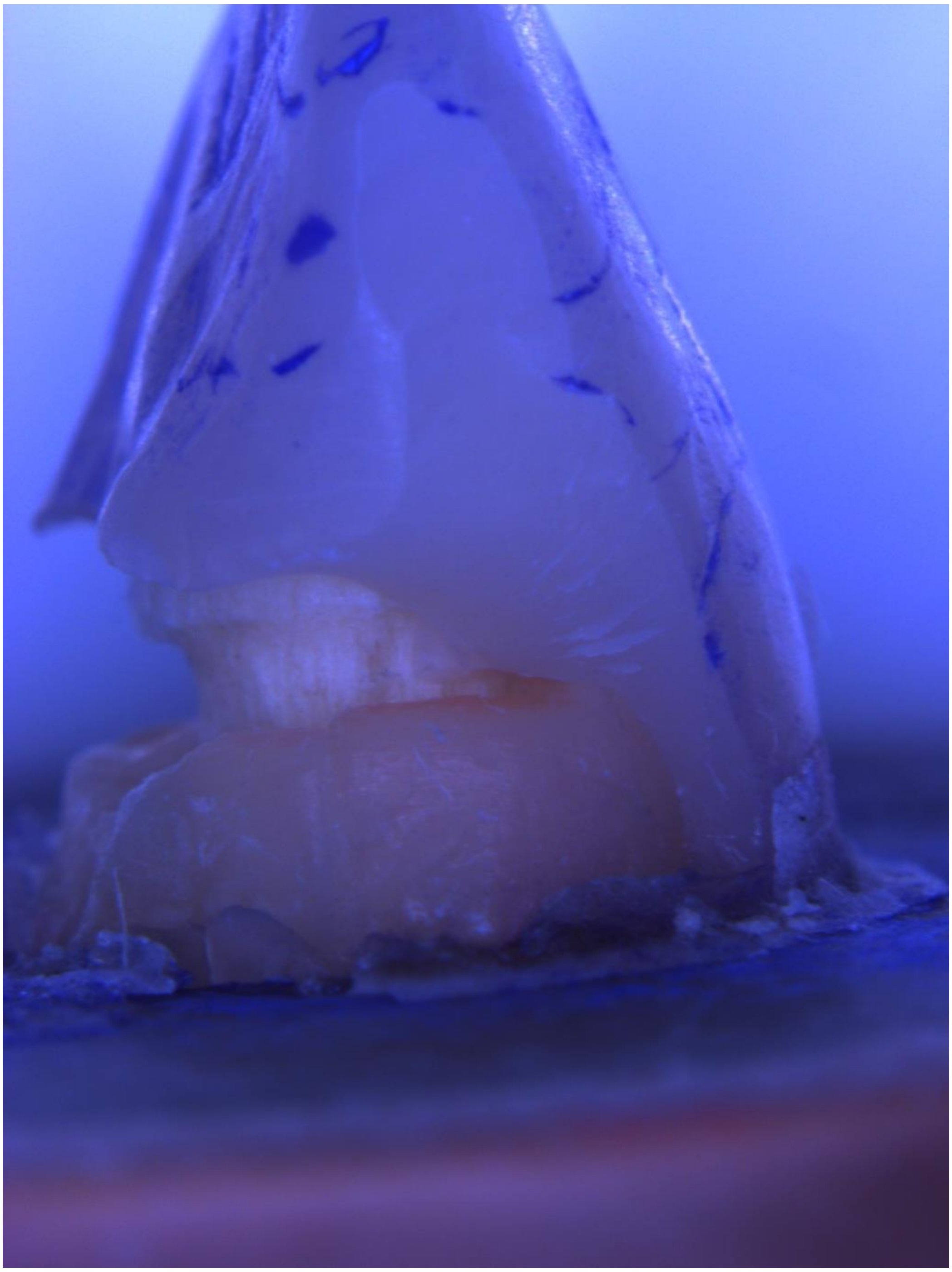
SCHMOLDT, S. J.; KIRKPATRICK, T. C.; RUTLEDGE, R. E.; YACCINO, J. M. Reinforcement of simulated immature roots restored with composite resin, mineral trioxide aggregate, gutta-percha, or a fiber post after thermocycling. **J Endod**, v. 37, n. 10, p. 1390-1393, out. 2011.

SILVA, C. F.; MARTINS, V. M.; MELO, A. P.; MARTINS, L. C.; SANTOS-FILHO, P. C. F. The use of bulk-fill flow in the customization of glass fiber post. **Eur J Dent**, v. 15, n. 1, p. 139-144, fev. 2021.

TSINTSADZE, N.; JULOSKI, J.; CARRABBA, M.; GORACCI, C.; VICHI, A.; GRANDINI, S.; FERRARI, M. Effects of scanning technique on in vitro performance of CAD/CAM-fabricated fiber posts. **Journal of Oral Science**, v. 60, n. 2, p. 262-268, 2018.

APÊNDICE – Imagens dos modos de fratura observados no ensaio mecânico de resistência à fratura

Figura 1 – Fratura tipo I

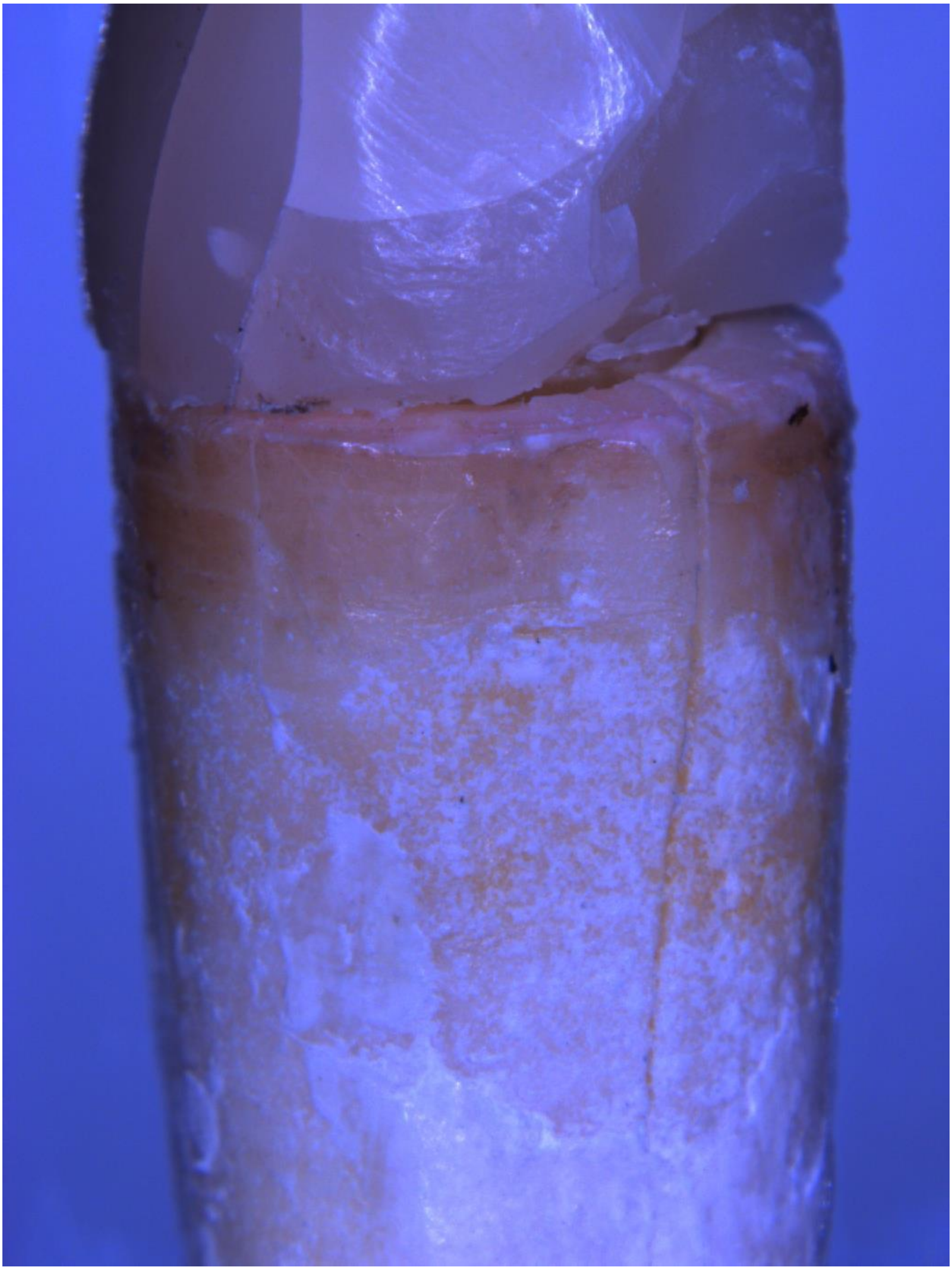


Fonte: elaborado pelo autor (2021)

Figura 2 – Fratura tipo II

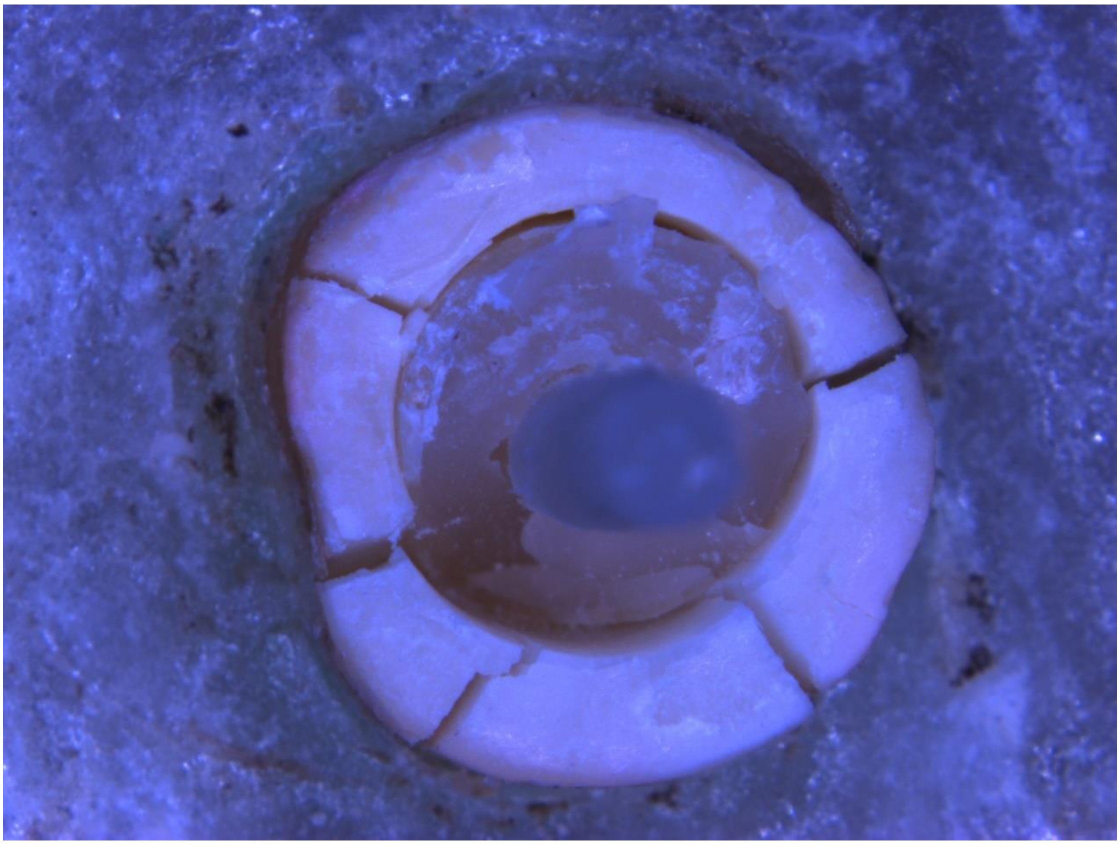
Fonte: elaborado pelo autor (2021)

Figura 3 – Fratura tipo III



Fonte: elaborado pelo autor (2021)

Figura 4 – Fratura tipo IV



Fonte: elaborado pelo autor (2021)

ANEXO – Instruções aos autores preconizadas pelo periódico *Journal of Prosthetic Dentistry*

JOURNAL OF PROSTHETIC DENTISTRY

The Official Publication for 24 Leading U.S. and International Prosthodontic Organizations

AUTHOR INFORMATION PACK

TABLE OF CONTENTS

ISSN: 0022-3913

DESCRIPTION

The Journal of Prosthetic Dentistry is the leading professional journal devoted exclusively to **prosthetic** and **restorative dentistry**. The *Journal* is the official publication for 24 leading U.S. international prosthodontic organizations. The monthly publication features timely, original peer-reviewed articles on the newest techniques, dental materials, and research findings. The *Journal* serves prosthodontists and dentists in advanced practice, and features color photos that illustrate many step-by-step procedures. *The Journal of Prosthetic Dentistry* is included in Index Medicus and CINAHL.

The Journal of Prosthetic Dentistry is one of the highest ranked Prosthodontics title by number of citations and impact factor on the 2016 Journal Citation Reports®, published by Thomson Reuters. The *Journal* has a five year impact factor of 2.201.

IMPACT FACTOR

2020: 3.426 © Clarivate Analytics Journal Citation Reports 2021

ABSTRACTING AND INDEXING

Scopus

EDITORIAL BOARD

GUIDE FOR AUTHORS

Instructions in Other languages

Spanish: 2013 Guía para la Preparación de ManuscritosTurkish: 2013 Makale Hazırlama RehberiPortuguese: 2013 Guia para a Preparação de Manuscritos

Now in its 65th year, *The Journal of Prosthetic Dentistry* is the leading professional journal devoted exclusively to prosthetic and restorative dentistry. The Journal is the official publication of 24 leading U.S. and international prosthodontic organizations, serving prosthodontists and dentists in advanced practice. It features timely, original peer-reviewed articles on the newest techniques, dental materials, and research findings, with color photographs that illustrate step-by-step procedures. *The Journal of Prosthetic Dentistry* is included in Index Medicus and CINAHL, and is the highest ranked Prosthodontics title by number of citations according to the 2014 Journal Citation Reports.®

Article Types

Articles are classified as one of the following: research/clinical science article, clinical report, technique article, systematic review, or tip from our readers. Required sections for each type of article are listed in the order in which they should be presented.

Research and Education/Clinical Research

The research report should be no longer than 10-12 double-spaced, typed pages and be accompanied by no more than 12 high-quality illustrations. Avoid the use of outline form (numbered and/or bulleted sentences or paragraphs). The text should be written in complete sentences and paragraph form.

Abstract (approximately 400 words): Create a structured abstract with the following subsections: Statement of Problem, Purpose, Material and Methods, Results, and Conclusions. The abstract should contain enough detail to describe the experimental design and variables. Sample size, controls, method of measurement, standardization, examiner reliability, and statistical method used with associated level of significance should be described in the Material and Methods section. Actual values should be provided in the Results section.

Clinical Implications: In 2-4 sentences, describe the impact of the study results on clinical practice.

Introduction: Explain the problem completely and accurately. Summarize relevant literature, and identify any bias in previous studies. Clearly state the objective of the study and the research hypothesis at the end of the Introduction. Please note that, for a thorough review of the literature, most (if not all references) should first be cited in the Introduction and/or Material and Methods section.

Material and Methods: In the initial paragraph, provide an overview of the experiment. Provide complete manufacturing information for all products and instruments used, either in parentheses or in a table. Describe what was measured, how it was measured, and the units of measure. List criteria for quantitative judgment. Describe the experimental design and variables, including defined criteria to control variables, standardization of testing, allocation of specimens/subjects to groups (specify method of randomization), total sample size, controls, calibration of examiners, and reliability of instruments and examiners. State how sample sizes were determined (such as with power analysis). Avoid the use of group numbers to indicate groups. Instead, use codes or abbreviations that will more clearly indicate the characteristics of the groups and will therefore be more meaningful for the reader. Statistical tests and associated significance levels should be described at the end of this section.

Results: Report the results accurately and briefly, in the same order as the testing was described in the Material and Methods section. For extensive listings, present data in tabular or graphic form to help the reader. For a 1-way ANOVA report of, F and *P* values in the appropriate location in the text. For all other ANOVAs, per guidelines, provide the ANOVA table(s). Describe the most significant findings and trends. Text, tables, and figures should not repeat each other. Results noted as significant must be validated by actual data and P values.

Discussion: Discuss the results of the study in relation to the hypothesis and to relevant literature. The Discussion section should begin by stating whether or not the data support rejecting the stated null hypothesis. If the results do not agree with other studies and/or with accepted opinions, state how and why the results differ. Agreement with other studies should also be stated. Identify the limitations of the present study and suggest areas for future research.

Conclusions: Concisely list conclusions that may be drawn from the research; do not simply restate the results. The conclusions must be pertinent to the objectives and justified by the data. In most situations, the conclusions are true for only the population of the experiment. All statements reported as conclusions should be accompanied by statistical analyses.

*References:*See Reference Guidelines and Sample References page.

Tables: See Table Guidelines.

Illustrations: See Figure Submission and Sample Figures page.

Clinical Report

The clinical report describes the author's methods for meeting a patient treatment challenge. It should be no longer than 4 to 5 double-spaced, pages and be accompanied by no more than 8 high-quality illustrations. In some situations, the Editor may approve the publication of additional figures if they contribute significantly to the manuscript.

Abstract: Provide a short, nonstructured, 1-paragraph abstract that briefly summarizes the problem encountered and treatment administered.

Introduction: Summarize literature relevant to the problem encountered. Include references to standard treatments and protocols. Please note that most, if not all, references should first be cited in the Introduction and/or Clinical Report section.

Clinical Report: Describe the patient, the problem with which he/she presented, and any relevant medical or dental background. Describe the various treatment options and the reasons for selection of the chosen treatment. Fully describe the treatment rendered, the length of the follow-up period, and any improvements noted as a result of treatment. This section should be written in past tense and in paragraph form.

Discussion: Comment on the advantages and disadvantages of the chosen treatment and describe any contraindications for it. If the text will only be repetitive of previous sections, omit the Discussion.

Summary: Briefly summarize the patient treatment.

References: See Reference Guidelines and Sample References page.

Illustrations: See Figure Submission and Sample Figures page.

Dental Technique

The dental technique article presents, in a step-by-step format, a unique procedure helpful to dental professionals. It should be no longer than 4 to 5 double-spaced, typed pages and be accompanied by no more than 8 high-quality illustrations. In some situations, the Editor may approve the publication of additional figures if they contribute significantly to the manuscript.

Abstract: Provide a short, nonstructured, 1-paragraph abstract that briefly summarizes the technique.

Introduction: Summarize relevant literature. Include references to standard methods and protocols. Please note that most, if not all, references should first be cited in the Introduction and/or Technique section.

Technique: In a numbered, step-by-step format, describe each step of the technique. The text should be written in command rather than descriptive form ("Survey the diagnostic cast" rather than "The diagnostic cast is surveyed.") Include citations for the accompanying illustrations.

Discussion: Comment on the advantages and disadvantages of the technique, indicate the situations to which it may be applied, and describe any contraindications for its use. Avoid excessive claims of effectiveness. If the text will only be repetitive of previous sections, omit the Discussion.

Summary: Briefly summarize the technique presented and its chief advantages.

References: See Reference Guidelines and Sample References page

Illustrations: See Figure Submission and Sample Figures page.

Systematic Review

The author is advised to develop a systematic review in the Cochrane style and format. The *Journal* has transitioned away from literature reviews to systematic reviews. For more information on systematic reviews, please see www.cochrane.org. An example of a Journal systematic review: Torabinejad M, Anderson P, Bader J, Brown LJ, Chen LH, Goodacre CJ, Kattadiyil MT, Kutsenko D, Lozada J, Patel R, Petersen F, Puterman I, White SN. Outcomes of root canal treatment and restoration, implant-supported single crowns, fixed partial dentures, and extraction without replacement: a systematic review. J Prosthet Dent 2007;98:285-311.

The systematic review consists of:

An Abstract using a structured format (Statement of Problem, Purpose, Material and Methods, Results, Conclusions).

Text of the review consisting of an introduction (background and objective), methods (selection criteria, search methods, data collection and data analysis), results (description of studies, methodological quality, and results of analyses), discussion, authors' conclusions, acknowledgments, and conflicts of interest. References should be peer reviewed and follow JPD format.

Tables and figures, if necessary, showing characteristics of the included studies, specification of the interventions that were compared, the results of the included studies, a log of the studies that were excluded, and additional tables and figures relevant to the review.

Tips From Our Readers

Tips are brief reports on helpful or timesaving procedures. They should be limited to 2 authors, no longer than 250 words, and include no more than 2 high quality illustrations. Describe the procedure in a numbered, step-by-step format; write the text in command rather than descriptive or passive form ("Survey the diagnostic cast" rather than "The diagnostic cast is surveyed").

Contact Information

The Journal of Prosthetic Dentistry
Editorial Office
The Journal of Prosthetic Dentistry
The Dental College of Georgia at Augusta University
1120 15th St., GC3094
Augusta, GA 30912-1255
Phone: (706) 721-4558
E-mail: JPD@augusta.edu
Website: http://www.prosdent.org
Online submission: https://www.editorialmanager.com/JPD/default.aspx

BEFORE YOU BEGIN

Submission Guidelines

Thank you for your interest in writing an article for *The Journal of Prosthetic Dentistry*. In publishing, as in dentistry, precise procedures are essential. Your attention to and compliance with the following policies will help ensure the timely processing of your submission.

Length of Manuscripts

Manuscript length depends on manuscript type. In general, research and clinical science articles should not exceed 10 to 12 double-spaced, typed pages (excluding references, legends, and tables). Clinical Reports and Technique articles should not exceed 4 to 5 pages, and Tips articles should not exceed 1 to 2 pages. The length of systematic reviews varies.

Number of Authors

The number of authors is limited to 4; the inclusion of more than 4 *must be justified* in the letter of submission. (Each author's contribution must be listed.) Otherwise, contributing authors in excess of 4 will be listed in the Acknowledgments. There can only be one corresponding author.

General Formatting

All submissions must be submitted via the Editorial Manager system in Microsoft Word with an 8.5×11 inch page size. The following specifications should also be followed:

Times Roman, 12 ptDouble-spacedLeft-justifiedNo space between paragraphs1-inch margins on all sidesHalf-inch paragraph indentsHeaders/Footers should be clear of page numbers or other informationHeadings are upper case bold, and subheads are upper/lower case bold. No italics are used.References should not be automatically numbered. Endnote or other reference-generating programs should be turned off.Set the Language feature in MS Word to English (US). Also change the language to English (US) in the style named Balloon Text.

Ethics in publishing

Please see our information on Ethics in publishing.

Informed consent and patient details

Studies on patients or volunteers require ethics committee approval and informed consent, which should be documented in the paper. Appropriate consents, permissions and releases must be obtained where an author wishes to include case details or other personal information or images of patients and any other individuals in an Elsevier publication. Written consents must be retained by the author but copies should not be provided to the journal. Only if specifically requested by the journal in exceptional circumstances (for example if a legal issue arises) the author must provide copies of the consents or evidence that such consents have been obtained. For more information, please review the Elsevier Policy on the Use of Images or Personal Information of Patients or other Individuals. Unless you have written permission from the patient (or, where applicable, the next of kin), the personal details of any patient included in any part of the article and in any supplementary materials (including all illustrations and videos) must be removed before submission.

Declaration of interest

All authors must disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. Examples of potential competing interests include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding. Authors must disclose any interests in two places: 1. A summary declaration of interest statement in the title page file (if double anonymized) or the manuscript file (if single anonymized). If there are no interests to declare then please state this: 'Declarations of interest: none'. 2. Detailed disclosures as part of a separate Declaration of Interest form, which forms part of the journal's official records. It is important for potential interests to be declared in both places and that the information matches. More information.

Submission declaration and verification

Submission of an article implies that the work described has not been published previously (except in the form of an abstract, a published lecture or academic thesis, see 'Multiple, redundant or concurrent publication' for more information), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. To verify originality, your article may be checked by the originality detection service Crossref Similarity Check.

Use of inclusive language

Inclusive language acknowledges diversity, conveys respect to all people, is sensitive to differences, and promotes equal opportunities. Content should make no assumptions about the beliefs or commitments of any reader; contain nothing which might imply that one individual is superior to another on the grounds of age, gender, race, ethnicity, culture, sexual orientation, disability or health condition; and use inclusive language throughout. Authors should ensure that writing is free from bias, stereotypes, slang, reference to dominant culture and/or cultural assumptions. We advise to seek gender neutrality by using plural nouns ("clinicians, patients/clients") as default/wherever possible to avoid using "he, she," or "he/she." We recommend avoiding the use of descriptors that refer to personal attributes such as age, gender, race, ethnicity, culture, sexual orientation, disability or health condition unless they are relevant and valid. These guidelines are meant as a point of reference to help identify appropriate language but are by no means exhaustive or definitive.

Author contributions

For transparency, we encourage authors to submit an author statement file outlining their individual contributions to the paper using the relevant CRediT roles: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; Writing - review & editing. Authorship statements should be formatted with the names of authors first and CRediT role(s) following. More details and an example

Changes to authorship

Authors are expected to consider carefully the list and order of authors **before** submitting their manuscript and provide the definitive list of authors at the time of the original submission. Any addition, deletion or rearrangement of author names in the authorship list should be made only **before** the manuscript has been accepted and only if approved by the journal Editor. To request such a change, the Editor must receive the following from the **corresponding author**: (a) the reason for the change in author list and (b) written confirmation (e-mail, letter) from all authors that they agree with the addition, removal or rearrangement. In the case of addition or removal of authors, this includes confirmation from the author being added or removed.
Only in exceptional circumstances will the Editor consider the addition, deletion or rearrangement of authors **after** the manuscript has been accepted. While the Editor considers the request, publication of the manuscript will be suspended. If the manuscript has already been published in an online issue, any requests approved by the Editor will result in a corrigendum.

Copyright

Upon acceptance of an article, authors will be asked to complete a 'Journal Publishing Agreement' (see more information on this). An e-mail will be sent to the corresponding author confirming receipt of the manuscript together with a 'Journal Publishing Agreement' form or a link to the online version of this agreement.

Subscribers may reproduce tables of contents or prepare lists of articles including abstracts for internal circulation within their institutions. Permission of the Publisher is required for resale or distribution outside the institution and for all other derivative works, including compilations and translations. If excerpts from other copyrighted works are included, the author(s) must obtain written permission from the copyright owners and credit the source(s) in the article. Elsevier has preprinted forms for use by authors in these cases.

For gold open access articles: Upon acceptance of an article, authors will be asked to complete a 'License Agreement' (more information). Permitted third party reuse of gold open access articles is determined by the author's choice of user license.

Author rights

As an author you (or your employer or institution) have certain rights to reuse your work. More information.

Elsevier supports responsible sharing
Find out how you can share your research published in Elsevier journals.

Role of the funding source

You are requested to identify who provided financial support for the conduct of the research and/or preparation of the article and to briefly describe the role of the sponsor(s), if any, in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. If the funding source(s) had no such involvement then this should be stated.

Open access

Please visit our Open Access page for more information.

Language (usage and editing services)

Please write your text in good American English. Authors who feel their English language manuscript may require editing to eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the English Language Editing service available from Elsevier's WebShop https://webshop.elsevier.com/language-editing-services/language-editing/ or visit our customer support site https://service.elsevier.com for more information.

Submission

Our online submission system guides you stepwise through the process of entering your article details and uploading your files. The system converts your article files to a single PDF file used in the peer-review process. Editable files (e.g., Word, LaTeX) are required to typeset your article for final publication. All correspondence, including notification of the Editor's decision and requests for revision, is sent by e-mail.

Submit your article
Please submit your article via https://www.editorialmanager.com/JPD/default.aspx.

PREPARATION

Use of word processing software

It is important that the file be saved in the native format of the MS Word program. The text should be in single-column format. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. In particular, do not use the word processor's options to justify text or to hyphenate words. However, do use bold face, italics, subscripts, superscripts etc. When preparing tables, if you are using a table grid, use only one grid for each individual table and not a grid for each row. If no grid is used, use tabs, not spaces, to align columns. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier: https://www.elsevier.com/guidepublication). Note that source files of figures, tables and text graphics will be required whether or not you embed your figures in the text. See also the section on Electronic artwork.

To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

Embedded math equations

If you are submitting an article prepared with Microsoft Word containing embedded math equations then please read this related support information (https://service.elsevier.com/app/answers/detail/a_id/302/).

Essential title page information

Title. Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae. Trade names should not be used in the title.*Author names and affiliations.* Author's names should be complete first and last names. Where the family name may be ambiguous (e.g., a double name), please indicate this clearly. Present the authors' current title and affiliation, including the city and state/country of that affiliation. If it is private practice, indicate the city and state/country of the practice. Indicate all affiliations with a lower-case superscript letter immediately after the author's name and in front of the appropriate affiliation.*Corresponding author.* Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. Ensure that phone numbers (with country and area code) are provided in addition to the e-mail address and the complete postal address. Contact details must be kept up to date by the corresponding author.

Title page format

Title: Capitalize only the first letter of the first word. Do not use any special formatting. Abbreviations or trade names should not be used. Trade names should not be used in the title.Authors: Directly under the title, type the names and academic degrees of the authors. Under the authors' names, provide the title, department and institutional names, city/state and country (unless in the U.S.) of each author. If necessary, provide the English translation of the institution. If the author is in private practice, indicate where with city/state/country. Link names and affiliations with a superscript letter (a,b,c,d). Presentation/support information and titles: If research was presented before an organized group, indicate name of the organization and location and date of the meeting. If work was supported by a grant or any other kind of funding, supply the name of the supporting organization and the grant number. Corresponding author: List the mailing address, business telephone, and e-mail address of the author who will receive correspondence. Acknowledgments: Indicate special thanks to persons or organizations involved with the manuscript. See Sample Title page.

Formatting of funding sources

List funding sources in this standard way to facilitate compliance to funder's requirements:

Funding: This work was supported by the National Institutes of Health [grant numbers xxxx, yyyy]; the Bill & Melinda Gates Foundation, Seattle, WA [grant number zzzz]; and the United States Institutes of Peace [grant number aaaa].

It is not necessary to include detailed descriptions on the program or type of grants and awards. When funding is from a block grant or other resources available to a university, college, or other research institution, submit the name of the institute or organization that provided the funding.

If no funding has been provided for the research, please include the following sentence:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Units

Follow internationally accepted rules and conventions: use the international system of units (SI). If other units are mentioned, please give their equivalent in SI.

Math formulae

Please submit math equations as editable text and not as images. Present simple formulae in line with normal text where possible and use the solidus (/) instead of a horizontal line for small fractional terms, e.g., X/Y. In principle, variables are to be presented in italics. Powers of e are often more conveniently denoted by exp. Number consecutively any equations that have to be displayed separately from the text (if referred to explicitly in the text).

Artwork

Figure Submission

JPD takes pride in publishing only the highest quality figures in its journal. All incoming figures must pass a thorough examination in Photoshop before the review process can begin. With more than 1,000 manuscripts submitted yearly, the manuscripts with few to no submission errors move through the system quickly. Figures that do not meet the guidelines will be sent back to the author for correction and moved to the bottom of the queue, creating a delay in the publishing process.

File Format

All figures should be submitted as TIF files or JPEG files only.

Image File Specifications

Figure dimensions must be 5.75 × 3.85 inches.

Figures should be size-matched (the same physical size) unless the image type prohibits size matching to other figures within the manuscript, as in the case of panoramic or periapical radiographs, SEM images, or graphs and screen shots. Do not "label" the faces of the figures with letters or numbers to indicate the order in which the figures should appear; such labels will be inserted during the publication process. Do not add wide borders to increase size.

Resolution

The figures should be of professional quality and high resolution. The following are resolution requirements:
Color and black-and-white photographs should be created and saved at 300 dots per inch (dpi).
Note: A 5.75 × 3.85-inch image at a resolution of 300 dpi will be approximately 6 megabytes. A figure of less than 300 dpi must not be increased artificially to 300 dpi; the resulting quality and resolution will be poor.
Line art or combination artwork (an illustration containing both line art and photograph) should be created and saved at a minimum of 600dpi.Clarity, contrast, and quality should be uniform among the parts of a multipart figure and among all of the figures within a manuscript.A uniform background of nontextured, medium blue should be provided for color figures when possible.

Text within Images

If text is to appear within the figure, labeled and unlabeled versions of the figures must be provided. Text appearing within the labeled versions of the figures should be in **Arial font and a minimum of 10 pt.** The text should be sized for readability if the figure is reduced for production in the Journal. Lettering should be in proportion to the drawing, graph, or photograph. A consistent font size should be used throughout each figure, and for all figures, Please note: Titles and captions should not appear within the figure file, but should be provided in the manuscript text (see Figure Legends).

If a key to an illustration requires artwork (screen lines, dots, unusual symbols), the key should be incorporated into the drawing instead of included in the typed legend. All symbols should be done professionally, be visible against the background, and be of legible proportion should the illustration be reduced for publication.

All microscopic photographs must have a measurement bar and unit of measurement on the image.

Color Figures

Generally, a maximum of 8 figures will be accepted for clinical report and dental technique articles, and 2 figures will be accepted for tips from our reader articles. However, the Editor may approve the publication of additional figures if they contribute significantly to the manuscript.
Clinical figures should be color balanced. Color images should be in CMYK (Cyan/Magenta/Yellow/Black) color format as opposed to RGB (Red/Green/Blue) color format.

Graphs/Screen Captures

Graphs should be numbered as figures, and the fill for bar graphs should be distinctive and solid; no shading or patterns. Thick, solid lines should be used and bold, solid lettering. Arial font is preferred. Place lettering on white background is preferred to reverse type (white lettering on a dark background). Line drawing should be a minimum of 600 dpi. Screen Captures should be a minimum of 300 dpi and as close to 5.75 and 3.85 as possible.

Composites

Composites are multiple images within one Figure file and, as a rule, are not accepted. They will be sent back to the author to replace them with each image sent separately as, Fig. 1A, Fig. 1B, Fig. 1C, etc. Each figure part must meet JPD Guidelines. (Some composite figures are more effective when submitted as one file. These files will be reviewed per case.) Contact the editorial office for more information about specific composites.

Figure Legends

The figure legends should appear within the text of the manuscript on a separate page after Tables and should appear under the heading FIGURES. Journal style requires that the articles (a, an, and the) are omitted from the figure legends. If an illustration is taken from previously published material, the legend must give full credit to the source (see Permissions).

File Naming

Each figure file must be numbered according to its position in the text (Figure 1, Figure 2, and so on) with Arabic numerals. The electronic image files must be named so that the figure number and format can be easily identified. For example, a Figure 1 in TIFF format should be named fig. 1.tif. Multipart figures must be clearly identifiable by the file names: Fig. 1A, Fig. 1B, Fig. 1C, Fig. 1-unlabeled, Fig. 1-labeled, etc.

Callouts

In the article, clearly reference each Figure and Table by including its number in parentheses at the end of the appropriate sentence before closing punctuation. For example: The sutures were removed after 3 weeks (Fig. 4). Or: are illustrated in Table 4.
The *Journal* reserves the right to standardize the format of graphs and tables.
Authors are obligated to disclose whether illustrations have been modified in any way.

Thumbnails

Place thumbnails (reduced size versions) of your figures in Figures section below each appropriate legend.
Thumbnails refers to placing a small (compressed file) copy of your figure into the FIGURES section of the manuscript after each appropriate legend. No smaller than 2" × 1.5" and approximately 72dpi. The goal is to give the editors/reviewers something to review but we want to keep the dimensions and the file size small for easy access. These small images are called thumbnails.

Figures Quick Checklist

All files are saved as TIFFs or JPEGs (only).Figure size: 5.75" × 3.85" (radiographs, SEMS, and screen captures may vary but they must all be size-matched). Figures are 300 dpi; line or combo line/photo illustrations are minimum 600 dpi.For text in figures use Ariel font.Label the Figure files according to their sequence in the text.Provide figure legends in the manuscript Figure section.Place thumbnails (small versions of figure files approx. 2" × 1.5") in Figure section below each legend.Submit composite figure parts as separate files.
A detailed guide to electronic artwork is available on our website: You are urged to visit this site; some excerpts from the detailed information about figure preparation are given here. https://www.elsevier.com/artworkinstructions.
Please make sure that artwork files are TIFFs and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) in addition to color reproduction in print. For further information on the preparation of electronic artwork, please see https://www.elsevier.com/artworkinstructions.

Illustration services

Elsevier's WebShop (https://webshop.elsevier.com/illustrationservices) offers Illustration Services to authors preparing to submit a manuscript but concerned about the quality of the images accompanying their article. Elsevier's expert illustrators can produce scientific, technical, and medical-style images, as well as a full range of charts, tables, and graphs. Image 'polishing' is also available, where our illustrators take your image(s) and improve them to a professional standard. Please visit the website to find out more.

Electronic Artwork

General points

- Make sure you use uniform lettering and sizing.
- Embed the used fonts if the application provides that option.
- Use the font Ariel or Helvetica in your illustrations.
- Number the illustration files according to their sequence in the text.
- Use a logical naming convention for your artwork files.
- Provide figure legends in the Figure section.
- Size the illustrations close to the desired dimensions of the published version.
- Submit each illustration as a separate file.

A detailed guide on electronic artwork is available on our website:
https://www.elsevier.com/artworkinstructions.**You are urged to visit this site; some excerpts from the detailed information are given here.**

Formats

If your electronic artwork is created in a Microsoft Office application (Word, PowerPoint, Excel) then please supply 'as is' in the native document format.

Regardless of the application used other than Microsoft Office, when your electronic artwork is finalized, please 'Save as' or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):
TIFF (or JPEG): Color or grayscale photographs (halftones), keep to a minimum of 300 dpi.
TIFF (or JPEG): Bitmapped (pure black & white pixels) line drawings, keep to a minimum of 600 dpi.
TIFF (or JPEG): Combinations bitmapped line/half-tone (color or grayscale), keep to a minimum of 600 dpi.

Please do not:

- Supply files that are optimized for screen use (e.g., GIF, PNG, PICT, WPG); these typically have a low number of pixels and limited set of colors;
- Supply files that are too low in resolution? or smaller than 5.75 × 3.85-inch.;
- Submit graphics that are disproportionately large for the content.

Color artwork
Please make sure that artwork files are in an acceptable format (TIFF or JPEG)and with the correct size and resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) in addition to color reproduction in print. For further information on the preparation of electronic artwork, please see https://www.elsevier.com/artworkinstructions.

Illustration services
Elsevier's Author Services offers Illustration Services to authors preparing to submit a manuscript but concerned about the quality of the images accompanying their article. Elsevier's expert illustrators can produce scientific, technical and medical-style images, as well as a full range of charts, tables and graphs. Image 'polishing' is also available, where our illustrators take your image(s) and improve them to a professional standard. Please visit the website to find out more.

Figure captions
Ensure that each illustration has a caption. Supply captions separately, not attached to the figure. A caption should comprise a brief title (**not** on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used. See Sample Figures page.

Tables

Tables should be self-explanatory and should supplement, not duplicate the text. Provide all tables at the end of the manuscript after the reference list and before the Figures. There should be only one table per page. Omit internal horizontal and vertical rules (lines). Omit any shading or color.Do not list tables in parts (Table Ia, Ib, etc.). Each should have its own number. Number the tables in the order in which they are mentioned in the text (Table 1., Table 2, etc).Supply a concise legend that describes the content of the table. Create descriptive column and row headings. Within columns, align data such that decimal points may be traced in a straight line. Use decimal points (periods), not commas, to mark places past the integer (eg, 3.5 rather than 3,5).In a line beneath the table, define any abbreviations used in the table.If a table (or any data within it) was published previously, give full credit to the original source in a footnote to the table. If necessary, obtain permission to reprint from the author/publisher.The tables should be submitted in Microsoft Word. If a table has been prepared in Excel, it should be imported into the manuscript.

References

Citation in text
Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not permitted in the reference list, but may be mentioned in the text. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Reference links
Increased discoverability of research and high quality peer review are ensured by online links to the sources cited. In order to allow us to create links to abstracting and indexing services, such as Scopus, CrossRef and PubMed, please ensure that data provided in the references are correct. Please note that incorrect surnames, journal/book titles, publication year and pagination may prevent link creation. When copying references, please be careful as they may already contain errors. Use of the DOI is highly encouraged.

A DOI is guaranteed never to change, so you can use it as a permanent link to any electronic article. An example of a citation using DOI for an article not yet in an issue is: VanDecar J.C., Russo R.M., James D.E., Ambeh W.B., Franke M. (2003). Aseismic continuation of the Lesser Antilles slab beneath northeastern Venezuela. Journal of Geophysical Research, https://doi.org/10.1029/2001JB000884. Please note the format of such citations should be in the same style as all other references in the paper.

Data references
This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

Acceptable references and their placement
Most, if not all, references should first be cited in the Introduction and/or Material and Methods section. Only those references that have been previously cited or that relate directly to the outcomes of the present study may be cited in the Discussion.

Only peer-reviewed, published material may be cited as a reference. Manuscripts in preparation, manuscripts submitted for consideration, and unpublished theses are not acceptable references.

Abstracts are considered unpublished observations and are not allowed as references unless follow-up studies were completed and published in peer-reviewed journals.

References to foreign language publications should be kept to a minimum (no more than 3). **They are permitted only when the original article has been translated into English.** The translated title should be cited and the original language noted in brackets at the end of the citation.

Textbook references should be kept to a minimum, as textbooks often reflect the opinions of their authors and/or editors. The most recent editions of textbooks should be used. Evidence-based journal citations are preferred.

Reference formatting
References must be identified in the body of the article with superscript Arabic numerals. At the end of a sentence, the reference number falls *after* the period.

The complete reference list, double-spaced and in numerical order, should follow the Conclusions section but start on a separate page. Only references cited in the text should appear in the reference list.

Reference formatting should conform to **Vancouver style** as set forth in "Uniform Requirements for Manuscripts Submitted to Biomedical Journals" (Ann Intern Med 1997;126:36-47).

References should be manually numbered.

List up to six authors. If there are seven or more, after the sixth author's name, add et al.

Abbreviate journal names per the **Cumulative Index Medicus**. A complete list of standard abbreviations is available through the PubMed website: http://www.ncbi.nlm.nih.gov/nlmcatalog/journals.

Format for journal articles: Supply the last names and initials of all authors; the title of the article; the journal name; and the year, volume, and page numbers of publication. Do not use italics, bold, or underlining for any part of the reference. Put a period after the initials of the last author, after the article title, and at the end of the reference. Put a semicolon after the year of publication and a colon after the volume. *Issue numbers are not used in Vancouver style.*

Ex: Jones ER, Smith IM, Doe JQ. Uses of acrylic resin. J Prosthet Dent 1985;53:120-9.

Book References: The most current edition must be cited. Supply the names and initials of all authors/ editors, the title of the book, the city of publication, the publisher, the year of publication, and the inclusive page numbers consulted. Do not use italics, bold, or underlining for any part of the reference.

Ex: Zarb GA, Carlsson GE, Bolender CL. Boucher's prosthodontic treatment for edentulous patients. 11th ed. St. Louis: Mosby; 1997. p. 112-23.

References should not be submitted in Endnote or other reference-generating software. Endnote formatting cannot be edited by the Editorial Office or reviewers, and must be suppressed or removed from the manuscript prior to submission. Nor should references be automatically numbered. Please number manually.

See Sample Manuscript.

Approved Abbreviations for Journals
Because the *Journal of Prosthetic Dentistry* is published not only in print but also online, authors must use the standard PubMed abbreviations for journal titles. If alternate or no abbreviations are used, the references will not be linked in the online publication. A complete list of standard abbreviations is available through the PubMed website: http://www.ncbi.nlm.nih.gov/nlmcatalog/journals.

Video

Elsevier accepts video material and animation sequences to support and enhance your scientific research. Authors who have video or animation files that they wish to submit with their article are strongly encouraged to include links to these within the body of the article. This can be done in the same way as a figure or table by referring to the video or animation content and noting in the body text where it should be placed. All submitted files should be properly labeled so that they directly relate to the video file's content. In order to ensure that your video or animation material is directly usable, please provide the file in one of our recommended file formats with a preferred maximum size of 150 MB per file, 1 GB in total. Video and animation files supplied will be published online in the electronic version of your article in Elsevier Web products, including ScienceDirect. Please supply 'stills' with your files: you can choose any frame from the video or animation or make a separate image. These will be used instead of standard icons and will personalize the link to your video data. For more detailed instructions please visit our video instruction pages. Note: since video and animation cannot be embedded in the print version of the journal, please provide text for both the electronic and the print version for the portions of the article that refer to this content.

Supplementary material

Supplementary material such as applications, images and sound clips, can be published with your article to enhance it. Submitted supplementary items are published exactly as they are received (Excel or PowerPoint files will appear as such online). Please submit your material together with the article and supply a concise, descriptive caption for each supplementary file. If you wish to make changes to supplementary material during any stage of the process, please make sure to provide an updated file. Do not annotate any corrections on a previous version. Please switch off the 'Track Changes' option in Microsoft Office files as these will appear in the published version.

Research data

This journal encourages and enables you to share data that supports your research publication where appropriate, and enables you to interlink the data with your published articles. Research data refers to the results of observations or experimentation that validate research findings. To facilitate reproducibility and data reuse, this journal also encourages you to share your software, code, models, algorithms, protocols, methods and other useful materials related to the project.

Below are a number of ways in which you can associate data with your article or make a statement about the availability of your data when submitting your manuscript. If you are sharing data in one of these ways, you are encouraged to cite the data in your manuscript and reference list. Please refer to the "References" section for more information about data citation. For more information on depositing, sharing and using research data and other relevant research materials, visit the research data page.

Data linking
If you have made your research data available in a data repository, you can link your article directly to the dataset. Elsevier collaborates with a number of repositories to link articles on ScienceDirect with relevant repositories, giving readers access to underlying data that gives them a better understanding of the research described.

There are different ways to link your datasets to your article. When available, you can directly link your dataset to your article by providing the relevant information in the submission system. For more information, visit the database linking page.

For supported data repositories a repository banner will automatically appear next to your published article on ScienceDirect.

In addition, you can link to relevant data or entities through identifiers within the text of your manuscript, using the following format: Database: xxxx (e.g., TAIR: AT1G01020; CCDC: 734053; PDB: 1XFN).

Mendeley Data

This journal supports Mendeley Data, enabling you to deposit any research data (including raw and processed data, video, code, software, algorithms, protocols, and methods) associated with your manuscript in a free-to-use, open access repository. During the submission process, after uploading your manuscript, you will have the opportunity to upload your relevant datasets directly to *Mendeley Data*. The datasets will be listed and directly accessible to readers next to your published article online.

For more information, visit the Mendeley Data for journals page.

Data statement

To foster transparency, we encourage you to state the availability of your data in your submission. This may be a requirement of your funding body or institution. If your data is unavailable to access or unsuitable to post, you will have the opportunity to indicate why during the submission process, for example by stating that the research data is confidential. The statement will appear with your published article on ScienceDirect. For more information, visit the Data Statement page.

Submission Checklist

The following list will be useful during the final checking of an article before sending it to the journal for review. Please consult this Guide for Authors for further details of any item. **Ensure the following items are present:**

One author has been designated as the corresponding author with contact details:

Email addressFull postal addressPhone number

All necessary files have been uploaded, and contain the following:

All figure thumbnails and legends All tables (including title, description, footnotes) Justification letter for more than 4 authors Patient photo permission IRB statements

Further considerations: Manuscript has been 'spell-checked' and 'grammar-checked'References are in the correct format for this journal All references mentioned in the Reference list are cited in the text, and vice versaThere are call-outs for each figure in the text Permission has been obtained for the use of copyrighted material from other sources (including the Web)

For any further information please visit our customer support site at https://service.elsevier.com.

AFTER ACCEPTANCE

Proofs

One set of page proofs (as PDF files) will be sent by e-mail to the corresponding author or, a link will be provided in the e-mail so that authors can download the files themselves. Elsevier now provides authors with PDF proofs which can be annotated; for this you will need to download Adobe Reader version 7 (or higher) available free from http://get.adobe.com/reader. Instructions on how to annotate PDF files will accompany the proofs (also given online). The exact system requirements are given at the Adobe site: http://www.adobe.com/products/reader/tech-specs.html.

If you do not wish to use the PDF annotations function, you may list the corrections (including replies to the Query Form) and return them to Elsevier in an e-mail. Please list your corrections quoting line number. If, for any reason, this is not possible, then mark the corrections and any other comments (including replies to the Query Form) on a printout of your proof and return by fax, or scan the pages and e-mail, or by post. Please use this proof only for checking the typesetting, editing, completeness and correctness of the text, tables and figures. Significant changes to the article as accepted for publication will only be considered at this stage with permission from the Editor. We will do everything possible to get your article published quickly and accurately – please let us have all your corrections within 48 hours. It is important to ensure that all corrections are sent back to us in one communication: please check carefully before replying, as inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely your responsibility. Note that Elsevier may proceed with the publication of your article if no response is received.

Online proof correction

To ensure a fast publication process of the article, we kindly ask authors to provide us with their proof corrections within two days. Corresponding authors will receive an e-mail with a link to our online proofing system, allowing annotation and correction of proofs online. The environment is similar to MS Word: in addition to editing text, you can also comment on figures/tables and answer questions from the Copy Editor. Web-based proofing provides a faster and less error-prone process by allowing you to directly type your corrections, eliminating the potential introduction of errors.
If preferred, you can still choose to annotate and upload your edits on the PDF version. All instructions for proofing will be given in the e-mail we send to authors, including alternative methods to the online version and PDF.
We will do everything possible to get your article published quickly and accurately. Please use this proof only for checking the typesetting, editing, completeness and correctness of the text, tables and figures. Significant changes to the article as accepted for publication will only be considered at this stage with permission from the Editor. It is important to ensure that all corrections are sent back to us in one communication. Please check carefully before replying, as inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely your responsibility.

Offprints

The corresponding author will, at no cost, receive a customized Share Link providing 50 days free access to the final published version of the article on ScienceDirect. The Share Link can be used for sharing the article via any communication channel, including email and social media. For an extra charge, paper offprints can be ordered via the offprint order form which is sent once the article is accepted for publication. Both corresponding and co-authors may order offprints at any time via Elsevier's Author Services. Corresponding authors who have published their article gold open access do not receive a Share Link as their final published version of the article is available open access on ScienceDirect and can be shared through the article DOI link.

Permissions

All quoted material must be clearly marked with quotation marks and a reference number. If more than 5 lines are quoted, a letter of permission must be obtained from the author and publisher of the quoted material.All manuscripts are submitted to software to identify similarities between the submitted manuscript and previously published work. If quotations are more than 1 paragraph in length, open quotation marks at the beginning of each paragraph and close quotation mark at the end of the final paragraph only. Type all quoted material exactly as it appears in the original source, with no changes in spelling or punctuation. Indicate material omitted from a quotation with ellipses (3 dots) for material omitted from within a sentence, 4 dots for material omitted after the end of a sentence). If any submitted photographs include the eyes of a patient, the patient must sign a consent form authorizing use of his/her photo in the Journal. If such permission is not obtained, the eyes will be blocked with black bars at publication. Illustrations that are reprinted or borrowed from other published articles/books cannot be used without the permission of the original author and publisher. The manuscript author must secure this permission and submit it for review. In the illustration legend, provide the full citation for the original source in parentheses.

Interest in Commercial Companies and/or Products

Authors may not directly or indirectly advertise equipment, instruments, or products in which they have a personal investment.Statements and opinions expressed in the manuscripts are those of the authors and not necessarily those of the editors or publisher. The editors and publisher disclaim any responsibility or liability for such material. Neither the editors nor the publisher guarantee, warrant, or endorse any product or service advertised in the Journal; neither the editors nor the publisher guarantee any claim made by the manufacturer of said product or service. Authors must disclose any financial interest they may have in products mentioned in an article. This disclosure should be typed after the Conclusions section.

Writing Guidelines

General Policies and Suggestions
Authors whose native language is not English should obtain the assistance of an expert in English and scientific writing before submitting their manuscripts. Manuscripts that do not meet basic language standards will be returned before review.The Journal does not use first person (I, we, us, our, etc.).

"We conducted the study" can be changed easily to "The study was conducted." Avoid the use of subjective terms such as "extremely", "innovative" etc. The JPD uses the serial comma which is the comma that precedes the conjunction before the final item in a list of three or more items: The tooth was prepared with a diamond rotary instrument, carbide bur, and carbide finishing bur. We prefer the nonpossessive form for eponyms: the Tukey HSD test rather than Tukey's HSD test, Down syndrome rather than Down's syndrome and so on.Describe experimental procedures, treatments, and results in passive tense. All else should be written in an active voice. Describe teeth by name (eg, maxillary right first molar), not number. Hyphens are not used for common suffixes and prefixes, unless their use is critical to understanding the word. Some prefixes with which we do not use hyphens include: pre-, non-, anti-, multi-, auto-, inter-, intra-, peri-.Eliminate the use of i.e. and e.g. as they are not consistent with Journal style. Spell out seconds, minutes, hours, etc.Only use abbreviations in the Tables.Avoid the repeated use of Product names in the manuscript. Please initially identify all the products used in the experiment and subsequently refer to them by generic terms.It is generally better to paraphrase information from a published source than to use direct quotations. Paraphrasing saves space. The exception is a direct quotation that is unusually pointed and concise. When long terms with standard abbreviations (as in TMJ for *temporomandibular joint*) are used frequently, spell out the full term upon first use and provide the abbreviation in parentheses. Use only the abbreviation thereafter. Even very common acronyms should still be defined at first mention. We do not italicize foreign words such as "in vivo", "in vitro." Abbreviate units of measurement without a period in the text and tables (9 mm). Insert a nonbreaking space between all numbers and their units (100 mm, 25 MPa) except before % and °C. There should never be a hyphen between the number and the abbreviation or symbol except when in adjectival form (100-mm span). Spell out "degrees" for angles. Use the degree symbol only for temperature, include a space between the number and degree symbol (e.g., 37 C). Contractions such as don't, it's, wouldn't, etc are not used in scientific writing.Avoid using the words ""respectively"" or ""former/latter."" Both force the reader to stop and backtrack.For the common statistical outcomes P, a, ß omit the zero before the decimal point as these cannot be greater than 1. Proprietary names function as adjectives. Nouns must be supplied after their use, as in *Vaseline petroleum jelly*. Wherever possible, use only the generic term. Do not use trademark symbols as they are not consistent with Journal style.

Some Elements of Effective Style

Short words. Short words are preferable to long ones if shorter word is equally precise.Familiar words. Readers want information that they can grasp easily and quickly. Simple, familiar words provide clarity and impact. Specific rather than general words. Specific terms pinpoint meaning and create word pictures; general terms may be fuzzy and open to varied interpretations. Brisk opening. Plunge into your subject in the first paragraph of the article. Limited use of modifying words and phrases. Check your adjectives, adverbs, and prepositional phrases. If they are not needed, strike them out. No unnecessary repetition. An idea may be repeated for emphasis—so long as that repetition is effective. Short sentence length. Twenty words or less is recommended. Rambling sentences cluttered with subordinate clauses and other modifiers are hard to read and may cause readers to lose their train of thought. Short sentences should, however, be balanced with somewhat longer ones to avoid monotony. Paragraphs. Break up long sections into paragraphs but avoid the use of single sentence paragraphs. Restraint. Writers who use flamboyant words or overstate their proposition or conclusions discredit themselves. Facts speak for themselves. Clearly stated conclusions. Don't hedge. If you don't know something, say so.

Objectionable Terms

The following are selected objectionable terms and their proper substitutes. For a complete list of approved prosthodontic terminology, consult the eighth edition of the *Glossary of Prosthodontic Terms* (J Prosthet Dent 2005;94:10-92).

Or visit JPD http://www.prosdent.org and click on Collections/Glossary of Prosthodontic Terms.

Alginate *use* Irreversible hydrocolloidBite *use* OcclusionBridge *use* Partial fixed dental prosthesisCase *use* Patient, situation, or treatment as appropriateCure *use* PolymerizeFinal *use* DefinitiveFreeway space *use* Interocclusal distanceFull denture *use* Complete dentureLower (teeth, arch) *use* MandibularModel *use* CastModeling compound *use* Modeling plastic impression compoundMuscle trimming *use* Border moldingOverbite, overjet *use* Vertical overlap, horizontal overlapPeriphery *use* BorderPost dam, postpalatal seal *use* Posterior palatal sealPrematurity *use* Interceptive occlusal contactSaddle *use* Denture baseStudy model *use* Diagnostic castTake impressions, photographs, radiographs *use* MakeUpper (teeth, arch) *use* MaxillaryX-ray, roentgenogram *use* Radiograph

In addition, *specimen* should be used rather than *sample* when referring to an example regarded as typical of its class.

Additional Terminology Guidelines

Acrylic
An adjective form that requires a noun, as in acrylic resin.

Affect, effect
Affect is a verb; effect is a noun.

African American
Spelled thus and preferred over Negro and black in both adjective (African American patients) and noun (… of whom 20% were African Americans) forms.

Average, mean, median
Mean and average are synonyms. Median refers to the midpoint in a range of items; the midpoint has many items above as below it.

Basic
Like fundamental, this word is often unnecessary. An example of unnecessary use: Dental implants consist of two basic types: subperiosteal and endosteal.

Between, among
Use between when 2 things are involved and among when there are more than 2.

Biopsy
This noun should NOT be used as a verb. A biopsy was performed on the Tissue, rather than: The tissue was biopsied.

Centric
An adjective that requires a noun, as in centric relation.

Currently, now, at present, etc.
These expressions are often unnecessary, as in: This technique is currently being used…

Data
Use as a plural, as in: The data were…

Employ
Should not become an elegant variation of use, as in This method is employed …

Ensure
Preferred over insure in the sense of to make certain.

Fewer, less
Use fewer with nouns that can be counted (fewer patients were seen) and less with nouns that cannot be counted (less material was used).

Following
After is preferred.

Imply, infer
The speaker implies; the listener infers.

Incidence
The rate at which a disease occurs in a given time; sometimes confused with prevalence (the total number of cases of a disease in a given region).

Majority
Means more than half; use most when you mean almost all. **Male, female**

For adult humans, use men and women. For children, use boys and girls.

Must, should
Must means that the course of action is essential. Should is less strong and means that the course of action is recommended.

Numbers
Spell out numbers used in titles or headings and numbers at the beginning of a sentence. The spelled version may also be preferable in a series of consecutive numbers that may confuse the reader (eg, 2 3.5-inch disks should be written two 3.5-inch disks). In all other cases, use Arabic numerals.

Orient
Proper form; avoid orientate.

Pathologic
Use instead of pathological. Other words in which the suffix -al has been dropped include biologic, histologic, and physiologic.

Pathology
The study of disease; often mistaken for pathosis (the condition of disease)

Percent
Use the percent sign in the text, as in The distribution of scores was as follows: adequate, 8%; oversized, 23%; and undersized, 69%. But spell out when the percent opens a sentence, as in Twenty percent of the castings ...

Prior to
Before is preferred.

Rare, infrequent, often not, etc.
Whenever possible, these vague terms should be backed up with a specific number.

Rather
Like very, this word should be avoided.

Regimen
A planned program for taking medication, dieting, exercising, etc. Not to be confused with regime, meaning a system of government or management.

Sex
Use "sex" rather than "gender" unless you are referring to the socially constructed roles, behaviors, activities, and attributes that a given society considers appropriate for men and women.

Symptomatology
The science or study of symptoms; this word is not a synonym for the word symptoms.

Technique
Preferred over technic.

Using
Avoid the dangling modifier in sentences such as "The impression was made using vinyl polysiloxane impression material." Write "with" or "by using" instead.

Utilize
Use is preferred.

Vertical
An adjective that needs a noun, as in vertical relation.

Via
Use through, with, or by means of.

White
Preferred over Caucasian. This is true only if the patient is from the Caucasus region of Eastern Europe. If not, use the term, white to describe the patient.

Sample Manuscript
https://www.elsevier.com/__data/promis_misc/ymprsamplemanuscript.pdf

AUTHOR INQUIRIES

Visit the Elsevier Support Center to find the answers you need. Here you will find everything from Frequently Asked Questions to ways to get in touch.
You can also check the status of your submitted article or find out when your accepted article will be published.