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CAROLINA BENDER HOPPE

Fatores clínicos e radiográficos associados ao sucesso do tratamento endodôntico.

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Linha de pesquisa:
Epidemiologia, etiopatogenia e repercussão das doenças da cavidade bucal e estruturas anexas

Tese apresentada ao programa de Pós-Graduação em Odontologia da Universidade Federal do Rio Grande do Sul, como requisito final para obtenção do título de Doutor em Odontologia, área de concentração Clínica Odontológica, Endodontia.

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RESUMO

Introdução: A complexidade anatômica do sistema de canais radiculares é um desafio para o desempenho técnico do tratamento endodôntico. As filosofias de tratamento são diversas e, mesmo dentro de protocolos prescritos, é difícil definir qual é mais eficaz. O objetivo desta tese foi avaliar a influência de diferentes fatores no sucesso clínico e radiográfico do tratamento endodôntico, e foi dividida em 2 artigos: artigo 1 – uma revisão sistemática de como são descritos os resultados de estudos observacionais que avaliam o sucesso do tratamento endodôntico; artigo 2 – um estudo retrospectivo de Coorte para avaliar a influência de diferentes fatores no sucesso clínico e radiográfico do tratamento endodôntico realizado nos curso de especialização em Endodontia da Universidade Federal do Rio Grande do Sul e no curso de especialização em Endodontia do Centro de Estudos Odontológicos Meridional da cidade de Passo Fundo, Rio Grande do Sul. **Metodologia:** A revisão sistemática (artigo 1) foi realizada por meio de três bancos de dados de busca eletrônica (PubMed / MEDLINE, Embase e Lilacs). Estudos retrospectivos ou prospectivos de proservação dos desfechos endodônticos, publicados em inglês, português ou espanhol, de janeiro de 2007 a dezembro de 2018 foram selecionados com base na estrutura PICO (paciente, intervenção, comparação e desfecho) e com base nos critérios de inclusão e exclusão. Dois revisores avaliaram a elegibilidade para inclusão e os dados foram extraídos. O estudo de Coorte retrospectivo (artigo 2) incluiu acompanhamento clínico e radiográfico de 134 tratamentos endodônticos de molares realizados em dois programas de pós-graduação. Dados pré, intra e pós-operatórios foram coletados. As radiografias foram avaliadas por 2 examinadores calibrados através do índice Periapical (PAI). Os dentes foram classificados como sucesso (PAI ≤2, sem sintomas ou sinais clínicos) ou insucesso (PAI ≥3, presença de sintomas ou sinais clínicos). A unidade avaliada foi o dente. Os participantes foram acompanhados por até 48 meses. Modelos bivariados e multivariados utilizando regressão de Poisson com variância robusta foram utilizados para avaliar os fatores preditivos para resultado do tratamento. **Resultados:** No artigo 1, dezoito artigos corresponderam aos critérios de inclusão. Características dos fatores que poderiam afetar o resultado tratamento endodôntico e informações dos resultados obtidos nos estudos foram coletadas. Os métodos utilizados para avaliar o sucesso também foram registrados. Apenas quatro artigos relatam todas as características a respeito da

execução do tratamento endodôntico propostas pela diretriz da ESE (European Society of Endodontology) – história médica e dental do paciente, exame clínico intra e extra-oral, diagnótico, plano de tratamento, registros do tratamento, revisões. No artigo 2, não houve diferença estatística entre os dois programas de pós-graduação considerando o sucesso do tratamento endodôntico. A presença de periodontite apical pré-operatória está associada à pior taxa de sucesso do tratamento endodôntico (P = 0,007), e a força dessa associação é válida mesmo quando o modelo é ajustado para idade, gênero, programa de pós-graduação, localização do dente, extensão do material obturador e período de proservação. A técnica de obturação da compressão vertical hidráulica está associada ao maior extravasamento de materiais obturadores (P = 0,000). **Conclusões:** O artigo 1 mostrou que a padronização dos critérios de coleta de dados do tratamento endodôntico para possibilitar estudos observacionais clínicos comparativos favoreceria futuras análises, aumentando a relevância científica das pesquisas. Um protocolo para a descrição dos resultados poderia minimizar a heterogeneidade dos estudos, considerando principalmente os fatores mais descritos em afetar o resultado do tratamento endodôntico (condição pulpar, periodontite apical e tamanho da lesão, tipo de dente e número de raízes, complicações, extensão apical do material obturador). O artigo 2 concluiu que independentemente da técnica e filosofia de tratamento utilizada, a taxa de sucesso não foi influenciada por fatores intraoperatórios. O fator de risco preditor para diminuir a taxa de sucesso foi a presença de periodontite apical prévia ao tratamento.

Palavras-chave: endodontia, estudo de Coorte, estudo retrospectivo, estudos de proservação, resultado do tratamento, revisão sistemática.

ABSTRACT

Introduction: The anatomical complexity of the root canal system and the pulp condition are challenges for the technical performance of endodontic treatment. Several methods and principles have been applied to reach the goal of endodontic treatment. The objective of this thesis was to evaluate the influence of different factors on the clinical and radiographic success of endodontic treatment, and was divided into 2 articles: article 1 – a systematic review to assess how the endodontic outcomes have been described by observational long-term studies and if the studies follow what was proposed by the ESE guideline; article 2 - a retrospective Cohort study to evaluate the influence of different factors on the clinical and radiographic success of the endodontic treatment performed in the endodontic post-graduation programs of the Federal University of Rio Grande do Sul and in the Centro de Estudos Odontológicos Meridional da cidade de Passo Fundo, Rio Grande do Sul. **Methodology:** in article 1, the systematic review was conducted through three electronic search databases (PubMed/MEDLINE, Embase and Lilacs). Retrospective or prospective follow-up studies of endodontic outcomes, published in English, Portuguese or Spanish from January 2007 to December 2018 were selected based on the PICO (patient, intervention, comparison, and outcome) framework and based on inclusion and exclusion criteria. Two reviewers assessed the eligibility for inclusion and the data were extracted. In Article 2, the retrospective cohort study included clinical and radiographic follow-up of 134 endodontic treatment of molars realized in two postgraduate programs. Pre-, intra- and postoperative data were collected. Radiographs were evaluated by 2 calibrated examiners through Periapical Index (PAI) score. Teeth were classified as success treatment (PAI ≤2, no symptoms or clinical signs) or failure (PAI ≥3, presence of symptoms or clinical signs). The evaluated unit was the tooth. Participants were followed-up for up to 48 months. Bivariate and multivariate models using Poisson regression with robust variance were used to evaluate the predicted factors of treatment outcome. **Results:** in article 1, eighteen articles matched the inclusion criteria. Aspects of root canal procedure that may affect endodontic treatment and information about the characteristics and outcomes of the studies were collected. The methods for assessing the success outcome used in the studies were also recorded. Only four articles report all features proposed by ESE quality guideline for

endodontic treatment – medical and dental history, clinical examination (intra and extra-oral), diagnosis, treatment planning, records, review. In article 2, there was no statistical difference considering the outcome of endodontic treatment between the two postgraduate programs. The presence of preoperative apical periodontitis is associated with poorer success rate of endodontic treatment (*P*=0.007), and the strength of this association holds true even when the model is adjusted for age, sex, postgraduate program, tooth location, filling level and recall period. Hydraulic vertical condensation filling technique is associated with the overextension of filling materials (*P*=0.000). **Conclusions:** the article 1 showed that standardization of endodontic treatment data collection criteria to enable comparative clinical observational studies would favour future analysis, increasing the scientific relevance of the researches. A guideline to regulate the description of the results could minimize the heterogeneity of the studies, mainly considering the factors that are most reported in affecting the outcome of endodontic treatment (pulp status, apical periodontitis and lesion size, tooth type and the number of roots, complications, the apical extent of root filling). The article 2 presented that regardless of the technique and treatment philosophy used, the success rate was not associated by intraoperative factors. The predictor risk factor to decrease the success rate was the presence of apical periodontitis prior to treatment.

Keywords: cohort study endodontics, follow-up studies, retrospective study, systematic review, treatment outcome.

LISTA DE SIGLAS E ABREVIATURAS

% - porcentagem

N – número amostral

NaOCl - hipoclorito de sódio

CHX - gluconato de clorexidina

PMCC - paramonoclorofenol canforado

ESE - European Society of Endodontology

NOS - Newcastle-Ottawa Scale

PAI - Periapical Index

UFRGS - Federal University of Rio Grande do Sul

CEOM-IMED - Centro de Estudos Odontológicos Meridional

AP - periodontite apical / apical periodontitis

RR - risco relativo

95%CI – intervalo de confiança 95%

SUMÁRIO

1. ANTECEDENTES E JUSTIFICATIVAS

A complexidade anatômica do sistema de canais radiculares e a condição da polpa são desafios para o desempenho técnico do tratamento endodôntico. Dessa forma, inúmeros métodos e princípios têm sido aplicados objetivando a desinfecção e modelagem adequada do sistema de canais radiculares, somados a uma obturação permanente que visa selar o canal radicular e manter ou restabelecer os tecidos periapicais de forma íntegra e saudável (IMURA *et al.*, 2007). A maneira de execução dos procedimentos endodônticos é diversa e mesmo dentro de protocolos prescritos é difícil definir qual é mais preciso, e é aceitável que as intervenções terapêuticas não sejam, por natureza, totalmente padronizáveis (NG *et al.*, 2008).

A literatura está repleta de estudos que documentam a influência de diversas variáveis técnicas, biológicas e clínicas sobre os resultados do tratamento endodôntico (ORSTRAVIK; QVIST; STOLTZE, 2004; IMURA *et al.*, 2007; NG *et al.*, 2008). Frequentemente esses estudos avaliam o sucesso com base no exame clínico e radiográfico (IMURA *et al.*, 2007) e comparam os procedimentos clínicos, os materiais e os medicamentos usados (ORSTRAVIK; QVIST; STOLTZE, 2004).

Dentre as variáveis técnicas e filosóficas, uma das mais controversas na terapia do canal radicular refere-se ao limite apical de instrumentação e obturação (RICUCCI, 1998). Esse tema vem sendo discutido por um longo tempo sem a definição de um consenso. Weine (1982) e Ingle (1973), por exemplo, defendem a ideia de um preparo abrangendo o interior do canal radicular até a zona de maior constrição apical, ou seja, 0,5 a 1 mm aquém do vértice radiográfico. Segundo os autores, com a sobre extensão da instrumentação, corre-se o risco de produtos tóxicos, provenientes do interior do canal radicular, serem empurrados para os tecidos periapicais.

Langeland (1967, 1987) segue a mesma vertente filosófica. Em seus estudos, demonstrou histologicamente que a polpa na porção apical do canal radicular, nos canais laterais e nas ramificações apicais permanece vital e frequentemente não inflamada, mesmo na presença de uma radiolucência. Ainda, afere que a instrumentação além da constrição foraminal causa um aumento desnecessário da ferida, de forma que os contaminantes do canal interferirão na cicatrização e os medicamentos e/ou materiais causarão destruição tecidual, inflamação e uma reação

de corpo estranho no tecido periapical. Independentemente de uma polpa vital ou necrótica, no entanto, ele sugere a terminação da obturação na constrição apical, aquém ao ápice, o que resultará na menor ferida possível e cura ideal.

Por outro lado, outros autores defendem a instrumentação até ou além do ápice radiográfico. Schilder (1967, 2006) afirmou que o objetivo é desbridar e preencher o canal radicular até o ápice, contemplando os canais laterais e ramificações apicais. Ele admitiu que seu procedimento, na maioria dos casos, envolvia instrumentação além do limite do canal radicular, dentro do ligamento periodontal adjacente. Souza-Filho, Benatti e Almeida (1987) relatam que se as alterações periapicais são causadas por microrganismos localizados em torno do forame apical, não há motivos para a limpeza e modelagem se limitarem antes do término do canal radicular. Ainda, defendem que a instrumentação seja feita ultrapassando o ápice, alargando o forame apical, com o intuito de produzir um coágulo de sangue responsável pelo reparo.

Existe a sugestão de que o alargamento apical não só permite uma maior redução das bactérias remanescentes e da dentina infectada, como também resulta em uma ação mais eficaz da solução irrigadora. Apesar das vantagens do alargamento foraminal, uma desvantagem frequentemente relatada é a possibilidade de dor pós-operatória relacionada com trauma físico da região periapical (SILVA *et al.*, 2013). Yaylali e colaboradores (2017) realizaram um estudo clínico randomizado para avaliar dor pós-operatória quando realizado ou não o alargamento foraminal. A intensidade da dor foi avaliada através de escala analógica visual durante 7 dias após o tratamento. Uma diferença significativa foi observada na dor pós-operatória nos dois primeiros dias; o grupo em que se realizou o alargamento foraminal relatou mais dor, sendo que mais de 30% relataram dor severa, do que o grupo em que o preparo dos canais foi realizado 1 mm aquém da contrição apical.

Em contrapartida, Silva e colaboradores (2013) relatam em seu estudo clínico randomizado de dor pós-operatória, que o preparo alargando o forame apical não mostrou diferença estatisticamente significativa em relação ao grupo em que o procedimento não foi efetuado. Desta forma, os autores concluem que o alargamento foraminal deve ser realizado para uma melhor descontaminação bacteriana, sem o aumento da dor pós-operatória.

A falha do tratamento endodôntico tem sido predominantemente associada a uma remoção ineficaz de microrganismos do sistema de canais radiculares. Portanto, a infecção persistente no canal radicular está relacionada ao remanescente de tecido necrótico e contaminado que, por sua vez, afeta a cicatrização tecidual na região periapical (GONÇALVES *et al.*, 2016). Substâncias químicas distintas têm sido sugeridas como soluções irrigadoras eficientes para a desinfecção de canais radiculares. Entre eles, o hipoclorito de sódio (NaOCl) é o mais utilizado no tratamento endodôntico devido à sua efetiva atividade antimicrobiana e capacidade de dissolver tecidos orgânicos (ZEHNDER 2006). As propriedades antimicrobianas e solvente matéria orgânica do NaOCl conferem sua eficácia como agente irrigante (GONÇALVES *et al.*, 2016). Por outro lado, o NaOCl é um potencial irritante dos tecidos periapicais, especialmente em altas concentrações (GERNHARDT *et al.*, 2004). Assim, a busca por outros irrigantes de canal radicular com menor potencial de induzir efeitos colaterais adversos é desejável. O gluconato de clorexidina (CHX) tem sido proposto como um promissor agente de irrigação para substituir o NaOCl durante a desinfecção do canal radicular e a instrumentação endodôntica (FERRAZ *et al.*, 2000; GONGALVES *et al.*, 2016). A CHX possui excelentes propriedades antibacterianas e anti-sépticas, e sua principal limitação como irrigante endodôntico é a sua incapacidade de dissolver o tecido pulpar (OKINO *et al.*, 2004; GONGALVES *et al.*, 2016).

Existem também diferentes opiniões sobre outras variáveis em relação ao tratamento endodôntico. Sessões múltiplas ou únicas ou casos de polpa necrótica ou polpa vital continuam sendo foco de inúmeras pesquisas (FIGINI *et al.*, 2008; ELMUBARAK; ABU-BAKR; IBRAHIM, 2010; SCHWENDICKE & GÖSTEMEYER, 2016; MOREIRA *et al.*, 2017).

A realização do tratamento endodôntico em uma sessão ou em várias é normalmente definida pelas circunstâncias particulares de cada caso e pela escolha da técnica que melhor se encaixa na situação. Assim, a complexidade do procedimento, a fadiga do paciente, a habilidade e a experiência do operador, as condições do dente (polpa vital ou não vital, sintomática ou assintomática, presença ou ausência de aumento de volume, drenagem ou fístula), a história médica atual e pregressa do paciente, como também alterações anatômicas e biológicas são

determinantes para a decisão do protocolo a ser utilizado (GURGEL-FILHO *et al.*, 2007; FIGINI *et al.*, 2008; MOREIRA *et al.*, 2017).

A evolução das técnicas de tratamento endodôntico e os avanços no conhecimento anatômico e biológico de doenças pulpares e periapicais possibilitaram a alternativa de tratamento em uma única visita ao consultório odontológico (FIGINI *et al.,* 2008; MOREIRA *et al.*, 2017). A abordagem da terapia no protocolo de sessão única é uma mudança de paradigma do tratamento endodôntico convencional realizado em mais sessões. Ambos os tratamentos possuem vantagens e desvantagens. No entanto, problemas relacionados com a infiltração no selamento coronal entre consultas, responsável pela reinfecção do sistema dos canais radiculares, e dificuldades na eliminação dessas bactérias são citados como proponentes para justificar a escolha da sessão única. Além disso, a diminuição do tempo de consulta para o paciente, possivelmente a redução dos custos do procedimento e a redução da morbidade decorrente de anestesias repetidas e colocação de isolamento absoluto também justificam o tratamento (FIGINI *et al.,* 2008).

Divergindo desse ponto de vista, outros profissionais preferem a abordagem de sessão múltipla para garantir a ausência de dor ou complicações pós-operatórias prévias à obturação do sistema de canais radiculares, bem como alcançar uma maior redução dos níveis microbiológicos, compatível com a reparação dos tecidos periapicais, através da utilização de uma medicação intracanal (SJÖGREN *et al.*, 1997).

Quando a realização do tratamento em mais de uma sessão for a opção, faz-se necessário a utilização de uma medicação intracanal, por exemplo, o hidróxido de cálcio, entre as consultas (ELMUBARAK; ABU-BAKR; IBRAHIM, 2010). Apesar de o preparo químico-mecânico ser o procedimento mais importante para otimizar a desinfecção do canal radicular (GURGEL-FILHO *et al.*, 2007), o uso do hidróxido de cálcio na endodontia está bem consolidado. Inúmeras propriedades biológicas foram atribuídas a essa substância, tais como a atividade antimicrobiana, a capacidade de dissolução de tecidos, inibição da reabsorção de dentes, indução para formação de tecido duro, inativação da endotoxina bacteriana, barreira física contra penetração bacteriana (SJÖGREN *et al.*, 1997; SIQUEIRA & LOPES, 1999; SILVA *et al.*, 2002).

Apesar das qualidades do hidróxido de cálcio, o seu espectro antibacteriano é limitado e não afeta todos os componentes da microbiota endodôntica. Além disso, as propriedades físico-químicas desta substância podem limitar a sua eficácia na desinfecção após uma utilização por períodos curtos (SIQUEIRA & LOPES, 1999).

Com o intuito de melhorar sua ação antimicrobiana, foram adicionados à pasta de hidróxido de cálcio veículos ativos. Dentre esses, destaca-se o uso da substância Paramonoclorofenol canforado (PMCC), que pode aumentar o espectro bactericida e promover a penetração mais profunda da medicação na dentina, pela sua volatilidade. Em relação aos benefícios da adição de clorexidina, outra substância que tem sido associada à pasta de hidróxido de cálcio, tem-se demonstrado a capacidade desta combinação agir contra bactérias gram-positivas e gram-negativas (ZANCAN *et al.*, 2016)

Ao analisar as taxas de sucesso e dor pós-operatória, quando comparados os tratamentos em sessão única e múltipla, estudos apontam não haver diferenças entre as técnicas (FIGINI *et al.*, 2008; ELMUBARAK; ABU-BAKR; IBRAHIM, 2010; FLEMING *et al.*, 2010; MOREIRA *et al.*, 2017). Figini et. al (2008), em sua revisão sistemática, relata também que nem o tratamento em sessão única nem o em sessão múltipla pode prevenir 100% as complicações de curto e longo prazo. Além disso, constatou que dentes submetidos à sessão única podem apresentar uma frequência ligeiramente mais elevada de processos agudos e referem uma maior necessidade de uso de analgésicos. Já Moreira *et al.* (2017), após analisar diferentes revisões sistemáticas, concluiram que tratamentos em sessão única ou múltiplas apresentaram taxas de reparo ou sucesso semelhantes, independentemente da pré-condição da polpa e do periápice. Quando avaliada a periodontite apical, foi encontrada uma menor incidência de complicações pós-operatórias e maior eficiência do tratamento em sessão única.

O estado pré-operatório da polpa e seu efeito sobre o tratamento também tem sido foco de estudos que relacionam fatores ao sucesso/insucesso. Ng *et al.* (2008) e Kojima *et al.* (2004) encontraram, através de suas meta-análises, que os dentes vitais apresentavam taxas de sucesso maiores (5-9%), demostrando uma melhor capacidade de cicatrização. Ambos concluíram que o estado pulpar pré-operatório é um fator influenciador significativo no sucesso do tratamento endodôntico. Por outro

lado, quando uma radiografia apresenta sinais de lesão periapical, invariavelmente conclui-se a presença de infecção no canal radicular, as taxas de sucesso caem entre 9-13% (NG *et al.*, 2008). Em relação ao tamanho inicial da lesão, diferenças no resultado do tratamento não foram encontradas, entretanto, o tempo para cicatrização aumentou, exigindo períodos de proservação mais longos (NG *et al.*, 2008; CHANDRA, 2009)

Existem fortes evidências de que não é possível a remoção de todos os microrganismos após o preparo químico-mecânico do canal radicular (BYSTRÖM & SUNVQVIST, 1985, SJÖGREN *et al.*, 1997). No entanto, é possível minimizar a quantidade de bactérias presentes aderindo a protocolos para controle da infecção, permanecendo assim a quantidade de microrganismos abaixo do "nível crítico". Manter um bom selamento coronal após a conclusão da obturação do canal radicular também é fundamental para minimizar a propagação microbiana. Na maioria dos casos, quando o crescimento bacteriano é controlado, o sistema hospedeiro responderá adequadamente ao antígeno. Assim, fundamental para o resultado do tratamento endodôntico é a capacidade do clínico de minimizar a quantidade de (re) colonização bacteriana, independente do protocolo escolhido para alcançar tal objetivo (CHANDRA, 2009).

A classificação dos resultados do tratamento é fundamental ao avaliar os fatores que afetam a terapêutica endodôntica. Em termos histológicos, o sucesso endodôntico ocorre quando há uma reparação completa dos tecidos periapicais sem a presença de células inflamatórias (SELTZER *et al.*, 1967; CHANDRA, 2009). No entanto, não é possível avaliar o reparo histológico clinicamente. Assim, contamos com achados radiográficos e clínicos, como a presença ou ausência de sinais e/ou sintomas, para aferir o resultado do tratamento endodôntico (SELTZER *et al.*, 1967; BENENATI & KHAJOTIA, 2002; CHANDRA, 2009).

As polpas necróticas e infectadas podem causar uma lesão inflamatória, gradualmente crescente, do tecido periapical. Esta inflamação é acompanhada por alterações estruturais no osso periapical, alterações essas visíveis e caraterísticas nas radiografias de diagnóstico (ORSTRAVIK; KEREKES; ERIKSEN, 1986; ORSTRAVIK; QVIST; STOLTZE, 2004).

Por conseguinte, o processo inflamatório pode mudar sua direção para fase de cicatrização ou para fase irritativa/destrutiva. Para se classificar de forma confiável e reprodutível essas fases biológicas, um sistema de pontuação de escala ordinal em avaliações radiográficas de periodontite apical foi aprimorado por Orstravik e colaboradores, em 1986. Tal sistema emprega, por meio de pontuação, uma categoria que representa o momento biológico que se encontra o dente estudado. Esse sistema, conhecido como índice periapical (PAI), tem sido ferramenta útil para estudos epidemiológicos, para ensaios clínicos e análises retrospectivas de resultados de tratamento em endodontia (ORSTRAVIK; QVIST; STOLTZE, 2004).

O PAI atribui um valor numérico conforme a extensão/gravidade da condição periapical e classifica a situação do dente estudado da seguinte forma: 1- destruição óssea periapical definitivamente não está presente; 2- destruição óssea periapical provavelmente não está presente; 3- incerto; 4- destruição óssea periapical provavelmente está presente; 5- destruição óssea periapical definitivamente está presente. Para fins analíticos, foi atribuída uma pontuação de 6 às raízes extraídas independentemente do motivo da exodontia (ORSTRAVIK; KEREKES; ERIKSEN, 1986; ORSTRAVIK; QVIST; STOLTZE, 2004).

Embora a infecção seja a causa dominante da periodontite apical e, portanto, remeta ao resultado negativo do tratamento endodôntico, as variáveis técnicas e biológicas durante a realização dos procedimentos desempenham um papel direto ou indireto na determinação desse resultado (ORSTRAVIK; QVIST; STOLTZE, 2004).

Os resultados encontrados em estudos que avaliam a influência de variáveis técnicas e biológicas sobre os resultados do tratamento têm mostrado diferenças consideráveis em relação à composição dos dados e metodologia (IMURA *et al.*, 2007). Além disso, abordam variáveis individuais de forma isolada e sem análise em conjunto com outras determinantes (ORSTRAVIK; QVIST; STOLTZE, 2004).

O resultado do tratamento deve ser acompanhado periodicamente. O principal objetivo dessa avaliação é monitorar a cicatrização ou o desenvolvimento de periodontite apical. Registros dos sintomas, queixas, história odontológica, resultados de exames clínicos e dos testes endodônticos, além de tomadas radiografias são fundamentais para a proservação de cada caso. Recomenda-se acompanhamento clínico e radiográfico em intervalos regulares durante um período mínimo de

observação de 1 ano, mas o tempo de acompanhamento pode aumentar quando a cicatrização se apresentar incompleta (EUROPEAN SOCIETY OF ENDODONTOLY, 2006).

Métodos multivariados têm sido desenvolvidos para analisar a influência simultânea de vários fatores sobre uma variável dependente, podendo permitir julgamentos e discussões a respeito da importância relativa de cada fator (ORSTRAVIK; QVIST; STOLTZE, 2004). Dessa forma, a obtenção de dados amostrais robustos, quando abordado o tratamento endodôntico, é significativa, especialmente em se tratando de seleção e planejamento de casos. Tal informação proporciona ao clínico ferramentas para a determinação do tratamento, auxilia em decisões mais previsíveis quanto ao prognóstico a longo prazo, permitindo que o paciente mantenha sua dentição natural em função (IMURA *et al.*, 2007).

Neste sentido, este trabalho pretende avaliar, através de uma revisão sistemática, como os estudos observacionais de desfechos endodônticos têm descrito seus resultados e se seguem as orientações propostas pelo *guideline* “Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology” (EUROPEAN SOCIETY OF ENDODONTOLY, 2006). Além disso, comparar, através de um estudo de Coorte retrospectivo, diferentes fatores técnicos e clínicos de tratamentos realizados em dois cursos de especialização em Endodontia distintos no sucesso do tratamento endodôntico.

2. OBJETIVOS

2.1 Objetivo Geral

O objetivo geral deste estudo foi avaliar como os desfechos endodônticos são descritos na literatura e como diferentes fatores influenciam no sucesso clínico e radiográfico do tratamento endodôntico.

2.2 Objetivos Específicos

Avaliar, com base em uma busca sistemática da evidência disponível, estudos observacionais que avaliaram sucesso endodôntico e como este foi descrito a partir do ano de 2007 e compará-los com as diretrizes preconizadas pela Sociedade Européia de Endodontia (European Society of Endodontology (2006) Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology).

Comparar os tratamentos endodônticos realizados no curso de especialização em Endodontia da Universidade Federal do Rio Grande do Sul e no curso de especialização em Endodontia do Centro de Estudos Odontológicos Meridional da cidade de Passo Fundo, Rio Grande do Sul, e associá-los ao sucesso ou insucesso do tratamento endodôntico.

3. ARTIGOS CIENTÍFICOS

Artigo 1- CB Hoppe, PM Lang, RA Mendes, F Montagner, FS Grecca. *How the studies h*ave been described the clinical and radiographic outcomes of endodontic treatment after European Society of Endodontology (2006) guideline publication: *A Systematic Review.*

Artigo 2 - CB Hoppe, PM Lang, L Dotto, RK Scarparo, MSM Hartmann, MS Gomes, FS Grecca. *Long-term outcome of multi-rooted endodontic treatment performed in postgraduate programs.*

Artigo 1- CB Hoppe, PM Lang, RA Mendes, F Montagner, FS Grecca. *How the studies h*ave been described the clinical and radiographic outcomes of endodontic treatment after European Society of Endodontology (2006) guideline publication: *A Systematic Review.* (Formatado para a revista International Endodontic Journal)

How the studies h*ave been described the clinical and radiographic outcomes of endodontic treatment after European Society of Endodontology (2006) guideline publication: *A Systematic Review.

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Abstract

Aim: The purpose of this systematic review was to assess how the endodontic outcomes have been described by observational long-term studies and if the studies follow what was proposed by the ESE guideline.

Methodology: This systematic review was conducted through three electronic search databases (PubMed/MEDLINE, Embase and Lilacs), following the guidelines of Transparent Reporting of Systematic Reviews and Meta-analyses (PRISMA-statement). Retrospective or prospective follow-up studies of endodontic outcomes, published in English, Portuguese or Spanish from January 2007 to December 2018 were selected based on the PICO (patient, intervention, comparison, and outcome) framework and based on inclusion and exclusion criteria. Two reviewers assessed the eligibility for inclusion and the data were extracted.

Results: Eighteen articles matched the inclusion criteria. Aspects of root canal procedure that may affect endodontic treatment and information about the characteristics and outcomes of the studies were collected. The methods for assessing the success outcome used in the studies were also recorded. Only four articles report all features proposed by ESE quality guideline for endodontic treatment.

Conclusion: Standardization of endodontic treatment data collection criteria to enable comparative clinical observational studies would favour future analysis, increasing the scientific relevance of the researches. A guideline to regulate the description of the results could minimize the heterogeneity of the studies, mainly considering the factors that are most reported in affecting the outcome of endodontic treatment (pulp status, apical periodontitis and lesion size, tooth type and the number of roots, complications, the apical extent of root filling).

Introduction

Endodontic treatment comprehends procedures that are designed to maintain the patient's health (European Society of Endodontics 2006), focused on asepsis and disinfection of root canal system, with functional preservation of the remaining tooth structure (Chungal *et al.* 2007). The aetiology and diagnosis of dental pain and diseases are integral parts of endodontic practice. For this reason, the principles for root canal treatment have been supported by guidelines that are based on clinical/microbiological evidence and long-term clinical outcome data.

The European Society of Endodontology (ESE) (2006) requirement for endodontic treatment suggests how to procedure when the dental pulp is diseased or injured, or apical periodontitis has occurred. This is usually carried out by root canal treatment which aims to preserve or to restore the periradicular tissues to health. Thus, it is expected that every dental practitioner will be able to recognize and treat effectively pulpal and periapical injuries and diseases that are commonplace, within the skills acquired by graduates of dental schools (European Society of Endodontics 2006).

Besides knowing how to deal with pulpal/periapical diseases, it is essential to understand which factors positively or negatively influence the outcome of endodontic treatment (Liang *et al.* 2011). The longitudinal studies have been performed evaluating the outcome and allowing the clinician to estimate the best prognosis of the proposed root canal treatment (Patel *et al.* 2012). Clinical evaluation and periapical radiographs have been the traditional method to confirm the absence of both pain and periapical lesion as criteria for success of endodontic treatment (Fernández *et al.* 2013). Moreover, additional information through the three-dimensional radiographic assessment of teeth and their surrounding structures with cone beam computed tomography may increase and/or improve diagnostic accuracy (Patel *et al.* 2019). Such information enables to make more predictable decisions regarding the long-term survival of endodontic treatment, allowing the patient to retain their natural dentition in function.

Success or failure rates of treatment modalities are an important part of evidence-based practice in endodontics (Zmener & Pameijer 2012). Nonetheless, there is still much disagreement on treatment protocols, and studies have shown considerable differences in the data composition, clinical procedures, and methodology (Imura *et al.* 2007). Thence, it is interesting that the treatments

performed, and the data collected follow the protocol guidelines to enable the comparison of the results obtained with the endodontic treatment. Another approach to evaluate the outcome of endodontic therapy is the analysis of treatment variables, providing the clinician more tools for clinical decision making and assessment of teeth prognosis (Imura *et al.* 2007).

Considering the exposed topic, the purpose of this systematic review was to assess how the endodontic outcomes have been described by long-term observational studies and if the studies follow what was proposed by the ESE guideline.

Methodology

Search strategy

This systematic review was conducted through electronic search databases, following the guidelines of Transparent Reporting of Systematic Reviews and Meta-analyses (PRISMA-statement). The electronic PubMed/MEDLINE, Embase and Lilacs databases were used for research, in addition a manual investigation of relevant articles. Studies were selected based on the PICO (patient, intervention, comparison, and outcome) framework and based on inclusion and exclusion criteria. Two reviewers screened the titles and abstracts of all articles identified in the electronic and manual searches. Articles that did not meet the inclusion criteria were excluded while remaining articles were full-text reviewed and subjected to critical analysis.

The following keywords and their combinations were used: “ROOT CANAL THERAPY” [MeSH], “ENDODONTIC PROCEDURE” [Emtree], “ROOT CANAL THERAPY” [DeCS], “RADIOGRAPHIC EVALUATION”, “FOLLOW-UP ENDODONTIC TREATMENT”, “ENDODONTIC FOLLOW-UP”, “OUTCOME OF ENDODONTIC TREATMENT”, “RADIOGRAPHIC HEALING OUTCOME”, “ENDODONTIC CLINICAL OUTCOME”, “ENDODONTIC OUTCOME”

Eligibility criteria

The full texts of the studies were obtained and reviewed to establish whether the studies met the following inclusion criteria:

1- Retrospective or prospective follow-up studies.

2- Stratified data analysis and sample size described or available raw data to be calculated.

3- Permanent teeth with fully formed apex undergoing endodontic treatment

4- Success rate in terms of number of teeth/roots and based on clinical and radiographic evaluation

5- Articles published in English, Portuguese or Spanish from January 2007 to December 2018.

6- At least 6-month postoperative follow-up.

The exclusion criteria consist of the literature that did not fit these inclusion criteria and studies that only assess prevalence. Disagreements on study inclusion were resolved by discussion. The reasons for study rejection at this or subsequent stages were recorded.

Data extraction and Quality assessment

A data extraction sheet was developed by the authors to collect information about study characteristics and all aspects of treatment that could affect the outcomes (title, year of publication, journal, authors, location, number of samples, sex, age, type of tooth, tooth location, recall rate, success rate, pulpal/periapical diagnosis, follow-up period, treatment operator, patient contact, single or multiple visits, irrigation solution, intracanal dressing, filling technique, endodontic sealer, apical extent of filling, electronic apex locator, coronal seal). Reviewers independently rated the quality of each study based on established criteria and the Newcastle-Ottawa Scale (NOS), and a consensus was reached (Table 1).

Results

Figure 1 details a flowchart of the systematic review process. An initial electronic search identified 394 studies, and a hand searching process identified six studies. Of the total, 65 were select by titles, 9 described duplicated studies and were removed. The abstracts of all remaining articles were screened, and 32 articles were excluded because they did not meet the search criteria. Twenty-four full-text papers were read in full and 18 matched the inclusion and exclusion criteria. All the papers were found in the databases in their full version, and the authors did not need to be contacted.

Table 2 summarizes the information collected about the characteristics and outcomes of the studies. Among the 18 articles, most of the studies were carried out in the American continent (n=13), followed by European (n=4) and Asian (n=1). The population in the studies varied considerably from 32 (Benvenutti *et al.* 2016) to 2000 (Imura *et al.* 2007) patients. Some studies use the tooth as a unit of evaluation and others the roots or both, and these numbers varied between 38 (Benvenutti *et al.* 2016) to 2000 (Imura *et al.* 2007) teeth and roots endodontic treated. Retreatment data were disregarded. The women were the majority of the patients treated (in 16 of 18 studies assessed), one study did not specify the sex of the participants (Azim *et al.* 2016), and Imura *et al.* (2007) related more men than women. The age of the patients ranged between 9 and 83. Posterior teeth were the most treated teeth. The recall rates range from 18.7% to 75% and the success rate varied between 78% and 94%. The shortest follow-up time was eight months, and the highest was 120 months. In 10 studies the operators were endodontists, in 4 were dental student, in 3 were postgraduate students, and in 1 was a clinical practice. The patient's contact was realized mainly through telephone, and then through letter and e-mails.

Table 3 summarizes all aspects of root canal procedure that may affect outcomes of endodontic treatment.

Table 4 evaluates whether the studies follow the guidelines for endodontic treatment suggested by the European Society of Endodontology (2006).

Table 5 describes the methods for assessing the success outcome used in the studies. One study used the criteria of the American Association of Endodontics (http://www.aae.org/dentalpro/guidelines.htm) (Benvenutti *et al.* 2016), nine used their own evaluation methods (Zmener & Pameijer 2012, 2010, 2007, Liang *et al.* 2011, Nery *et al.* 2012, Patel *et al.* 2012, Azim *et al.* 2016, Chybowski *et al.* 2018, Ng *et al.* 2011), one used criteria of the European Society of Endodontology 1994 (Imura *et al.* 2007), two used slight modification of Strindberg's criteria (Chungal *et al.* 2007, Ricucci *et al.* 2011), and five used periapical Index (PAI) by Orstavik *et al.* (1986) (Monardes *et al.* 2016, Fernández *et al.* 2013, Craveiro *et al.* 2015, Pirani *et al.* 2015, de Chevigny *et al.* 2008).

Discussion

Longitudinal studies constitute one of the instruments to establish the quality of endodontics. Clinical findings enable to guide and transpose the experimental, biological, microbiological and physicochemical results (Nery *et al.* 2012). The main disadvantage of a longitudinal design is the data analysis is restricted to the available information and is therefore vulnerable to interpretation bias (Craveiro *et al.* 2015).

Although many criteria are similar, none of the studies is exactly alike. The heterogeneity of the studies derives from the variation of the factors under observation such as participants and interventions (clinical heterogeneity), variations in study design and evaluation techniques (methodological heterogeneity), and variations in the analysis of the data derived from each study (statistical heterogeneity) (Gillen *et al.* 2011). Standardization of study criteria would make the future analysis more manageable and produce a stronger impact (Gillen *et al.* 2011). Therefore, one way to solve the lack of standardization of study protocols could be to follow what is proposed in the guidelines of root canal treatment.

Treatment guidelines are developed to assure the quality of service rendered by a member of the dental profession. The European Society of Endodontology addresses two essential elements: (i) appropriateness of treatment modality and (ii) quality or level of treatment rendered (European Society of Endodontology 2006), accepting the responsibility to formulate treatment guidelines intended to represent current good practice. As there is not one single way of performing treatment, these guidelines have been formulated in broad terms European Society of Endodontology 2006). Thus, ESE guideline shows how to procedure and describe an endodontic treatment.

Many features of evaluation in Endodontics are common to all aspects of practice, however, it is important to include all information during the treatment, such as medical and dental history, clinical examination (extra- and intra-oral), diagnosis, treatment planning and records (informed consent, treatment records, follow-up/review). It was observed that the factors poorly describe in the studies are about the patient's dental and medical history and clinical examination, and only four studies report all features proposed by ESE guideline (Ng *et al.* 2011, Nery *et al. 2012,* Fernández *et al.* 2013*,* Azim *et al.* 2016). In addition, the development of specific guidelines for describing outcomes of endodontic treatment in observational studies could benefit standardization and enable a suitable comparison between the studies.

Sample sizes ranging from 32 (Benvenutti *et al.* 2016) to 2000 (Imura *et al.* 2007) patients were found between the studies of this review. The additional problem is to define the unit of evaluation, because some studies consider the tooth (Imura *et al.* 2007, Chungal *et al.* 2007, de Chevigny *et al.* 2008, Zmener & Pameijer 2007, 2010, 2012, Ricucci *et al.* 2011, Nery *et al.* 2012, Patel *et al.* 2012, Craveiro *et al.* 2015, Pirani *et al.* 2015, Benvenutti *et al.* 2016, Monardes *et al.* 2016, Chybowski *et al.* 2018) and others the root as sample unit (Chungal *et al.* 2007, Liang *et al.* 2011, Ricucci *et al.* 2011, Ng *et al.* 2011, Patel *et al.* 2012, Fernández *et al.* 2013, Azim *et al.* 2016). Our point of view understands that the unit of evaluation should consider the tooth in its entirety since if one of the roots is not healthy and cured, the tooth cannot be considered functional and the tooth survival will be impaired.

The focus of endodontic treatment is directed at disinfection through chemomechanical debridement and preparation, followed by a complete three-dimensional filling of the root canal system, preserving the remaining tooth structure and rehabilitating lost structures with an appropriate permanent restoration (Chungal *et al.* 2003). Despite the presence of a host of factors that contribute to success or failure of root canal treatment, the fundamental biologic principle that determines clinical success remains in focus (Gillen *et al.* 2011).

The presence and the extent of a preoperative periapical lesion had the strongest negative effect on endodontic outcome (Chungal *et al.* 2001, 2003, Chybowsky *et al.* 2018). Sjögren *et al.* (1990) reported that teeth with no preoperative periapical lesions do not constitute a therapeutic problem (96% of success), but teeth with pulp necrosis and periapical lesions and those with periapical lesions undergoing retreatment constitute major therapeutic problems decreasing the success rates to 86% and 62%, respectively. Similar results were found (Imura *et al.* 2007, de Chevigny *et al.* 2008, Ricucci *et al.* 2011, Ng *et al.* 2011, Patel *et al.* 2012, Pirani *et al.* 2015, Azim *et al.* 2016).

Nevertheless, Sjögren *et al.* (1990) also suggested that the prognosis for initial endodontic treatment of necrotic teeth with periapical lesions was as good as that for vital teeth when the instrumentation and filling of the root canal could be carried out to an optimal level. The presence of the preoperative apical radiolucent area did not appear to adversely affect the outcome of endodontic treatment in some studies of this review (Zmener & Pameijer 2007, 2010, 2012). In addition, other studies did not present significant differences in success rate (Zmener & Pameijer 2007, 2010, 2012,

Craveiro *et al.* 2015, Benvenutti *et al.* 2016, Chybowski *et al.* 2018) regarding the preoperative pulp diagnosis.

The success rate is a comparable factor that evaluates the prognosis of endodontic treatment. In this study, success rate values varied between 94% and 78%. The higher success rate can be related to respect for technical precepts. The decreasing rate might be related to the level of professional experience, among other factors. This difference in success rate can be explained by the fact that the improvement of the technique through practice and specialization affects the results of endodontic treatments (Benvenutti *et al.* 2016), even if patients referred to the specialist usually present cases with a higher degree of difficulty and complexity (Chybowski *et al.* 2018).

The complexity of the treatment is higher for posterior teeth due to anatomy and number of root canals. Azim *et al.* (2016) observed a more favourable outcome in roots with one canal compared to those having two, proving that complex canal systems are more challenging to disinfect owing to the presence of debris accumulation at the intercanal communication spaces (Azim *et al.* 2016). Most of the treated cases in the studies reviewed were posterior teeth and some studies presented the outcome data regarding tooth location (Imura *et al.* 2007, de Chevigny *et al.* 2008, Liang *et al.* 2011, Ricucci *et al.* 2011, Ng *et al.* 2011, Patel *et al.* 2012, Fernández *et al.* 2013, Craveiro *et al.* 2015, Pirani *et al.* 2015, Azim *et al.* 2016).

The assessment of healing or progression of apical periodontitis (AP) after treatment is usually monitored radiographically. Bone density changes are the most consistent feature of progression or resolution of periapical inflammation present in radiographs (Delano *et al.* 2001). Clinical and radiographic follow-ups at regular intervals for a minimum observation period of one year are desirable, but longer may be necessary where healing is incomplete, or there is a history of trauma and annual recall for up to 4 years before a case is judged a failure is suggested (European Society of Endodontology 2006). Azim *et al.* (2016) found an average healing time of 11.78 months, corroborating with previous findings (Orstavik 1996, Imura *et al.* 2007) and indicating that 1 year is perhaps the minimal time required for most cases before concluding treatment outcome. The extended follow-up period of most studies analyzed in this review could also explain the high success rates that were found, whereas complete healing may require a longer period of monitoring time (Orstavik 1996, Molven *et al.* 2002).

The conventional radiography presents some limitations as two-dimensional shadowgraph, distortions and the need of perforation of the overlying cortical plate to diagnosed periapical radiolucent lesions (Liang *et al.* 2011, Patel *et al.* 2019), This last limitation may cause an overestimation of the success rate (Fernández *et al.* 2013). The incorporation of CBCT, multi-slice imaging information in 3 dimensions, overcomes some of these barriers, presenting a higher sensitivity for detection of periapical lesions (Fernández *et al.* 2013, Patel *et al.* 2019). However, an important aspect that must be addressed is the potential presence of false readings in the reconstructed CBCT images, considering that the resolution of CBCT images is lower than that of periapical radiographs (Fernández *et al.* 2013) and the artefact of metallic restorations is enough to compromise the image details. Furthermore, the potential benefits of CBCT must be balanced with the higher levels of risk from radiation exposure, but it is an alternative to take into account when the diagnosis from a clinical and radiographic assessment is inconclusive (Patel *et al.* 2019).

Three studies of this review (Zmener & Pameijer 2007, 2010, 2012) used the same sample but different times of follow-up and it could be seen that the recall rates are reduced when the recall period increases, as described by Orstavik in 1996. The recall rates assessed in this review range from 18.7% to 75%. The problems of recalling patients in clinical studies are often cited for failing or the inability to attend review appointments for reasons as expense (for example, transport), the transient nature of the working population in large cities and lack of time, including travelling to and from work/home (Friedman *et al.* 2003, Ng *et al.* 2011) or simply because it is not possible to contact them (Orstavik1996).

When a patient does not respond to recall there is always the possibility that one is dealing with a root canal treatment failure and therefore, the data that was generated may not be representative of the actual results (Zmener & Pameijer 2007, 2010, 2012). However, patients in pain could be more likely to attend the recall appointment. This higher attendance of symptomatic cases could skew the outcome measures toward a higher failure rate than the actual failure rate, or asymptomatic failures could have less likely to be counted in the study's outcome measurements (Chybowski *et al.* 2018).

Regarding the aspects of root canal procedure, six studies performed the endodontic treatment exclusively in single visit (Zmener & Pameijer 2007, 2010, 2012, Patel *et al.* 2012, Pirani *et al.* 2015, Chybowski *et al.* 2018), ten studies reported one

or more sessions (Chungal *et al.* 2007, Imura *et al.* 2007, de Chevigny *et al.* 2008, Liang *et al.* 2011, Ricucci *et al.* 2011, Ng *et al.* 2011, Nery *et al.* 2012, Fernández *et al.* 2013, Craveiro *et al.* 2015, Azim *et al.* 2016), and two did not report this data (Benvenutti *et al.* 2016, Monardes *et al.* 2016). Single-visit treatment is attractive because it is faster and reduces staff and costs (e.g., no repeated application of anesthetics, no intermediary restorations, no canal medication, fewer displacements) (Schwendicke & Göstemeyer 2016). However, one session treatment depends on some features as dentists' endodontic skills, patient collaboration and the complexity level of the case. In this systematic review, all studies that performed root canal treatment exclusively in a single session the operator was an endodontist.

On the other hand, Figini *et al.* (2007) have shown that the outcome of treatment was not significantly influenced by the number of visits, but people undergoing root canal treatment in a single visit may be more likely to experience pain in the first week than those whose procedure was over multiple visits (Manfredi *et al.* 2016). Consequently, the used of painkiller was significantly less in patients undergoing multiple-visit treatment (Figini *et al.* 2007, Manfredi *et al.* 2016). It is possible that in the single-visit approach the working time is longer, causing a more severe acute inflammatory response. Another factor could be the beneficial effect of the intracanal medication in the between-visit interval (Manfredi *et al.* 2016).

The most popular intracanal medication currently in use is calcium hydroxide (Figini *et al.* 2007, Manfredi *et al.* 2016), and its benefits (osteogenic properties, to stimulate mineralization and repair, to neutralize the remaining bacterial toxins, antibacterial actions, to maintain the temporary sealing avoiding percolation of fluids) are well established in the literature (Siqueira & Lopes 1999, Silva *et al.* 2002, Estrela & Holland 2003, Estrela *et al.* 2014, Holland *et al.* 2003, 2017). In this review, all the studies that reported interappointment medication chose calcium hydroxide as intracanal dressing (Chungal *et al.* 2007, Imura *et al.* 2007, de Chevigny *et al.* 2008, Liang *et al.* 2011, Ricucci *et al.* 2011, Ng *et al.* 2011, Nery *et al.* 2012, Fernández *et al.* 2013, Craveiro *et al.* 2015, Azim *et al.* 2016).

Cleaning and shaping of root canal system using irrigant solutions play an essential role in the success of debridement and disinfection (Estrela *et al.* 2002, 2008). Distinct chemicals have been suggested as efficient irrigant solutions for root canal disinfection (Gonçalves *et al.* 2016). Among them, sodium hypochlorite (NaOCl) is the most widely used in endodontic treatment because of its effective antimicrobial

activity and ability to dissolve organic tissues (Estrela *et al.* 2002, Zehnder 2006). Nonetheless, the solution concentration is still a matter of debate and remains controversial (Hülsmann & Hahn 2000). Rôças and Siqueira (2010) reported bacterial diversity of the root canal decreased significantly after chemomechanical endodontic preparation using NaOCl at 2.5%. (Gonçalves *et al.* 2016). Herein, it can be showed the NaOCl solution was the preferred alternative of irrigant in all studies, and the concentration most used was 2.5%, ranging between 0.5% to 6%.

For an enhanced anti-bacterial effect, sodium hypochlorite is particularly recommended at higher concentrations; however, increased concentrations have greater toxicity and can irritate periapical and periodontal tissue (Estrela *et al.* 2002, Gernhardt *et al.* 2004). To avoid these inconvenient complications, NaOCl should be used with caution. The incorrect determination of endodontic working length, iatrogenic widening of the apical foramen, lateral perforation, or wedging of the irrigating needle could be the reason of mishaps (Hülsmann & Hahn 2000). The use of apex locator to detect the real length of the root canal and the apical constriction and/or to distinguish perforations or resorptions before irrigating may be a way to support the use of NaOCl with safety (Gernhardt *et al.* 2004). Eight studies (Liang *et al.* 2011, Ng *et al.* 2011, Ricucci *et al.* 2011, Patel *et al.* 2012, Fernández *et al.* 2013, Craveiro *et al.* 2015, Azim *et al.* 2016, Chybowski *et al.* 2018) of this review reported the used of apex locator to determine the working length of root canals. Different working lengths were defined as in apical constriction (Ricucci *et al.* 2011, Ng *et al.* 2011, Craveiro *et al.* 2015), 1 mm short of the radiographic apex (Imura *et al.* 2007, Zmener & Pameijer 2007, 2010, 2012), 1 mm short of the ‘0’ apex locator (Patel *et al.* 2012), 0.5 from radiographic apex (Pirani *et al.* 2015) and cleaning apical foramen (Nery *et al.* 2012).

About root canal filling level, the studies presented adequate filling, but some under or overextended of root canal filling material were describe. An association between the apical limit of the root canal filling and the success of the endodontic therapeutics has been described (Ricucci *et al.* 2011, Benvenutti *et al.* 2016). Root canals filled below the apex presented higher unsuccessful rates (Ricucci *et al.* 2011, Ng *et al.* 2011, Fernández *et al.* 2013, Pirani *et al.* 2015, Azim *et al.* 2016, Benvenutti *et al.* 2016). The incomplete filling of the root canal often results in inadequate instrumentation and allows the maintenance of the necrosis remnants and bacteria close to the periapical region (Estrela *et al.* 2014). Schaeffer *et al.* (2005) recommend that the root canal filling should achieve the proximities of the apical foramen,

approximately 1-2mm short of the apex. According to Ricucci *et al.* (2011), both for cases with vital pulp and cases with necrotic pulp, a successful treatment outcome is less likely when overfilling the root canal.

Filling material protruding into the periapical tissues may cause immediate tissue destruction and inflammation. A resulting asymptomatic foreign body reaction may explain some of the radiolucencies recorded after the end of the normal follow-up period (Nair *et al.* 1990, Ricucci & Langeland 1998, Molven *et al.* 2002). The healing processes in most of the successful cases appeared to be disturbed and delayed by extension of root filling material into the periapical area. Small radiolucencies around surplus material should not be misinterpreted as failures (Molven *et al.* 2002).

The most used filling technique in the studies evaluated was cold lateral condensation. Cold lateral condensation is an obturation technique widely applied by dental practitioners throughout the world because of its advantages of controlled placement of gutta-percha in the root canal and low cost (Dummer *et al.* 1994, Peng *et al.* 2007). Peng *et al.* (2007) compared the outcome of root canal obturation using warm gutta-percha versus cold lateral condensation and demonstrated that a greater incidence of overextension was seen in the warm gutta-percha obturation group than in the cold lateral condensation group. The obturation quality, long-term outcome, and postoperative pain prevalence were similar between these two techniques.

The quality of the coronal restoration seems to have an impact on periapical status as the quality of the root filling (Craveiro *et al.* 2015). Liang *et al.* (2011) concluded that root fillings with voids and unsatisfactory coronal restorations negatively influenced the outcome. Craveiro *et al.* (2015) indicate that the influence of coronal restoration quality on endodontic treatment outcome was smaller when the root canal filling was adequate, and treatment success decreased when no coronal restoration was in place, allowing frank exposure of the root canal filling to microorganisms from saliva and establishing a pathway for microbial ingress into the root canal system.

Chugal *et al.* (2007) also observed successful results more frequently for teeth with a permanent restoration (amalgam, composite, crown) than for teeth with a temporary restoration; however, the differences did not reach statistical significance. Also, Ricucci *et al.* (2011) did not find statistical differences and suggested that the quality of the restoration did not significantly influence the treatment outcome, regardless of pretreatment pulp diagnosis. Unlike, Imura *et al.* (2007), in multivariate analysis, identified the absence of the restoration at follow-up as a significant predictor

of outcome, showing lower success rates. Although the mean time for the placement of restorations was not possible to be considered, teeth that did not have a permanent restoration placed during the follow-up interval showed a higher percentage of failure. This fact lends credibility to the philosophy of the importance of the coronal restoration and the adequate root canal filling in successful endodontic outcomes (Imura *et al.* 2007).

Conclusions

Through the data analyzed in this review, standardization of endodontic treatment data collection criteria to enable comparative clinical observational studies would favour the future analysis, increasing the scientific relevance of the researches. The factors poorly described in the studies are about the patient's dental and medical history, clinical examination, and only four studies report all features proposed by ESE quality guideline for endodontic treatment. There was no consensus of radiographic evaluation criteria for success, which also difficult to compare the results found in the studies (table 5). The success rate in all the studies evaluated was similar and relatively high. A difficulty in clinical studies is the recall rate and indeed varied greatly between studies. A guideline to regulate the description of the results could minimize the heterogeneity of the studies, mainly considering the factors that are most reported in affecting the outcome of endodontic treatment (pulp status, apical periodontitis and lesion size, tooth type and the number of roots, complications, the apical extent of root filling).

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The authors deny any conflicts of interest related to this study.

Figure 1. Flowchart showing the search strategy, excluded and included articles.

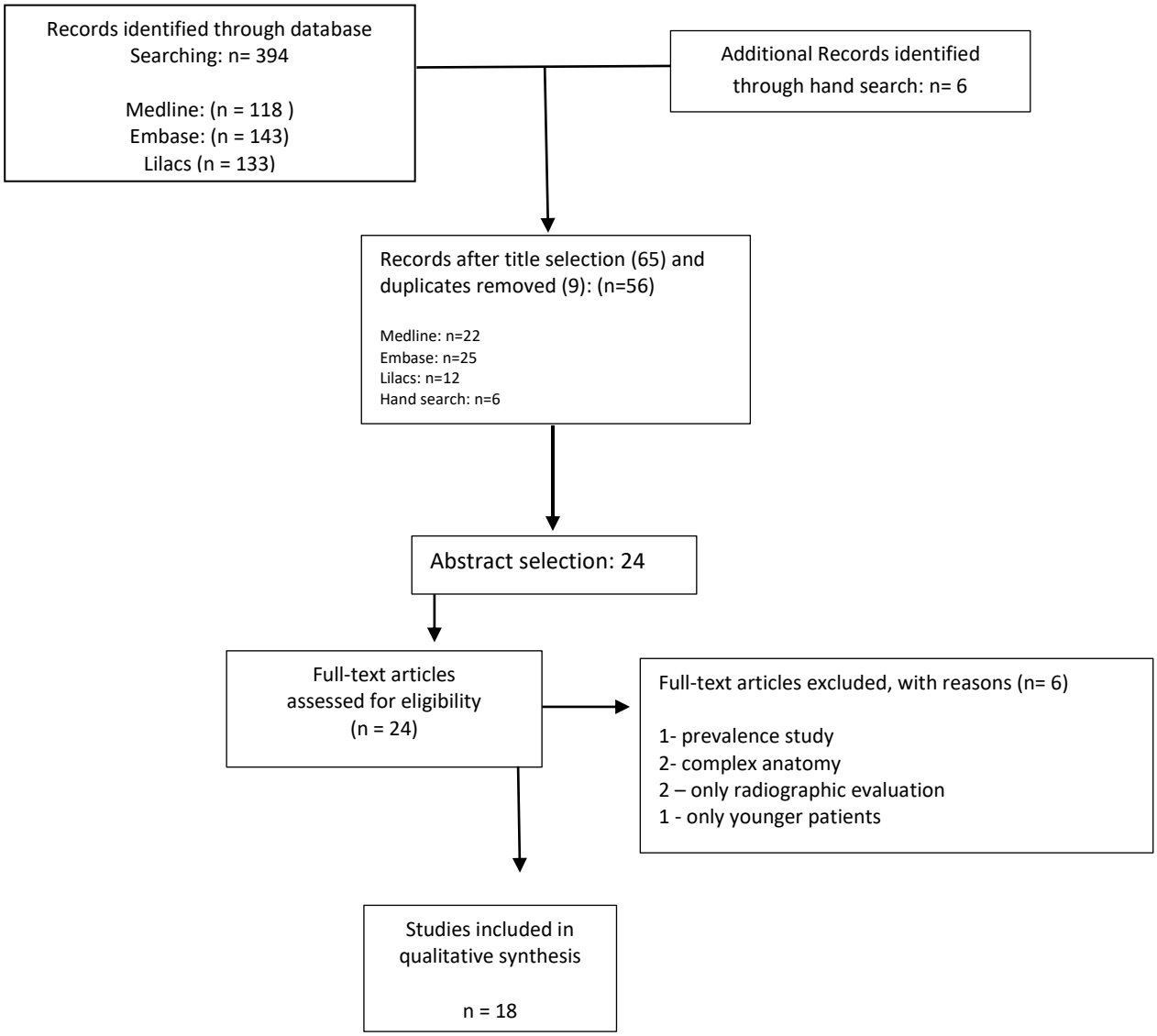

Table 1. Methodologic quality assessment of studies according to Newcastle-Ottawa criteria.

NOS	Benvenutti *et al.* 2016	Zmener and Pameijer 2012	Zmener and Pameijer 2010	Zmener and Pameijer 2007	Liang *et al.* 2011	Chugal *et al.* 2007	Monardes *et al.* 2016	Fernández *et al.* 2013	Craveiro *et al.* 2015	Nery *et al.* 2012	Patel *et al.* 2012	Imura *et al.* 2007	Azim *et al.* 2016	Ricucci *et al.* 2011	Chybowski *et al.* 2018	Ng *et al.* 2011	Pirani *et al.* 2015	de Chevigny *et al.* 2008
Selection																		
1 Representativeness of the exposed cohort	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Selection of the non-exposed cohort	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3 Ascertainment of exposure	-	*	*	*	*	*	-	*	*	*	*	*	*	*	*	*	*	*
4 Demonstration that outcome of interest was not present at start of study	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Comparability																		
1 Comparability of cohorts on the basis of the design or analysis	*	*	*	*	-	*	*	*	*	*	-	*	*	*	*	*	*	*
Outcome																		
1 Assessment of outcome	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
2 Was follow-up long enough for outcomes to occur (Mean 12 months)	*	*	*	*	*	*	*	*	*	-	*	*	*	*	*	*	*	*
3 Adequacy of follow-up of cohorts (<40% of lost)	-	-	*	*	-	-	-	-	-	*	*	*	*	*	*	*	*	-
Total awarded stars	4	5	6	6	4	5	4	5	5	5	5	6	6	6	6	6	6	5

Table 2. Summarized information collected about the characteristics and outcomes of the studies.

STUDY	LOCATION	PATIENTS (N)	TEETH (N)	ROOTS (N)	SEX %	AGE	TYPE OF TOOTH %	RECALL RATE %	SUCCESS RATE %	PULPAL/PERIAPICAL DIAGNOSIS %	FOLLOW-UP (MONTH)	OPERATOR	PATIENT'S CONTACT
Benvenutti *et al.* 2016.	Brazil	32	38	-	M: 47.4 W: 52.6	21-56 Mean: 43.9% (±12.8)	A: 47.5 PM: 36.9 M: 15.6 MAX: 65.8 MAND: 34.2	55.2	S: 89.5 F: 10.5 S vital: 91.6 S necro: 88.4	Pulp vitality: 31.6 Necrosis: 15.8 Apical periodontitis present: 52.6	8 – 28 MEAN: 13,8	Dental students	Telephone
Zmener and Pameijer 2012.	Argentina	89	89	175	M: 46.1 W: 53.9	12-75	A: 41.5 PM: 26.2 M: 32.3 MAX: 59.5 MAND: 40.5	49.44	S: 92.13 F: 7.87 S vital: 90.5 S necro: 93.6	Pulp vitality: 47.2 Necrosis: 52.8 Apical periodontitis present: 43.8	120	Endodontist One operator	Letters, telefone, e-mail
Zmener and Pameijer 2010.	Argentina	112	112	212	M: 44.6 W: 55.4	12-75	A: 42 PM: 28.5 M: 29.5 MAX: 58 MAND: 42	62.2	S: 93.75 F: 6.25 S vital: 93.87 S necro: 93.65	Pulp vitality: 44 Necrosis: 15 Apical periodontitis present: 41	96	Endodontist One operator	Letters, telefone, e-mail
Zmener and Pameijer 2007.	Argentina	120	120	218	M: 43 W: 57	12-75	A: 42 PM: 28 M: 30 MAX: 58 MAND: 42	66.66	S: 93.4 F: 6.6 S vital: 94.11 S necro: 92.75	Pulp vitality: 42.5 Necrosis: 57.5 Apical periodontitis: 40	60	Endodontist One operator	Letters, telefone, e-mail
Liang *et al.* 2011.	China	74	115	143	M: 43 W: 57	54 (MEAN)	A: 31.5 PM: 28.6 M: 39.9 (mandible molars)	36.2	S clinic: 100% S radiog: 87.4 F radiog: 12.6	Pulp vitality: 100	24	Endodontists	Letter
Chugal *et al.* 2007.	USA	120	117 / 200	441	M: 49 W: 51	-	A: 10 PM: 22 M: 68	18.7	S: 79.5 F: 20.5	Apical periodontitis: absent: 60 present: 40	48	Postgraduate students	Telephone

Monardes *et al.* 2016.	Chile	227	227	-	M: 49.4 W: 50.6	20-83	-	20	S: 93.8 F: 6.2	-	36	Endodontists	telephone
Fernández *et al.* 2013.	Colombia	60	132	208	M: 47 W: 53	52 (MEAN)	A: 18.3 PM: 24.5 M: 57.2 MAX: 74 MAND: 26	58.8	S: 94.3 F: 5.7	Apical periodontitis: Absent: 100	60	Postgraduate student	Telephone, e-mail
Craveiro *et al.* 2015.	Brazil	337	523	-	M: 36.2 W: 63.8	18-30= 24.5% 31-50= 47.7% >50= 27.6%	A: 31.7 PM: 30.2 M: 38.1	23.2	S: 85 F: 15	Necrosis: 100	≥ 24	Endodontist One operator	Letter, telephone
Nery *et al.* 2012.	Brazil	65	65	-	M: 48 W:52	18-70	-	65	S: 78.46 F: 21.53	Apical periodontitis: present: 100	8-11	Dental student	-
Patel *et al.* 2012.	UK	99	123	218	M: 42 W: 58	9-76 Mean: 44.5±13.7	A: 24.4 POST: 75.6 MAX: 54.4 MAND: 45.6	75	S clinic: 100% S radiog: 87 F radiog: 13	Apical periodontitis: absent: 61 present: 39	12	Endodontist	-
Imura *et al.* 2007.	Brazil	2000	2000 OF TREATMENT 1376	-	M: 62.4 W:37.6	<20 >60	A: 23 PM: 27 M: 50 MAX: 53.5 MAND: 46.5	-	S: 94 F: 6	Pulp vitality: 69.5 Necrosis: 30.5 Apical periodontitis present 21%	≥18 - 61	Endodontist One operator	Returns
Azim *et al.* 2016.	USA	235	291	422 OF TREATMENT 381	-	49.1 (MEAN)	A: 24.6 PM: 28.4 M: 47 MAX: 53 MAND: 47	-	S: 78 F: 22	Pulp vitality: 47.2 Necrosis: 52.8 Apical periodontitis present 40% (all sample)	Mean: 24	Dental student	Returns
Ricucci *et al.* 2011.	Italy	470	816	1369	M: 41 W: 59	<10 >70	A: 41.7 PM: 32.6 M: 25.7 MAX: 63.7 MAND:36.3	60.3	S: 88.6 F: 10.9 Q: 0.5 VITAL: 91.5	Pulp vitality: 58.4 Necrosis: 41.6 Apical periodontitis: Present 35% (all sample)	60	Clinical practice with special interest in endodontics One operaror	-

									NECRO: 89.5 NECRO w/ AP: 82.7%				
Chybowski *et al.* 2018.	USA	307	307	-	M: 41.4 W: 58.6	48 (±13.5) (MEAN)	A: 7.8 P: 92.2 MAX: 41 MAND: 59	-	S: 90.9 F: 9.1	-	30.1	Endodontists	Letter
Ng *et al.* 2011.	UK	534	702	1170	M: 41.9 W: 58.1	41.5 (MEAN)	A: 233 PM: 10.2 M: 66.5 MAX: 59 MAND: 41	76	S: 82.8 F: 17.2	Pulp vitality: 19.2 Necrosis: 80.8 Apical periodontitis: present: 66.3	24-48	Postgraduate students	Letter
Pirani *et al.* 2015.	Italy	61	209	-	M: 43 W: 57	20≥50	A: 34 PM: 29 M:37	70	S: 79 F: 21	Pulp vitality: 68.5 Apical periodontitis present: 31.5	120	Endodontists	-
de Chevigny *et al.* 2008.	Canada	-	137	-	M: 46 W: 54	52 (MEAN)	A: 18 P: 82 MAX: 57 MAND:43	32	S: 88 F: 12	Pulp vitality: 33 Necrosis: 67 Apical periodontitis: present: 61	48-72	Dental students	Letter, telephone

Table 3. Aspects of root canal procedure.

STUDY	VISITS (N)	IRRIGATION	DRESSING	FILLING TECHNIQUE	SEALER	APEX LOCATOR	APICAL EXTENT OF FILLING %	WORKING LENGTH	CORONAL SEAL
Benvenutti *et al.* 2016.	-	-	-	-	-	-	A: 93 I: 7	-	A: 78.9 I: 21.1
Zmener and Pameijer 2012.	1	NaOCl 2.5%	-	Lateral Compaction	EndoREZ (ER, Ultradent Products Inc. South Jordan, UT, USA)	-	A: 87.64 I: 12.25	1 mm short of the radiographic apex	A: 100
Zmener and Pameijer 2010.	1	NaOCl 2.5%	-	Lateral Compaction	EndoREZ (ER, Ultradent Products Inc. South Jordan, UT, USA)	-	A: 80 I: 20 Short: 17 Long: 3	1 mm short of the radiographic apex	A: 98.2 I: 1. 8
Zmener and Pameijer 2007.	1	NaOCl 2.5%	-	Lateral Compaction	EndoREZ (ER, Ultradent Products Inc. South Jordan, UT, USA)	-	A: 76.7 I: 23.3	1 mm short of the radiographic apex	A: 96.7 I: 3.3
Liang *et al.* 2011.	1 or 2	NaOCl 1%	Calcium hydroxide	Lateral Compaction	zinc oxide–based sealer	Root ZX (J. Morita Corp, Kyoto, Japan)	A: 64.4 I: 35.6	-	A: 82.5 I: 17.5
Chugal *et al.* 2007.	2	NaOCl 1%	Calcium hydroxide	Lateral Compaction	AH26 (De Trey Frères, Zurich, Switzerland)	-	-	-	A: 92.5 (79.5 success) I: 7.5 (60 success)
Monardes *et al.* 2016.	-	-	-	-	-	-	-	-	A: 95 I: 5
Fernández *et al.* 2013.	1 (54.3%) or ≥2 (45.7%)	NaOCl 5.25%	Calcium hydroxide	Lateral Compaction (50%) and Vertical compaction (50%)	Topseal (Dentsply Maillefer)	Root ZX (J. Morita Corp, Kyoto, Japan)	A: 81.3 I: 18.7 Short: 10	-	A: 91.3 I: 8.7

							Long: 8.7		
Craveiro *et al.* 2015.	2	NaOCl 2.5%	Calcium hydroxide	Lateral Compaction	AH Plus (Dentsply DeTrey, Konstanz, Germany)	Apex DSP (Apex DSP; Septodont, Saint-Maur-des-Foss_es, France)	A: 84 I: 16	Apical constriction	A: 63.8 I: 36.2
Nery *et al.* 2012.	2	NaOCl 2.5%	Calcium hydroxide	Lateral Compaction	Sealapex (Sybron Endo, USA)	-	-	Cleaning apical foramen	-
Patel *et al.* 2012.	1	NaOCl 2%	-	Warm Vertical compaction	AH Plus (Dentsply DeTrey, Konstanz, Germany)	Yes Root ZX (J. Morita Corp, Kyoto, Japan)	-	working length was always 1 mm short of the '0' apex locator	A: 100
Imura *et al.* 2007.	1 (44%) or ≥2 (56%)	NaOCl 0.5% or 2.5%	Calcium hydroxide	Lateral Compaction	-	-	A: 93.55 I: 6.45 ≥ 1: 76.8 zero: 16.75 Long: 6.45	working length was established at 1 mm from the radiographic apex.	A: 93 (94.4 success) I: 7 (87.9 success)
Azim *et al.* 2016.	1 or ≥2	NaOCl 3-6%	Calcium hydroxide	Lateral Compaction	-	Yes	A: 89.5 I: 10.5 Short: 4.3 Long: 6.2	-	-
Ricucci *et al.* 2011.	1 or 2	NaOCl 1%	Calcium hydroxide	Lateral Compaction	AH26 (De Trey Frères, Zürich, Switzerland), Bioseal (Ogna), Pulp Canal Sealer (Sybron Dental, Orange, CA, USA), Tubliseal (Sybron Dental), Apexit (Ivoclar Vivadent, Schaan, Lichtenstein), Mynol (Hygienic, Akron, OH, USA), and ndomethasone (Septodont, Saint- Maur-des-Fossés, France)	Yes	A: 89 I: 11 Short: 3.8 Long: 7.2	Apical constriction	A: 84 I: 16
Chybowski *et al.* 2018.	1	NaOCl 5.25%	-	Single-cone technique and vertical compaction	EndoSequence BC Sealer (BC; Brasseler USA, Savannah, GA)	Yes Root ZX (J. Morita Corp, Kyoto, Japan)	A: 52.6 Long: 47.4	-	A: 100

Ng *et al.* 2011.	1 or ≥2	NaOCl 2.5 or 5%	Calcium hydroxide	lateral compaction, thermoplastic lateral compaction using warm finger spreaders, thermoplastic lateral compaction using ultrasonically energized files, modified Schilder's warm vertical compaction technique, continuous wave technique	zinc oxide-eugenol root canal sealer (Roth Dental Company, Chicago, IL, USA)	Yes [Root ZX (J Morita Co, Tustin, CA, USA); AFA Apex Finder (Analytic Endodontics, Orange, CA, USA); or Elements diagnostic (SybronEndo, Orange, CA, USA)]	A: 81.5 I: 18.5 Short: 6 Long: 12.5	Apical constriction	A: 95 I: 5
Pirani *et al.* 2015.	1	NaOCl 5%	-	Compacted warm gutta-percha cones	CRCS (Hygienic Coltene/Whaledent Inc. Cuyahoga Falls, OH USA) sealer	-	A: 70 Short: 27 Long: 3%	0.5 from radiographic apex	A: 100
de Chevigny *et al.* 2008.	1 = 31% or ≥2 = 69%	NaOCl 2.5% and CLX 2%	Calcium hydroxide	Lateral compaction or Vertical compaction of warm gutta-percha	with a variety of sealers	-	A: 83 Short: 8 Long: 9	-	A: 91 I: 9

Table 4 Evaluation whether the studies follow the guidelines for endodontic treatment suggested by European Society of Endodontology (2006).

STUDY	Benvenutti *et al.* 2016	Zmener and Pameijer 2012	Zmener and Pameijer 2010	Zmener and Pameijer 2007	Liang *et al.* 2011	Chugal *et al.* 2007	Monardes *et al.* 2016	Fernández *et al.* 2013	Craveiro *et al.* 2015	Nery *et al.* 2012	Patel *et al.* 2012	Imura *et al.* 2007	Azim *et al.* 2016	Ricucci *et al.* 2011	Chybowski *et al.* 2018	Ng *et al.* 2011	Pirani *et al.* 2015	de Chevigny *et al.* 2008
Medical and dental history								*		*			*			*		
Clinical examination -Extra-oral examination -Intra-oral examination					*	*	*	*	*	*	*	*	*	*		*	*	*
Diagnosis	*	*	*	*	*	*	*	*	*	*		*	*	*		*	*	*
Treatment planning		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Records -signs and symptoms, patient's complaint, report radiographs taken, diagnosis and treatment plan. -Informed consent -Record of treatment		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Review	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Table 5 describes the methods for assessing the success outcome used in the studies.

STUDY	OUTCOME ASSESSMENT
Benvenutti *et al.* 2016.	Assessed clinically and radiographically and dichotomized as satisfactory' or 'unsatisfactory', based on the criteria of the American Association of Endodontics.
Zmener and Pameijer 2012.	Evaluated as failure when (1) periapical radiolucency was observed in the preoperative radiograph and remained unchanged or increased in size over time or (2) a root in absence of preoperative periapical pathosis developed a radiolucency over time. And as successful when (1) Radiographically, the contours and width of the PDL space were within normal limits or slightly widened around an accidental overfill and the patient was free of symptoms. Slight tenderness to percussion for a brief postoperative period was considered acceptable. (2) The size of a preoperative radiolucent area decreased by at least 50%, and the patient was free of symptoms, or the contours and width of the PDL space had returned to the normal. (3) Absence of preoperative periapical radiolucency which remained unchanged over time.
Zmener and Pameijer 2010.	Same of Zmener and Pameijer 2012.
Zmener and Pameijer 2007.	Same of Zmener and Pameijer 2012.
Liang *et al.* 2011.	Signs and symptoms were recorded, and the absence of periapical lesions was defined as conditions such that the radiographic periodontal ligament space was not wider than 0.5 mm.
Chugal *et al.* 2007.	Criteria for the assessment of outcome were adopted from Strindberg.
Monardes *et al.* 2016.	Success: not show signs and / or clinical symptoms (pain on percussion, increase in volume, (presence of fistula), maintaining periapical health (PAI 1 or 2), that the previous periapical lesion has reduced its size (PAI 1 or 2). Failure: presence of symptoms, developed a periapical lesion (PAI ≥ 3) or increased the size of the periapical lesions (PAI ≥ 3).
Fernández *et al.* 2013.	The presence of provoked or spontaneous pain and sinus were considered as failure, independent of the radiographic findings. PAI was used to evaluate radiographies and score 1 indicated periapical health, and scores ≥2 were associated with periapical lesions.

Craveiro *et al.* 2015.	The criteria used for radiographic evaluation were slightly modified from those described by Tronstad *et al.* 2000. Healthy/success (PAI 1 and PAI 2, no symptoms or clinical signs) or diseased/failure (PAI 3, 4, and 5, presence of symptoms and/or clinical signs).
Nery *et al.* 2012.	The criteria used for the clinical evaluation were absence of pain, periradicular pathosis and fistula, in addition to the tooth presenting a reconstructed crown and being in correct occlusion. For radiographic evaluation was used scores 1 (total repair), 2 (partial repair), 3 (doubtful repair) and 4 (lack of repair). Scores 1 to 3 were evaluated as success and 4 as failure.
Patel *et al.* 2012.	Clinical evaluation of signs and symptoms and radiographically scores 1 to 6. Score 1 (new periapical radiolucency), 2 (enlarged periapical radiolucency), 3 (unchanged periapical radiolucency), 4 (reduced periapical radiolucency), 5 (resolved periapical radiolucency) and 6 (unchanged healthy periapical status). For the purposes of clinically defined outcomes, a 'healed' outcome was defined where a periapical radiolucency was absent (outcome 5 and 6) and a 'healing' outcome where a radiolucency had reduced in size or was absent (outcome 4–6) and failed (outcome 1, 2 or 3).
Imura *et al.* 2007.	The following criteria of the European Society of Endodontology 1994 were used to judge the success rate of root canal therapy: (1) clinical examination: absence of pain, swelling and other symptoms, no sinus tract, and no loss of function and (2) radiographic examination: the periodontal ligament space was normal on the original diagnostic radiograph, and it remained unchanged on recall radiographs, or healing of a radiolucent area visible on the original preoperative radiograph was observed and the periodontal ligament space had returned to normal. Cases were considered as failures in the presence of pain, swelling, and sinus tract. Radiographically, failures were identified when a lesion appeared subsequent to endodontic treatment, when a preexisting lesion increased in size, and when a lesion had remained the same or had only diminished in size.
Azim *et al.* 2016.	Healed (complete healing) = absence of a periapical lesion with no pain, swelling or discomfort, healing (incomplete healing) = reduction in the size of the periapical lesion but not completely resolved with no pain, swelling or discomfort, not healing (Uncertain healing or Unsatisfactory healing) = no change in the size of the periapical lesion/increase in the size of the periapical lesion/development of a new periapical lesion/ development of clinical signs or symptoms (pain, swelling or discomfort).
Ricucci *et al.* 2011.	Criteria, based on both clinical and radiographic examinations, consisting of a slight modification of Strindberg's criteria. *Successful:* No signs or symptoms present on follow-up examination. Complete resolution of the lesion with redevelopment of a continuous lamina dura and a normal-appearing periodontal membrane space around the entire root perimeter. *Doubtful:* No signs or symptoms present on follow-up examination and the initial radiographic lesion has decreased considerably in size, but normal periapical conditions are not still established at the end of the 5-year period. Periodontal ligament space may be widened around excess filling material. *Unsuccessful:* Signs or symptoms present on follow-up examination. Periapical bone lesion may be present; the initial radiographic lesion has stayed the same size or increased in size; or the initial radiographic lesion has decreased in size, but complete healing has not been achieved at the end of the 5-year period.

Chybowski *et al.* 2018.	Healed: Functional, asymptomatic teeth with no or minimal radiographic periradicular (apical) pathosis (radiolucency). Nonhealed: Nonfunctional, symptomatic teeth with or without radiographic periradicular (apical) pathosis (radiolucency) or asymptomatic teeth with unchanged, new, or enlarged radiographic periradicular (apical) pathosis (radiolucency). Healing: Teeth that are asymptomatic and functional with a decreased size of radiographic periradicular (apical) pathosis (radiolucency). The outcome assessment was dichotomized. Both healed and healing cases were considered success, and nonhealed cases were considered failure.
Ng *et al.* 2011.	Successful treatment based on strict criteria was defined as absence of pain, clinical evidence of inflammation or swelling and conventional radiographic measures of complete healing/presence of a normal periodontal ligament space. Four categories of radiographic healing: (1) complete, in the presence of a normal periodontal ligament space, (2) incomplete, if there was reduction in size of the lesion without return to normal periodontal ligament space width, (3) uncertain, when it was radiographically impossible to make a definitive decision on status of postoperative healing (these cases were excluded from further analyses) or (4) failure, if a pre-existing periapical lesion had increased in or remained the same size.
Pirani *et al.* 2015.	Radiographic and clinical criteria were used to classify the outcome. Periapical tissues were classified at the endpoint evaluation on the basis of the Toronto study criteria and dichotomized as: ‘‘healed’’ in the absence of radiographic signs of AP (corresponding to PAI ≤ 3), and clinical signs and symptoms other than tenderness to percussion; and ‘‘disease’’ in presence of discernible radiolucency (corresponding to PAI > 3).
de Chevigny *et al.* 2008.	Symptoms and signs were recorded, and radiographs were exposed to PAI: healed (PAI ≤2), no symptoms or clinical signs other than tenderness to percussion) or diseased (PAI ≥3), presence of symptoms or clinical signs other than tenderness to percussion.

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Artigo 2 - CB Hoppe, PM Lang, L Dotto, RK Scarparo, MSM Hartmann, MS Gomes, FS Grecca. *Long-term outcome of multi-rooted endodontic treatment performed in postgraduate programs.* (Formatado para a revista International Endodontic Journal)

Long-term outcome of multi-rooted endodontic treatment performed in postgraduate programs.

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Abstract

Aim To evaluate the influence of different factors on the clinical and radiographic success of the endodontic treatment performed in the endodontic post-graduation programs.

Methodology This retrospective cohort study included clinical and radiographic follow-up of 134 endodontic treatment of molars realized in two postgraduate programs. Pre-, intra- and postoperative data were collected. Radiographs were evaluated by 2 calibrated examiners through Periapical Index (PAI) score. Teeth were classified as success treatment (PAI ≤2, no symptoms or clinical signs) or failure (PAI ≥3, presence of symptoms or clinical signs). The evaluated unit was the tooth. Participants were followed-up for up to 48 months. Bivariate and multivariate models using Poisson regression with robust variance were used to evaluate the predicted factors of treatment outcome.

Results There was no statistical difference considering the outcome of endodontic treatment between the two postgraduate programs. The presence of preoperative apical periodontitis is associated with poorer success rate of endodontic treatment (*P*=0.007), and the strength of this association holds true even when the model is adjusted for age, sex, postgraduate program, tooth location, filling level and recall period. Hydraulic vertical condensation filling technique is associated with the overextension of filling materials (*P*=0.000).

Conclusion Therefore, regardless of the technique and treatment philosophy used, the success rate was not associated by intraoperative factors. The predictor risk factor to decrease the success rate was the presence of apical periodontitis prior to treatment.

Introduction

The anatomical complexity of the root canal and the pulp condition are challenges for the technical performance of endodontic treatment (Ørstavik *et al.* 2004). Several methods and principles have been applied to reach the goal of endodontic treatment. The healing or prevention of apical periodontitis, through the combination of instrumentation, chemical debridement and the hermetic filling of the root canal system are the purpose of endodontic treatment (Ørstavik *et al.* 2004, Imura *et al.* 2007, Ng *et al.* 2008, Fleming *et al.* 2010). However, the technical, biological and clinical variables of endodontic procedures are diverse and even within prescribed protocols it is difficult to define or to standardize which is more accurate and effective (Ørstavik *et al.* 2004, Ng *et al.* 2008).

Among the technical variables, one of the most controversial refers to the apical limit of instrumentation and obturation (Ricucci & Langeland 1998). Weine (1982) and Ingle (1973) defend the idea of a preparation restricted to root canal, until to the apical constriction or cemento-dentine junction. On the other hand, Schilder (1967, 2006) declared his aim was to debride and to fill to the apex, including lateral canals and apical ramifications and he admitted that his procedure, in most cases, involve instrumentation beyond the root canal limit, inside the adjacent periodontal ligament.

The failure of root canal treatment has predominantly been associated with an ineffective removal of microorganisms from the root canal system which affects tissue healing in the periapical area (NG *et al.* 2008, Gonçalves *et al.* 2016). Distinct chemicals have been suggested as efficient irrigant solutions for root canal disinfection (Gonçalves *et al.* 2016). Sodium hypochlorite (NaOCl) is the most widely used in endodontic treatment (Estrela *et al.* 2002, Zehnder 2006). Chlorhexidine gluconate (CHX) has been proposed as a promising irrigation agent to replace NaOCl during root canal disinfection and endodontic instrumentation (Ferraz *et al.* 2001, Gonçalves *et al.* 2016).

Another focus of research is on multiple or single visit endodontic treatment or cases of necrotic or vital pulp (Gurgel-filho *et al.*, 2007; Figini *et al.* 2008, Moreira *et al.*, 2017). When analyzing the success rates comparing the treatments in single and multiple sessions, some studies point out that there are no differences between the

techniques (Figini *et al.* 2008, Elmubarak *et al.* 2010, Fleming *et al.*, 2010, Moreira *et al.*, 2017.)

The preoperative pulp status is a significant influencing factor in the success of endodontic treatment and the presence of apical periodontitis, therefore, presence of infection in the root canal, decreases success rates in 9-13% (Kojima *et al.* 2004, Ng *et al.*, 2008). Contradicting, Zmener & Pameijer (2007, 2010, 2012) reported the presence of the preoperative apical radiolucent area did not appear to adversely affect the outcome of endodontic treatment.

Success or failure rates of treatment modalities are an important part of evidence-based practice in endodontics (Zmener & Pameijer 2012). The evaluation of endodontic therapy protocols is essential to establish guidelines to improve clinical outcomes in endodontics (Gonçalves *et al.* 2016). Multivariate methods of evaluation have been developed to analyze the simultaneous influence of several factors and the importance of each variable on the outcome of treatments (Ørstavik *et al.* 2004). Such information provides the clinician to make more predictable decisions regarding the long-term prognosis of endodontic treatment, allowing the patient to maintain their natural dentition in function (Imura *et al.* 2007).

The aim of this study is to evaluate the influence of different factors on the clinical and radiographic success of the endodontic treatment performed in the Endodontics post-graduation program of Federal University of Rio Grande do Sul (UFRGS) and in the Centro de Estudos Odontológicos Meridional (CEOM-IMED), Rio Grande do Sul, Brazil.

Methodology

The ethics institutional committee at UFRGS and CEOM-IMED, Brazil approved this retrospective study, protocol number # 2.434.263 (12/13/2017).

Five-hundred and sixteen patients referred of postgraduate program that received treatment at UFRGS and at CEOM–IMED between December 2013 and December 2017 were contacted by phone and invited to participate of the study. A total of 124 (134 teeth) accepted to sign the informed consent (Figure 1). The inclusion criteria of the study were patients who treated molar teeth in this period. Teeth with endodontic retreatment, incomplete rhizogenesis, traumatized teeth, parendodontic surgery, absence of available radiographic examinations and / or lack of data recorded

in the medical records, teeth extracted for non-endodontic reasons, pregnancy in clinical / radiographic control periods were excluded from the study. A minimum follow-up of 6 months was required.

The treatments were performed by postgraduate students. They were supervised by a qualified and experienced postgraduate professor. All the preoperative, intraoperative, and postoperative information was properly compiled from the clinical and radiographic patients' records. Previous dental and medical history were also collected through self-report of the patient.

Endodontic Therapy Procedure

For each tooth, the following preoperative information was recorded: demographic data, tooth location, number of root canals, clinical signs and symptoms, response to percussion, vitality tests, and periapical status.

Based on these findings, the preoperative condition was classified as one of the following: vital (healthy or irreversibly inflamed pulpitis), nonvital, with or without apical periodontitis, and symptomatic or asymptomatic.

Intraoperative data were also collected as single or multiple visits, intracanal dressing, irrigants, working length, filling techniques, filling level, complications, postoperative pain.

The two postgraduate programs use different variables for root canal prepare. At UFRGS, the priority is the use of sodium hypochlorite (NaOCl) as irrigant. The working length is restricted to intracanal space and the most cases are realized in multiple visits. The filling techniques used are lateral compaction and thermoplastic Tagger's hybrid. At CEOM-IMED, chlorhexidine is always used as irrigant, and the preparation is realized beyond to the root apex, with foraminal enlargement, and the filling technique used in almost all cases is hydraulic vertical condensation.

After achieving coronal access and coronal flaring, the working length was determined by using electronic apex locator and with periapical radiographic. Both manual and rotary/reciprocating techniques were used to prepare root canals. The apical enlargement was defined depending on the root canal morphology. During preparation, between exchanges of instruments, each canal was irrigated with 2,5% sodium hypochlorite (NaOCl) solution or with chlorhexidine gel 2% (CHX) and saline by using a syringe and a 27-gauge needle. When a second visit was required, an intracanal dressing was used between visits as calcium hydroxide (Ultradent Products,

Inc. Utah, USA) or others (Corticosteroid-antibiotic association, camphorated paramonochlorophenol - PMCC, Tricresol-formalin, CHX 2%). All canals were filled with gutta-percha cones and sealer AH Plus (Dentsply Maillefer, Ballaigues, Switzerland) or, in few cases, others - MTA Fillapex (Angelus, Londrina, Brazil), zinc oxid and eugenol (Dentsply Maillefer, Ballaigues, Switzerland), Sealer 26 (Dentsply Maillefer, Ballaigues, Switzerland). The rubber dam was used in all patients. Restorative glass ionomer was used for temporary restoration, both between the sessions and the end of the treatment, before tooth rehabilitation.

Follow-up

Clinical and Radiographic Examination

Recall appointments included a radiographic and clinical examination of the treated tooth. Extra-oral and intra-oral examination were documented. Pain, asymmetry, presence and extent of swelling in the head and neck region, lymphadenopathy, presence of sinus tracts, condition of oral mucosa, intra-oral swelling, tenderness to apical and gingival palpation and percussion, sinus tracts, condition of teeth present, periodontal condition, absence of coronal restorations were recorded. Radiographs were evaluated by 2 calibrated examiners (Kappa 0.78) exposed to assign a Periapical Index (PAI) score (Ørstavik *et al.* 1986). In case of disagreement, the case was discussed until consensus was reached.

The main outcome, long-term endodontic treatment outcome, comprised teeth classified as success treatment (PAI ≤2, no symptoms or clinical signs) or failure (PAI ≥3, presence of symptoms or clinical signs). The evaluated unit was the tooth, with multi-rooted teeth assigned the highest score of all roots. Participants were followed-up for up to 48 months (mean of 25.8 ±11.7, minimum of 6 months, maximum of 48 months).

Statistical Analysis

Bivariate and multivariate models using Poisson regression with robust variance were used to evaluate which combination of independent variables pertaining to endodontic treatment proper best predicted treatment outcome. All variables associated with success/failure in the bivariate analysis with a *P*-value <0.25 and important variables as age and postgraduate program were considered potential

confounders (risk factors to treatment outcome). These variables were included in the multivariate models predicting success, where the value for rejection of the null hypothesis was set at $P \leq 0.05$. Wald chi-square test estimated the strength of the association.

Results

One hundred twenty-four (74 from UFRGS and 50 from CEOM-IMED) patients returned to follow-up appointments and were included for analysis. Table 1 shows the distribution of prognostic factors of endodontic treatment sample, total number and percentage sample, and number of samples of each postgraduate program. Recall rate was also reported.

Table 2 shows the prognostic factors related to the success rate of endodontic treatment through Poisson Regression with robust variance. A statistically significant difference was found regarding apical periodontitis (*P*=0.007), and tooth presenting apical periodontitis decrease the success rate of 90% to 71.6%. In this table, the systemic alterations variable summarized data about the general health and also habits of the patient such as smoking, hypertension, cardiovascular diseases, diabetes, arthritis, depression, asthma, hepatitis, chronic kidney disease, HIV, hypothyroidism, gastritis, lupus, Parkinson's disease, epilepsy, cancer, anemia.

Table 3 show a multivariate analysis with adjusted models associating success of endodontic treatment and all variables in the bivariate analysis (table 2) with a *P*-value <0.25 and important variables as age and postgraduate program. Model A is adjusted for demographic variables, model B is adjusted for demographic variables and apical periodontitis, and model C is adjusted for demographic variables, apical periodontitis and dental covariates. The presence of preoperative apical periodontitis is associated with poorer success rate of endodontic outcome, and Wald chi-square tests revealed high strength of association after adjustment.

Table 4 shows the association between filling technique and the overextension of filling materials. Hydraulic vertical condensation increased the risk of overextension of filling material more than 4-fold, with statistical significance (*P*=0.000).

Discussion

The present study compared endodontic treatments performed in two different postgraduate programs that advocate different preparation techniques. One hundred and twenty-four of the 516 patients who had received endodontic treatment during December 2013 to December 2017 were reexamined for treatment outcome. Considering the success rate, there were no significant differences between the two programs (81.6% for UFRGS and 77.6 for CEOM-IMED). Consequently, the irrigation solution and working length did not influence the outcome of endodontic treatment (P=0.633 and P=0.472, respectively).

Intraoperative and postoperative variables did not show to have a negative impact on treatment outcome.The findings of this study showed that the critical factor for the endodontic treatment outcome is the presence of apical periodontitis, corroborating with some other studies (Chungal *et al.* 2001, 2003, de Chevigny *et al.* 2008, Craveiro *et al.* 2015*,* Chybowsky *et al.* 2018). The bivariate and multivariate analysis presented that the existence of a preoperative apical lesion had the strongest negative effect on endodontic outcome, decreasing significantly the success rate (without AP 90% and with AP 71.6%, P<0.05).

Regarding the outcome of all endodontic treatments, the success rate was 79.9%. Chungal *et al.* (2007) and Ng *et al.* (2011), in agreement with our study, found similar results for success rate (79.5% and 82.8%, respectively) when cases were carried out by postgraduate students.

Although the endodontic outcome is a multifactorial phenomenon, Chungal *et al.* 2001 revealed that preoperative periapical diagnosis appears to be the most significant predictor of endodontic outcome. This factor is likely associated with the presence and the amount of dentin infection and periapical complications (Chungal *et al.* 2003). Even knowing the difficulty of eliminating microorganisms from the infected root canals, endodontic procedures are always aiming to improve and achieve the maximum disinfection to enhance the success of treatment outcome (Chungal *et al.* 2003). Sjögren *et al.* (1990) suggested that the prognosis for initial endodontic treatment of necrotic teeth with periapical lesions was as good as that for vital teeth when the instrumentation and filling of the root canal could be carried out to an optimal level. In another studies, the presence of the preoperative apical radiolucent area did not appear to adversely affect the outcome of endodontic treatment (Zmener & Pameijer 2007, 2010, 2012), discording with our results.

It is commonly accepted that instrumentation and obturation should be terminated 0–2 mm short of the radiographic apex (Sjögren *et al.* 1990, Liang *et al.* 2011). Even without statistical differences, the better success rate was detected when instrumentation was realized until apical constriction. Liang *et al.* (2011) suggest instrumentation 2–3 mm short of the apical foramen as the favorable point for vital cases, and it seems unnecessary to terminate the procedures close to the apical foramen. In teeth with preoperative AP, the apical portion of the root canal is infected (Nair *et al.* 2005). Disinfection of the root canal system might be compromised, and periapical healing might be hindered when the instrumentation procedures are not terminated close to the apical foramen (Liang *et al.* 2011). Therefore, the reason for the higher prevalence of endodontic failure associated with short limit preparation is the incapacity of debriding the apical segment or canal, or due to accumulation of contaminated dentin that holds persistent infection agents in the root apex (Nair *et al.* 2005). In our study, the working length of most cases were realized between over or 0-2mm from apex.

In this study, only patients who treated molars were selected and the tooth was always considered as the unit of evaluation and classified according to the worst prognosis, because if one of the roots is not healthy, the tooth cannot be considered functional. The complexity of the treatment is higher for posterior teeth due to anatomy and number of root canals which increased the risk for persistence of disease (de Chevigny *et al.* 2008). Some studies found a better healed rate in single-rooted teeth than in multi-rooted teeth (de Chevigny *et al.* 2008, Azim *et al.* 2016) and the results have been reflected the greater challenge encountered when multi-rooted teeth are treated.

Most of the treatments performed in this study required multiple visits, and this may be related to the operator, who were only realized by postgraduate students, and to the tooth type, exclusively molars. Single-visit treatment is attractive because it is faster and reduces staff and costs (e.g., no repeated application of anesthetics, no intermediary restorations, no canal medication, fewer displacements) (Schwendicke & Göstemeyer 2016). However, one session treatment depends on some features as dentists' endodontic skills, patient collaboration and the complexity level of the case. Our results have shown that the outcome of treatment was not significantly influenced by the number of visits.

The most popular intracanal medication currently in use is calcium hydroxide (Figini *et al.* 2008, Manfredi *et al.* 2016), and in this study was the medication of preference among the cases. Its benefits as osteogenic properties, to stimulate mineralization and repair, to neutralize the remaining bacterial toxins, antibacterial actions, to maintain the temporary sealing avoiding percolation of fluids, are well established in the literature (Siqueira & Lopes 1999, Silva *et al.* 2002, Estrela & Holland 2003, Estrela *et al.* 2014, Holland *et al.* 2003, 2017).

The persistent infection in the root canal is related to remaining necrotic tissue and bacteria, which in turn affects tissue healing in the periapical (Gonçalves *et al.* 2016). Different chemical substances have been suggested as efficient irrigating solutions for the disinfection of root canals. Among them, sodium hypochlorite (NaOCl) is the most used in endodontic treatment due to its effective antimicrobial activity and the ability to dissolve organic tissues (Zehnder 2006). On the other hand, NaOCl is a potential irritant of periapical tissues, especially at high concentrations (Gernhardt *et al.* 2004). Chlorhexidine gluconate (CHX) has been proposed as a promising irrigation agent to replace NaOCl during root canal disinfection and endodontic instrumentation (Ferraz *et al.* 2001, Gonçalves *et al.* 2016). The main limitation of CHX as an endodontic irrigant is its inability to dissolve pulp tissue (Okino *et al.* 2004), however it is less cytotoxic to the periapical tissues than NaOCl and its substantivity in dentin seems to be an advantage over NaOCl (Gonçalves *et al.* 2016). In our clinical study there were no statistical differences between NaOCl and CLX regarding the endodontic treatment outcome.

In order to improve disinfection, apical enlargement has been suggested as another alternative to increase root canal cleansing by reducing the remaining bacteria and by enabling a more effective action of the irrigating solution. Despite the advantages of foraminal enlargement, a frequently reported disadvantage is the possibility of postoperative pain related to physical trauma of the periapical region (SILVA *et al.* 2013). Yaylali *et al.* (2017) conducted a randomized clinical trial to assess postoperative pain when performing foraminal enlargement. A significant difference was observed in postoperative pain when foraminal enlargement was realized, comparing with preparation of the canals performed 1 mm short of the apical contrition. Our results showed that performing the foraminal enlargement preparation, associated to a warm filling technique, a greater apical overextension of filling materials is

observed. However, there were no significant differences in relation to the success rate.

The filling level and the technique do not seem to affect the outcome of endodontic treatment. However, it is possible to notice, even without statistical significance, that the overextension of filling material reduced the success rate. According to Ricucci *et al.* (2011), both for cases with vital pulp and cases with necrotic pulp, a successful treatment outcome is less likely when overfilling the root canal. Filling material protruding into the periapical tissues may cause immediate tissue destruction and inflammation. A resulting asymptomatic foreign body reaction may explain some of the radiolucencies recorded after the end of the normal follow-up period (Nair *et al.* 1990, Ricucci & Langeland 1998, Molven *et al.* 2002). The healing processes in most of the successful cases appeared to be disturbed and delayed by extension of root filling material into the periapical area (Molven *et al.* 2002).

The table 4 shows the association between technique and the overextension of filling root canals. Teeth filled by the hydraulic vertical condensation are associated with increased 4-fold the risk of overextension of filling materials ($p = 0.000$). Peng *et al.* (2007) compared the outcome of root canal obturation using warm gutta-percha versus cold lateral condensation and demonstrated that a greater incidence of overextension was seen in the warm gutta-percha obturation group. The obturation quality, long-term outcome, and postoperative pain prevalence were alike between these two techniques.

The relationship between coronal sealing and endodontic success has been controversial. Our study did not present enough numbers of absence of coronal sealing samples to consider the influence of this variable on the outcome. Chugal *et al.* (2007) observed successful results more frequently for teeth with a permanent restoration (amalgam, composite, crown) than for teeth with a temporary restoration; however, the differences did not reach statistical significance. Also, Ricucci *et al.* (2011) did not find statistical differences and suggested that the quality of the restoration did not significantly influence the treatment outcome, regardless of pretreatment pulp diagnosis. On the other hand, Imura *et al.* (2007), in multivariate analysis, identified the absence of the restoration at follow-up as a significant predictor of outcome, showing lower success rates.

Clinical and radiographic protocol have been suggested as the traditional method to evaluate endodontic treatment success. (Fernández *et al.* 2013). This

method is considered a reliable procedure when evaluating the outcome of endodontic treatment (Ørstavik *et al.* 1986, Ricucci *et al.* 2011, Fernández *et al.* 2013), especially because the evaluation criteria are currently being used by clinicians (Fernández *et al.* 2013). However, considering the limitations of the 2D view of the PA, new evaluations have incorporated as CBCT (Liang *et al.* 2011, Patel *et al.* 2012, Fernández *et al.* 2013). This technology can provide multi-slice imaging information in 3 dimensions that PA cannot, can allow for accurate diagnosis of extra canals, vertical root fractures, anatomical complexities, but its known limitations must be considered, such as the cost, both monetary and radiation dose (Liang *et al.* 2011).

After root canal treatment, it is desirable to recall the patient 6 months to 1 year later for a clinical and radiographic examination of the treated tooth to determine the outcome (Ross *et al.* 2009). This is also important when there is interest in conducting clinical research. Rubinstein (2002) has commented on the difficulty in obtaining enough recall numbers to realize this kind of search. With advanced age of patients, some uncontrollable variables begin to appear such as patient mobility, disability, and death. Besides that, patients may live in areas that are distant from the endodontic centers, which contribute to the difficulty in motivating the return for recall examinations (Ross *et al.* 2009).

This factor could be seen in our study due to the low recall rates (total 24%, at UFRGS 41.3% and at CEOM-IMED 14.8%). UFRGS probably presented higher recall rates because it is a referral center for several other nearby cities, it is in the metropolitan area and due to the older age of the patients (mean 51.2 ±13.5) than CEOM-IMED (mean 34.5 ±14). Ross *et al.* 2009 reported in their study that older patients (41–80 age group) used to return for recall at a statistically higher rate. They suggest that retired patients could potentially have more time available to attend appointments and a patient who is employed fulltime may have less time available and more difficulty in scheduling time away from work for a recall appointment. Ørstavik (1996) showed the recall rates in follow-up studies were substantially reduced as the recall period increased and the low recall rates reduce the impact of clinical outcome studies (Liang *et al.* 2011).

Clinical and radiographic follow-ups at regular intervals for a minimum observation period of one year are desirable, but longer may be necessary where healing is incomplete, or there is a history of trauma and annual recall for up to 4 years before a case is judged a failure is suggested (European Society of Endodontology

2006). Despite the limitations of a retrospective study, our data suggest that a longer follow-up period may be required to determine the endodontic outcome, presenting higher success rate to follow-up period longer than 24 months, even without statistical differences. Azim *et al.* (2016) found an average healing time of 11.78 months, corroborating with previous findings (Ørstavik *et al.* 1996, Imura *et al.* 2007) and indicating that 1 year is perhaps the minimal time required for most cases before concluding treatment outcome.

In dental care, it is possible that female patients may be more concerned with their dental health and aesthetics than male patients. This can contribute to make them more likely to return for a recall examination (Ross *et al.* 2009). Several studies agree with this factor, presenting a higher percentage of women in the recall rate (Zmener and Pameijer 2007, 2010, 2012, Liang et. al. 2011, Fernández *et al.* 2013, Craveiro *et al.* 2015, Chybowski *et al.* 2018). Instead, our study presented more men than women in the sample, and no statistical difference for success rate was found regarding sex. As well as sex was not an outcome predictor, age was not identified as a predictor too. Meanwhile, they are important demographic factors that characterize the sample, such as the postgraduate program where the data were collected, and for this reason they were included in the multivariate analysis.

Regarding intersubject differences, in the present study, patient's systemic alterations were not an influencing factor on outcome. It could be that our sample did not include enough subjects with adverse systemic health conditions, similar what were described by Liang *et al.* (2011) and Azim *et al.* (2016). This last study just found a delayed healing in the patients with medical conditions with a significant increase in the average healing time by almost 7 months (Azim *et al.* 2016). Aminoshariae *et al.* 2017, in a systematic review, concluded that all medical conditions and their severity are not the same. So, longitudinal investigations with well-designed research methodologies are needed to address this question that remains inconclusive.

Conclusions

This study emphasized the impact of preoperative, intraoperative and postoperative factors on the outcome of nonsurgical root canal treatment. The main disadvantage of a retrospective study is that the analysis is restricted to the available information and is therefore must be interpreted with caution to avoid bias. Within the

limitation of this study, there was no statistical difference considering the outcome of endodontic treatment between the two postgraduate programs. Therefore, regardless of the technique and treatment philosophy used, the success rate was not associated by intraoperative factors. The data showed the predictor risk factor to decrease the success rate was the presence of apical periodontitis prior to treatment, and the strength of this association holds true even when the model is adjusted for age, sex, postgraduate program, tooth location, filling level and recall period. More clinical research should be realized with long follow-up periods to improve the detection of all factors that may affect the root canal treatment outcome.

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The authors deny any conflicts of interest related to this study.

Figure 1. Flowchart of the study sample.

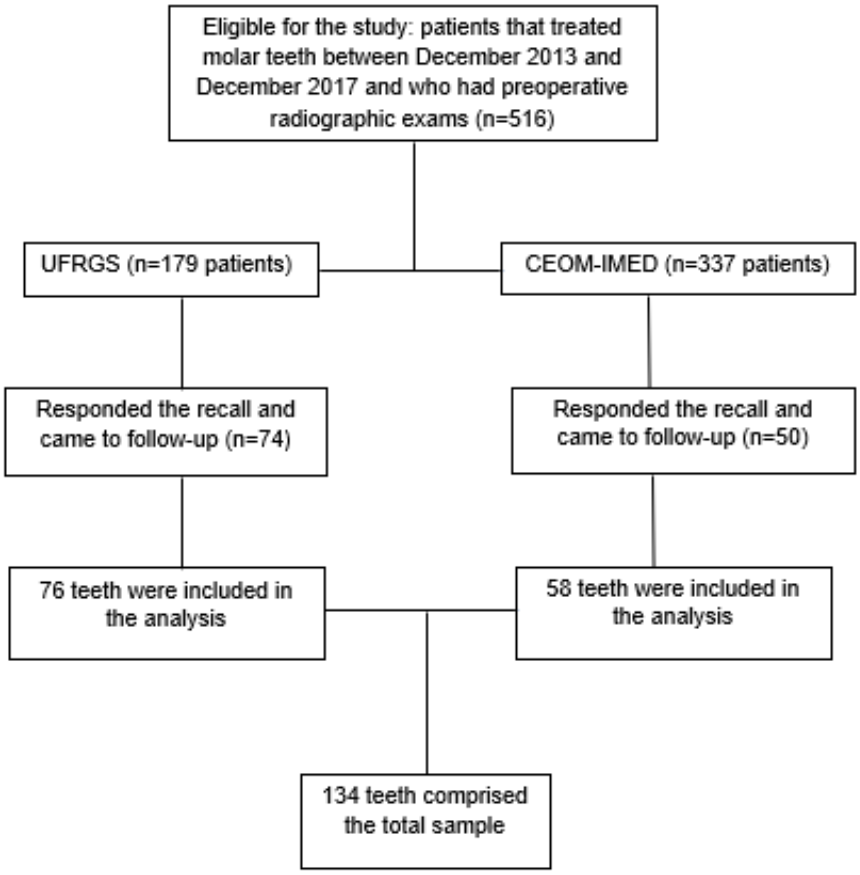

Table 1. Distribution of prognostic factors of endodontic treatment sample.

FACTORS (N)		N (%)	N (%) UFRGS	N (%) CEOM
Age (years) (122)	≤60	98 (80.3)	52 (72.2)	46 (92)
	>60	24 (19.7)	20 (27.8)	4 (8)
	Mean (years)	43,85 ±16	51.2 ±13.5	34.5 ±14
	Min-max	18-80	20-80	18-73
Sex (124)	Female	61 (49.2)	38 (51.4)	23 (46)
	Male	63 (50.8)	36 (48.6)	27 (54)
Postgraduate program (134)	UFRGS	76 (56.7)	76	58
	CEOM	58 (43.3)		
Tooth location (134)	Maxilla	70 (52.2)	42 (55.2)	28 (48.3)
	Mandible	64 (47.8)	34 (44.8)	30 (51.7)
Pulp diagnosis (113)	Pulp vitality	46 (40.7)	19 (34.5)	27 (46.5)
	Necrosis	67 (59.3)	36 (65.5)	31 (53.5)
Apical periodontitis (134)	Absent	60 (45)	32 (42.1)	28 (48.3)
	Present	74 (55)	44 (57.9)	30 (51.7)
Treatment session (134)	1	39 (29.1)	6 (8)	33 (56.9)
	≥2	95 (70.9)	70 (92)	25 (43.1)
Irrigant (134)	CLX	59 (44)	1 (1.3)	58 (100)
	NaOCl	75 (56)	75 (98.7)	0 (0)
Working Length (133)	Short (<2 mm)	9 (6.8)	9 (12)	0 (0)
	Zero	66 (49.6)	66 (88)	0 (0)
	Long	58 (43.6)	0 (0)	58 (100)
Intracanal medication (92)	Corticosteroid-antibiotic association	2 (2.2)	2 (2.9)	0
	PMCC	2 (2.2)	2 (2.9)	0
	Tricresol-formalin	16 (17.5)	9 (12.8)	7 (31.8)
	Calcium hydroxide	65 (70.5)	57 (81.4)	8 (36.4)
	Chlorhexidine gel 2%	7 (7.6)	0	7 (31.8)
Filling level from apex (134)	Short (<2mm)	13 (9.7)	13 (17.1)	0 (0)
	0-2mm	66 (49.3)	46 (60.5)	20 (34.5)
	Overfilled	55 (41)	17 (22.4)	38 (65.5)
Obturation technique (131)	Lateral compaction	36 (27.5)	36 (49.3)	0 (0)
	Thermoplastic Tagger's hybrid	38 (29)	37 (50.7)	1 (1.7)
	Hydraulic vertical condensation	57 (43.5)	0	57 (98.3)
Systemic alteration (124)	No	85 (68.6)	42 (56.7)	43 (86)
	Yes	39 (31.4)	32 (43.3)	7 (14)
Smoke (120)	No	105 (87.5)	61 (83.5)	44 (93.6)
	Yes	15 (12.5)	12 (16.5)	3 (6.4)
Symptoms prior to treatment (125)	Absent	42 (33.6)	36 (51.4)	6 (11)
	Present	61 (48.8)	31 (44.3)	30 (54.5)
	Absent with background	22 (17.6)	3 (4.3)	19 (34.5)
Coronal Sealing (134)	Absent	5 (3.7)	3 (4)	2 (3.5)
	Present	129 (96.3)	73 (96)	56 (96.5)
Type of Coronal Sealing (134)	Absent	5 (3.7)	3 (4)	2 (3.5)
	Inadequate	10 (7.5)	8 (10.5)	2 (3.5)
	Cast	22 (16.4)	20 (26.3)	2 (3.5)
	Restoration	70 (52.2)	32 (42.1)	38 (65.5)
	Temporary	27 (20.2)	13 (17.1)	14 (24)
Recall period (months)	Mean	25.8 (±11.7)	28.6 (±12.1)	22.2 (±9.8)
	6-12	(22) 16.4	12 (15.8)	10 (17.2)
	13-24	(34) 25.4	11 (14.5)	23 (39.7)
	25-36	(53) 39.5	32 (42.1)	21 (36.2)
	37-48	(25) 18.7	21 (27.6)	4 (6.9)
Recall rate (patients)	n=516	124 (24%)	74/179 (41.3%)	50/337 (14.8%)

Table 2. Prognostic factors related to the success rate of endodontic treatment. Bivariate model using Poisson Regression with robust variance.

Prognostic factor		Success N (%)	Failure N (%)	RR (95%CI)	*P* value
Age (years)	≤60	87 (81.3)	20 (18.7)	1.13 (0.87-1.47)	0.361
	>60	18 (72)	7 (28)		
Sex	Male	57 (83.8)	11 (16.2)	1.11 (0.93-1.31)	0.248
	Female	50 (75.8)	16 (24.2)		
Postgraduate program	UFRGS	62 (81.6)	14 (18.4)	1.05 (0.88-1.25)	0.574
	CEOM	45 (77.6)	13 (22.4)		
Systemic alteration	No	77 (81.9)	17 (18.1)	1.09 (0.89-1.34)	0.393
	Yes	30 (75)	10 (25)		
Tooth location	Maxilla	53 (75.7)	17 (24.3)	0.90 (0.76-1.06)	0.210
	Mandible	54 (84.4)	10 (15.6)		
Apical Periodontitis	Absent	54 (90)	6 (10)	1.26 (1.06-1.48)	0.007
	Present	53 (71.6)	21 (28.4)		
Irrigant	CLX	46 (78)	13 (22)	0.96 (0.80-1.14)	0.633
	NaOCl	61 (81.3)	14 (18.7)		
Treatment session	1	31 (79.5)	8 (20.5)	0.99 (0.82-1.20)	0.947
	≥2	76 (80)	19 (20)		
Calcium hydroxide	No	52 (78.8)	14 (21.2)	0.95 (0.80-1.12)	0.533
	Yes	54 (83.1)	11 (16.9)		
Working length	Short	6 (66.6)	3 (33.3)	1	
	0	56 (84.8)	10 (15.2)	1.27 (0.79-2.04)	0.318
	Long	45 (77.6)	13 (22.4)	1.16 (0.72-1.88)	0.538
Filling level	0 or short	66 (83.5)	13 (16.5)	1.12 (0.93-1.35)	0.222
	Overfilling	41 (74.5)	14 (25.5)		
Coronal sealing	Absent	3 (60)	2 (40)	0.744 (0.36-1.53)	0.422
	Present	104 (80.6)	25 (19.4)		
Pain after treatment	Absent	96 (80.7)	23 (19.3)	1.21 (0.80-1.82)	0.362
	Present	8 (66.7)	4 (33)		
Obturation technique	Lateral compaction	28 (77.8)	8 (22.2)	1	
	Thermoplastic Tagger's hybrid	33 (86.8)	5 (13.2)	1.12 (0.90-1.38)	0.313
	Hydraulic vertical condensation	44 (77.2)	13 (22.8)	0.99 (0.79-1.24)	0.947
Recall period	≤24	41 (73.2)	15 (26.8)	0.86 (0.72-1.04)	0.124
	>24	66 (84.6)	12 (15.4)		
Total		107 (79.9)	27 (20.1)		

Table 3. Multivariate analysis: adjusted models for association between success of endodontic treatment and (A) age, sex and postgraduate program; (B) apical periodontitis and (C) tooth location, filling level and recall period. Bold type indicates statistical significance (P-value <0.05), relative risk (RR), confidence interval (95% CI), and Wald chi-square, Poisson regression with robust variance.

		A			B			C	
Factors	**Wald**	**RR (95% CI)**	***P* value**	**Wald**	**RR (95% CI)**	***P* value**	**Wald**	**RR (95% CI)**	***P* value**
Age (≤60)	1.329	1.17 (0.90-1.52)	0.249	1.988	1.21 (0.93-1.59)	0.159	1.214	1.17 (0.88-1.55)	0.271
Sex (male)	1.680	1.12 (0.94-1.33)	0.195	2.506	1.14 (0.97-1.35)	0.113	2.125	1.13 (0.96-1.34)	0.145
Postgraduate program (UFRGS)	0.807	1.08 (0.91-1.30)	0.369	1.595	1.12 (0.94-1.34)	0.207	0.115	1.04 (0.84-1.28)	0.735
Apical periodontitis (absent)				8.426	1.29 (1.09-1.54)	**0.004**	7.843	1.27 (1.07-1.50)	**0.005**
Tooth location (maxilla)							1.188	0.91 (0.77-1.08)	0.276
Filling level (0 or short)							0.777	1.10 (0.89-1.34)	0.378
Recall period (≤24 months)							1.777	0.87 (0.72-1.06)	0.183

Table 4. Bivariate model using Poisson regression with robust variance to estimate the relationship between filling level and filling technique.

Technique	Short or 0	Overfilled	RR (CI 95%)	P Value
Lateral condensation	31(86.1%)	5 (13.9%)	1	
Thermoplastic Tagger's hybrid	26 (68.5%)	12 (31.5%)	2.27 (0.89-5.81)	0.086
Hydraulic vertical condensation	20 (35%)	37 (65%)	4.67 (2.03-10.78)	**0.000**

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4. CONSIDERAÇÕES FINAIS

Diante do exposto, esta tese contribuiu para a construção do conhecimento na área de avaliação e elaboração de estudos clínicos observacionais relacionados ao tratamento endodôntico. Através da realização da revisão sistemática, foi possível elencar as evidências disponíveis na literatura a respeito do desfecho do tratamento endodôntico e os fatores preditores de sucesso. Além disso, foi possível apontar as limitações metodológicas, bem como a falta de padronização dos estudos e da descrição dos resultados.

Dentre as maiores dificuldades encontradas para comparabilidade dos estudos estão a heterogeneidade clínica e metodológica, a grande variabilidade no número de amostras e de pacientes. A unidade amostral considerada também não foi unânime, sendo que alguns estudos apresentaram resultados por dente, por raiz ou utilizaram tanto um quanto o outro. Ao se transpor os resultados dos estudos para prática clínica, entende-se que a unidade de avaliação a ser considerada deve ser o dente em sua totalidade, pois se uma das raízes não estiver saudável, o dente não poderá permanecer em função e a sua manutenção ficará comprometida.

Além disso, poucos estudos atentaram em descrever ou coletar dados referentes a história médica e dentária do paciente, e de como são realizados os exames clínicos. Dessa forma, a dificuldade de se encontrar embasamentos referente a influência das alterações sistêmicas dos pacientes com desfechos endodônticos fica aumentada. Portanto, investigações longitudinais com metodologias de pesquisa bem projetadas são necessárias para abordar essa questão que permanece inconclusiva.

Em relação os resultados encontrados no estudo clínico, a presença de lesão apical mostrou ser um fator determinante para a diminuição da taxa de sucesso dos tratamentos, o que corrobora com outros estudos. Mesmo sabendo da dificuldade em eliminar microrganismos do canal radicular, técnicas de preparo, soluções químicas auxiliares e medicações intracanal continuam sendo aprimoradas para tentarem alcançar uma desinfecção mais eficiente. Diferentes filosofias de tratamento foram utilizadas nas duas instituições estudadas e esses fatores não mostraram influenciar o resultado do tratamento endodôntico.

O número de sessões não parece influenciar o resultado do tratamento, porém, pode-se perceber que a necessidade de realizar o tratamento em mais de uma sessão está ligada ao grau de dificuldade do dente proposto, como também a habilidade técnica do profissional. No estudo clínico, a maioria dos casos realizados por alunos de pós-graduação necessitou ser concluída em mais de uma sessão. O uso da técnica da condensação lateral para obturação dos canais foi majoritário nos estudos da revisão. Podemos constatar no estudo clínico que essa técnica apresentou menor risco de extravasamento de material obturador, perante as outras técnicas.

Na revisão sistemática podemos observar que a taxa de retorno dos pacientes é variável e diminui conforme aumenta o tempo de proservação. Isso também foi observado no estudo clínico, em que os dois programas de pós-graduação apresentaram taxas de retorno bastante distintas. Estudos clínicos dependem da disponibilidade de retorno dos pacientes, e por esse motivo alcançar amostras robustas e relevantes exigem insistência e tempo prolongado de coleta de dados e pesquisa.

Apesar da dificuldade na realização de estudos clínicos observacionais, essa ferramenta permite avaliar a influência simultânea de vários fatores sobre o resultado do tratamento endodôntico, possibilitando julgamentos e discussões a respeito da importância relativa de cada fator para a determinação do melhor procedimento. Como consequência, associações embasadas permitirão tomadas de decisões mais previsíveis quanto ao prognóstico a longo prazo.

A principal desvantagem de estudos observacionais retrospectivos é que a análise fica restrita às informações disponíveis e, portanto, devem ser interpretadas com cautela para evitar vieses. Dessa forma, a coleta de dados e o planejamento do estudo acabam por se basear na disponibilidade das informações presentes em prontuários previamente preenchidos. A elaboração de protocolos para facilitar a descrição e padronização dos resultados poderia minimizar a heterogeneidade dos estudos.

Como desfecho principal, o artigo 2 demostrou que independentemente da técnica e filosofia de tratamento utilizadas para a execução do tratamento endodôntico, a taxa de sucesso não foi afetada. Embora o desfecho do tratamento endodôntico seja um fenômeno multifatorial, o diagnóstico periapical mostrou ser o

preditor mais significativo para o insucesso endodôntico. Na revisão sistemática, os fatores que mais se destacaram por influenciar o sucesso do tratamento endodôntico foram a condição pulpar e periapical, o dente envolvido, complicações, e a extensão apical do material obturador.

Estudos clínicos com longos períodos de acompanhamento e protocolos bem definidos devem ser incentivados, a fim de facilitar a coleta de dados e sua comparabilidade, para que sejam elucidados outros fatores que podem afetar o resultado do tratamento endodôntico.

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ANEXO 1 – TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

CÓDIGO DO PACIENTE __ __ __

TERMO DE CONSENTIMENTO LIVRE ESCLARECIDO

Titulo do Projeto: “Avaliação da influência de diferentes protocolos técnicos no sucesso clínico e radiográfico do tratamento endodôntico.”

Pesquisadores:

- Profa. Dra. Fabiana Soares Grecca da Faculdade de Odontologia da Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, RS CPF- 161877588-03.

-Carolina Bender Hoppe, aluna do Doutorado em Clínica Odontológica – Endodontia/UFRGS CPF 018004860-06.

Esclarecimentos sobre a pesquisa poderão ser obtidos pelo telefone (51) 996255972 ou pelo email carolina.hoppe@hotmail.com

O contato com o comitê de Ética que avalia o projeto (Comitê de Ética em Pesquisa da UFRGS) pode ser realizado a partir do telefone (51) 33083738 ou pelo email etica@propesq.ufrgs.br

Caro (a) paciente, neste estudo, iremos avaliar os tratamentos endodônticos realizados por alunos do curso de Especialização em Endodontia da UFRGS e no Centro de Estudos Odontológicos Meridional (CEOM) em Passo Fundo. O tratamento de canal consiste na remoção do “nervo do dente”, isso ocorre por diversos motivos, entre eles, quando este “nervo” está morto ou inflamado. A realização deste tratamento promove uma limpeza e desinfecção dos canais e, após esta etapa, os canais serão obturados e vedados para evitar que o paciente volte a sentir dor e a lesão, que antes existia, seja curada.

O objetivo deste trabalho é avaliar os tratamentos que já foram realizados através de um exame feito por um dentista e por radiografias do dente em questão. Além do beneficio que o paciente terá em saber se o seu tratamento teve sucesso, este estudo irá auxiliar mais dentistas a embasarem os seus próximos tratamentos. Nos casos em que o tratamento não obteve sucesso, o paciente será devidamente encaminhado para receber tratamentos de acordo com o caso.

A participação neste trabalho não lhe trará riscos no que diz respeito ao atendimento odontológico, uma vez que não serão modificados protocolos, indicações de tratamento, e consultas de avaliação clínica e radiográfica dos procedimentos já realizados. Existe o risco de exposição à radiação ionizante (no momento da tomada de radiografia), porém essa exposição é necessária para a realização dos exames mesmo se você não quiser participar do nosso estudo, e os pesquisadores garantem a utilização de itens de proteção, como o avental de chumbo e o protetor de tireoide.

Para diminuir o risco de que a confidencialidade dos seus dados seja quebrada, todos os pesquisadores assinarão um termo em que se comprometem a mantê-las em sigilo. Você pode se desvincular da pesquisa a qualquer momento, sem que isso traga qualquer prejuízo ao seu atendimento nesta Faculdade.

Eu,_____ _____, fui informado sobre os objetivos, riscos, benefícios desta pesquisa, e concordo em participar de uma avaliação para o desenvolvimento desta pesquisa. Estou ciente de que todos os dados que forneci e que possam identificá-lo serão mantidos em sigilo. Compreendo que a minha única vinculação com a pesquisa será no momento da assinatura deste termo, que foi por/para mim lido, compreendido e todas minhas dúvidas foram esclarecidas pelos pesquisadores. A qualquer momento poderei entrar em contato com os responsáveis pela pesquisa, para quaisquer esclarecimentos sobre a mesma, pelo telefone: (51) 996255972.

PORTO ALEGRE, _____ DE _____ DE 20_____.

_____ _____

Assinatura do paciente Assinatura do Pesquisador

ANEXO 2 – TERMO DE CONFIDENCIALIDADE

TERMO DE CONFIDENCIALIDADE

Eu, _____, pesquisador(a) da Faculdade de Odontologia, Universidade Federal do Rio Grande do Sul, CPF nº _____e RG _____, comprometo-me a seguir as
diretrizes para segurança da informação definidas para o projeto de pesquisa "**Avaliação da influência de diferentes protocolos técnicos no sucesso clínico e radiográfico do tratamento endodôntico**.", de forma a não comprometer a confidencialidade dos dados obtidos com o projeto. Comprometo-me, dessa forma, a dispensar cuidado com as informações cadastradas em meu *login* pessoal e a manter sigilo de minha senha e das informações dos participantes da pesquisa (pacientes).

_____
Nome e assinatura do(a) Pesquisador(a)

_____, _____ de _____de _____.
Local e data

ANEXO 3 – TERMO DE COMPROMISSO PARA UTILIZAÇÃO DE DADOS

TERMO DE COMPROMISSO PARA UTILIZAÇÃO DE DADOS

Os pesquisadores do presente projeto se comprometem a preservar a privacidade dos pacientes cujos dados serão coletados diretamente de prontuários, nos locais de coleta estabelecidos. Concordam, igualmente, que essas informações serão utilizadas única e exclusivamente para a execução do projeto. As informações somente poderão ser divulgadas de forma anônima.

_____

Prof Fabiana Soares Grecca

_____

Prof. Mateus Silveira Martins Hartmann

_____

Prof. Dra Roberta Kochenborger Scarparo

_____

Aluna Carolina Bender Hoppe

_____

Aluna Pauline Mastella Lang

ANEXO 4 – TABELAS DE COLETA DE DADOS

UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL
FACULDADE DE ODONTOLOGIA

Histórico do Tratamento Endodôntico
Dados Retrospectivos e Transoperatórios

Local de atendimento: _____ Data: _____ Responsável pelo atendimento: _____	Código do paciente: ___ ___ ___
Dente: _____ n° de canais:_____	Data:____/_____/_____

1.Dados Demográficos:

Idade do paciente:
Gênero:
Fumo:
Variáveis Médicas:
( ) Doença cardiovascular
( ) Hipertensão
( ) Diabetes
( ) outra: _____

2.Diagnóstico Inicial:

( ) pulpite,
( ) necrose,
( ) periodontite apical aguda,
( ) periodontite apical crônica,
( ) indicação protética.

3.Sinais e Sintomas

Sintomas: ( ) ausentes
( ) ausentes com antecedentes
( ) presentes

a. início: ( ) dias ( ) meses ( ) anos

b. intensidade: ( ) leve ( ) moderada ( ) intensa

c. localização: ( ) localizada ( ) difusa ( ) irradiada

d. duração: ( ) instantânea ( ) passageira ( ) intermitente ( ) contínua

e. estímulo: ( ) espontâneo ( ) provocado

3.1 RECURSOS SEMIOTÉCNICOS AUXILIARES

a. ( ) percussão vertical (1) positiva (2) negativa
b. ( ) percussão horizontal (1) positiva (2) negativa
c. ( ) som metálico à percussão (1) positiva (2) negativa
d. ( ) pressão apical (1) positiva (2) negativa
e. ( ) digitação apical (1) positiva (2) negativa
f. ( ) teste de sensibilidade ao frio (0) normal (1) positiva e exacerbado (2) negativa

4.Classificação do Tratamento

4.1 ( ) NÚMERO DE SESSÕES

1- sessão única

2- sessão múltipla

4.2 ( ) MEDICAÇÃO INTRACANAL

1- Ausência de medicação

2- Hidrocortisona 10 mg + sulfato de neomicina 5 mg + sulfato de polimixina B 10000 (OTOSPORIN®)

3- Paramonoclorofenol Canforado (PMCC)

4-Tricresol Formalina,

5- Hidróxido de cálcio

6- Gel de digluconato de clorexidina 2%

7- Hidróxido de cálcio com PMCC

8- Hidróxido de cálcio com Gel de digluconato de clorexidina 2%.

4.3 ( ) SOLUÇÃO IRRIGADORA

1- Hipoclorito de sódio

2- Solução de digluconato de clorexidina 2%

3- Gel de digluconato de clorexidina 2% e soro fisiológico.

4.4 ( ) AGITAÇÃO DA SOLUÇÃO IRRIGADORA

1- Sim

2- Não

4.5 ( ) LIMITE DE TRABALHO

1- Aquém

2- Zero

3- Além

4.6 ( ) TÉCNICA OBTURADORA

1- Técnica da condensação lateral

2- Técnica da termoplastificação da guta-percha

3- Técnica da compressão vertical hidráulica

4.7 ( ) EXTENSÃO DO MATERIAL OBTURADOR
1- > 2 mm do vértice radiográfico 2- Entre 0 e 2 mm do vértice radiográfico 3- Sobreobturado
4.8 ( ) HISTÓRICO DE DOR PÓS-OPERATÓRIA
1- Presente 2- Ausente
4.9 ( ) ACIDENTE (1-Presente/ 2-Ausente) ( ) TIPO/LOCAL
1- Desvio 1- Terço cervical 2- Terço médio 3- Terço apical 2- Perfuração 1- Terço cervical 2- Terço médio 3- Terço apical 3- Fratura de instrumento 1- Terço cervical 2- Terço médio 3- Terço apical

UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL
FACULDADE DE ODONTOLOGIA

Histórico do Tratamento Endodôntico

Dados Prospectivos

Local de atendimento: _____ Data: _____ Responsável pelo atendimento: _____	Código do paciente: ___ ___ ___
Dente: _____ n° de canais:_____	Data:____/_____/_____
1.Exame Clínico	
1.1 ( ) EDEMA EXTRA-ORAL	
1-Presente 2- Ausente	
1.2 ( ) LINFADENOPATIA	
1-Presente 2- Ausente	

1.3 ( ) DOR À PALPAÇÃO EXTRA-ORAL
1-Presente 2- Ausente
1.4 ( ) EDEMA INTRA-ORAL
1-Presente 2- Ausente
1.5 ( ) FÍSTULA
1-Presente 2- Ausente
1.6 ( ) MOBILIDADE DENTAL
1-Presente 2- Ausente
1.7 ( ) SELAMENTO CORONÁRIO
1-Adequado 2- Inadequado
1.8 ( ) ALTERAÇÃO CROMÁTICA
1-Presente 2- Ausente
1.9 ( ) REABILITAÇÃO DENTÁRIA
1- ausente 2- inadequada 3- presença de coroa protética ou prótese provisória 4- restauração provisória 5- restauração definitiva ( ) direta ( ) indireta
1.10 RECURSOS SEMIOTÉCNICOS AUXILIARES
a. ( ) percussão vertical (1) positiva (2) negativa b. ( ) percussão horizontal (1) positiva (2) negativa c. ( ) som metálico à percussão (1) positiva (2) negativa d. ( ) pressão apical (1) positiva (2) negativa e. ( ) digitação apical (1) positiva (2) negativa
3. ( ) Avaliação radiográfica
1- destruição óssea periapical definitivamente não está presente; 2- destruição óssea periapical provavelmente não está presente; 3- incerto; 4- destruição óssea periapical provavelmente está presente; 5- destruição óssea periapical definitivamente está presente; 6- dentes extraídos durante o período de acompanhamento.
4. Tempo de proservação
_____ meses
5. ( ) Classificação dos casos em relação ao sucesso do tratamento
1- Sucesso 2- Insucesso

ANEXO 5 – PARECER CONSUBSTANCIADO DA COMISSÃO DE PESQUISA

UFRGS

Universidade Federal do Rio Grande do Sul — Faculdade de Odontologia

PARECER CONSUBSTÂNCIADO DA COMISSÃO DE PESQUISA

Parecer aprovado em reunião do dia 18 de julho de 2017

ATA nº 06/2017.

A Comissão de Pesquisa da Faculdade de Odontologia da Universidade Federal do Rio Grande do Sul após análise aprovou o projeto abaixo citado com o seguinte parecer:

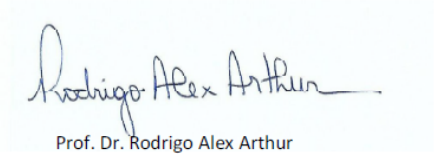
Prezada Pesquisadora Fabiana Soares Grecca,

Informamos que o projeto de pesquisa **Projeto:** 33530 - Avaliação da influência de fatores clínicos e radiográficos no sucesso do tratamento endodôntico: Estudo de Coorte Retrospectivo foi aprovado quanto ao mérito pela Comissão de Pesquisa de Odontologia com o seguinte parecer:

Trata-se de proposta de Projeto de pesquisa que tem por objetivo avaliar a influência de diferentes fatores no sucesso clínico e radiográfico do tratamento endodôntico de molares realizados no curso de especialização em Endodontia da Universidade Federal do Rio Grande do Sul e no curso de especialização em Endodontia do Centro de Estudos Odontológicos Meridional da cidade de Passo Fundo, Rio Grande do Sul. A amostra será constituída a partir de casos atendidos nos cursos durante o período de janeiro de 2014 a julho de 2017. Serão coletados para análise dados retrospectivos referentes ao paciente e ao tratamento realizado, bem como dados transoperatórios disponíveis nos prontuários. Os pacientes agendados para as consultas de proservação serão acompanhados e dados prospectivos serão coletados a partir dos exames clínicos e radiográficos. Tais dados serão incluídos em uma plataforma para inserção de dados, programada em linguagem PHP e em linguagem web, sendo seu armazenamento realizado em um provedor contendo pacote de dados freeware, do tipo postgres. Será realizada análise descritiva de características clínicas e radiográficas presentes nesses casos, considerando dados demográficos, fatores sistêmicos, dor, condição pré-operatória do dente, protocolo de preparo, extensão de material obturador, tempo de proservação. Estes dados serão analisados por métodos de regressão logística bi e multivariável, quanto ao potencial de interferir na obtenção de resultados tecnicamente satisfatórios e no sucesso clínico-radiográfico.

O presente projeto foi avaliado pela Comissão de Pesquisa e aprovado quanto ao mérito. Solicita-se aos pesquisadores que o projeto seja cadastrado na Plataforma Brasil.

Atenciosamente, Comissão de Pesquisa de Odontologia



Prof. Dr. Rodrigo Alex Arthur

Coordenador da Comissão de Pesquisa ODONTOLOGIA UFRGS

ANEXO 6 – PARECER CONSUBSTANCIADO DO CEP

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

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Avaliação da influência de fatores clínicos e radiográficos no sucesso do tratamento endodôntico: Estudo de Coorte Retrospectivo.

Pesquisador: Fabiana Soares Grecca

Área Temática:

Versão: 4

CAAE: 71875317.8.0000.5347

Instituição Proponente: UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 2.434.263

Apresentação do Projeto:

O projeto de pesquisa "Avaliação da influência de fatores clínicos e radiográficos no sucesso do tratamento endodôntico: Estudo de Coorte Retrospectivo" tem como pesquisadora responsável a Profa Fabiana Soares Grecca e conta com a participação de Mateus Silveira Martins Hartmann, Carolina Bender Hoppe, Roberta Kochenborger Scarparo, Pauline Mastella Lang. A origem do Projeto é o Programa de Pós-graduação em Odontologia da Faculdade de Odontologia da UFRGS (Porto Alegre, RS). Trata-se de um estudo multicêntrico, sendo realizado também no Instituto Meridional/Centro de Estudos Odontológicos Meridional(IMED/CEOM, Passo Fundo, RS).

Objetivo da Pesquisa:

Objetivo Geral: avaliar a influência de diferentes fatores no sucesso clínico e radiográfico do tratamento endodôntico de casos realizados no curso de Especialização em Endodontia da Universidade Federal do Rio Grande do Sul e no Curso de Especialização em Endodontia do Centro de Estudos Odontológicos Meridional da cidade de Passo Fundo, Rio Grande do Sul.

Avaliação dos Riscos e Benefícios:

- Riscos: não há riscos ou desconfortos adicionais ao participante que decorrem dos procedimentos clínicos/radiográficos relatados no protocolo de pesquisa. Os procedimentos a serem realizados não diferem daqueles adotados na rotina do serviço das instituições Segundo os pesquisadores, "os riscos referentes ao sigilo de dados e confidencialidade serão minimizados

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Bairro: Farroupilha **CEP:** 90.040-060
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Telefone: (51)3308-3738 **Fax:** (51)3308-4085 **E-mail:** etica@propesq.ufrgs.br

através da codificação dos dados de identificação e termos de consentimento, além de que o banco de dados poderá ser acessado somente por meio de senha eletrônica."

- Benefícios: Não há benefício direto. Em caso de necessidade de reintervenção, o mesmo será encaminhado para que receba o tratamento. Indiretamente, contribui-se para a avaliação do sucesso terapêutico de protocolos de tratamento endodôntico.

Comentários e Considerações sobre a Pesquisa:

- Delineamento: trata-se de um estudo observacional de coorte, retrospectivo.

- Locais de realização: Faculdade de Odontologia da UFRGS (Porto Alegre, RS) e Curso de Especialização em Endodontia do CEOM/IMED (Passo Fundo, RS).

- Critérios de inclusão: serão incluídos no estudo pacientes que retornarem para a consulta de proservação, que haviam sido atendidos no período de janeiro de 2014 a julho de 2017 no curso de especialização em Endodontia da FO-UFRGS e no curso de especialização do CEOM, e que realizaram tratamentos endodônticos em dentes molares.

- Critérios de exclusão: dentes com anatomias atípicas, retratamentos endodônticos, rizogênese incompleta, dentes que sofreram traumas, cirurgia parendodôntica, dentes com lesão endoperiodontal, ausência de exames radiográficos disponíveis e/ou falta de dados registrados nos prontuários, dentes extraídos por motivos não endodônticos, gravidez nos períodos de controles clínico/radiográfico previstos.

- Cálculo do tamanho amostral: realizado a partir dos parâmetros obtidos na literatura (Imura et al., 2007), e aplicados em pacote estatístico (Programa OpenEpi). Total de participantes: 460 (sendo 230 em cada centro).

- Procedimentos experimentais: coleta de dados clínicos e radiográficos no momento da avaliação de proservação; inclusão dos dados em uma plataforma para inserção de dados (http://dadosendoufrgs.kinghost.net/), sendo seu armazenamento realizado em um provedor contendo pacote de dados freeware, do tipo postgres; coleta dos dados retrospectivos; análise dos dados (análise descritiva e modelos regressão logística bi e multivariados).

- Variáveis de interesse: a) relacionados ao pré-tratamento, etapa transoperatória e pós-operatório imediato: número de sessões, medicação intracanal, solução irrigadora, agitação da solução irrigadora, limite de trabalho, técnica obturadora, extensão do material obturador, histórico de dor pós-operatória, acidentes; b) na etapa de acompanhamento: avaliação de sinais e sintomas, avaliação radiográfica.

- Cronograma: início da coleta de dados em Dezembro/2017. Previsão de encerramento do projeto em Agosto/2018.

- Orçamento previsto: R$250,00.
- Formulário para coleta de dados: presente.

Considerações sobre os Termos de apresentação obrigatória:

- TCLE: presente (consta apresentação da pesquisa, objetivo, justificativa, procedimentos, riscos e benefícios, garantia de confidencialidade e sigilo, garante possibilidade de desistência de participação,contato dos pesquisadores e do CEP-UFRGS).
- Termo de Compromisso para Utilização de Dados: presente.
- Termo de Confidencialidade: presente.
- Cronograma: Adequado.
- Orçamento: descrito.
- Termo de ciência dos responsáveis pela guarda dos prontuários nas duas instituições: presente.

Conclusões ou Pendências e Lista de Inadequações:

Os pesquisadores responderam ao questionamento encaminhado em diligência anterior. Havia sido solicitado esclarecimento quanto à data de início do estudo. Esta foi compatibilizada no projeto e no Formulário de Submissão da Plataforma Brasil. Assim, o projeto pode ser aprovado quanto aos aspectos éticos de pesquisa em seres humanos, conforme a Resolução 466/2012 do Conselho Nacional de Saúde. Contudo, considerando-se tratar de um estudo multicêntrico, a sua aprovação limita-se às etapas a serem realizadas na Universidade Federal do Rio Grande do Sul. Há necessidade de apreciação pelo CEP-IMED.

Considerações Finais a critério do CEP:

Aprovado.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_965935.pdf	09/12/2017 12:14:28		Aceito
Projeto Detalhado / Brochura Investigador	projetoplataforma2.docx	09/12/2017 12:13:06	Fabiana Soares Grecca	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.docx	06/11/2017 11:58:45	Fabiana Soares Grecca	Aceito
Folha de Rosto	Folha_de_rosto_FabianaSoares.pdf	25/07/2017	Fabiana Soares	Aceito

Folha de Rosto	Folha_de_rosto_FabianaSoares.pdf	17:33:56	Grecca	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

PORTO ALEGRE, 13 de Dezembro de 2017

Assinado por:
José Artur Bogo Chies
(Coordenador)

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