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Dissertação

Influência das técnicas de instrumentação manual, rotatória e reciprocante na dor pós-operatória endodôntica: revisão sistemática da literatura

Andressa Raquel Spohr

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Notas Preliminares

A presente dissertação foi redigida segundo o Manual de Normas para Dissertações, Teses e Trabalhos Científicos da Universidade Federal de Pelotas de 2013, adotando o Nível de Descrição 3 – estrutura em Capítulos não convencionais, descrita no Apêndice do referido manual. Disponível no endereço eletrônico: <http://sisbi.ufpel.edu.br/?p=documentos&i=7> Acesso em: 21/11/2016.

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Resumo

SPOHR, Andressa Raquel. **Influência das técnicas de instrumentação manual, rotatória e reciprocante na dor pós-operatória endodôntica: revisão sistemática da literatura.** 2017. 46f. Dissertação (Mestrado em Odontologia). Programa de Pós-Graduação em Odontologia. Universidade Federal de Pelotas, Pelotas, 2017.

O objetivo dessa revisão sistemática foi avaliar a influência das técnicas de instrumentação manual, rotatória e reciprocante na dor pós-operatória em pacientes submetidos a tratamento endodôntico em dentes permanentes. Os artigos foram selecionados para essa revisão de acordo com os seguintes critérios de inclusão: ensaios clínicos randomizados com pacientes submetidos a tratamento endodôntico em dentes permanentes, comparando técnicas de instrumentação com diferentes cinemáticas (limas manuais de aço inoxidável versus limas mecanizadas de níquel-titânio ou limas mecanizadas de níquel-titânio rotatórias versus reciprocantes) e seu efeito na dor pós-operatória. Dados sobre a ingestão de analgésicos também foram registrados. A busca eletrônica foi realizada nas bases de dados MEDLINE, ISI Web of Science e Scopus, além de pesquisas manuais. O risco de viés foi avaliado para cada artigo e o sistema GRADE foi aplicado para a avaliação da qualidade da evidência. Doze estudos e 1659 pacientes com idades entre 14 e 73 anos foram incluídos nessa revisão. Cinco estudos compararam as técnicas de instrumentação manual versus mecanizada (rotatória e/ou reciprocante). A maioria deles mostrou maiores níveis de dor pós-operatória para a técnica manual. Sete estudos e um conjunto de dados de um dos 5 artigos anteriores foram incluídos na comparação de técnicas rotatórias versus reciprocantes. A maioria deles mostrou maiores níveis de dor pós-operatória para a instrumentação reciprocante. Os dados sobre a ingestão de analgésicos revelaram resultados controversos. O sistema GRADE mostrou baixa qualidade de evidência. Pode-se concluir que a técnica de instrumentação manual induziu maiores níveis de dor pós-operatória quando comparada com as técnicas mecanizadas. Instrumentos reciprocantes levaram a maiores níveis de dor pós-operatória do que as técnicas rotatórias. No entanto, devido à baixa qualidade da evidência e aos achados conflitantes, os resultados devem ser considerados com cautela.

Palavras-chave: dor pós-operatória, preparo do canal radicular, instrumentos manuais, instrumentos rotatórios, instrumentos reciprocantes.

Abstract

SPOHR, Andressa Raquel. **Influence of hand, rotary and reciprocating instrumentation techniques on endodontic postoperative pain: A systematic review.** 2017. 46f. Dissertation (Master Degree in Dentistry). Graduate Program in Dentistry. Federal University of Pelotas, Pelotas, 2017.

This systematic review aimed to evaluate the influence of hand, rotary and reciprocating instrumentation techniques on postoperative pain in patients submitted to endodontic treatment in permanent teeth. Articles were selected for this review according to the following inclusion criteria: randomized clinical trials with patients undergoing endodontic treatment in permanent teeth, comparing instrumentation techniques with different kinematics (hand stainless steel files vs. engine-driven nickel-titanium files or rotary vs. reciprocating engine-driven nickel-titanium files) and their effect on postoperative pain. Data on analgesic intake was also recorded. The electronic search was undertaken in MEDLINE, ISI Web of Science and Scopus databases, in addition to hand searches. Risk of bias was evaluated for each study and GRADE framework was applied for quality of evidence assessment. Twelve studies and 1659 patients aged between 14 and 73 years old were included in this review. Five studies compared hand vs. engine-driven (rotary and/or reciprocating) instrumentation techniques. Most results showed higher postoperative pain levels for hand preparation. Seven studies and one dataset from one of the five previous studies were included in the comparison of rotary vs. reciprocating techniques, with contrasting results. Most studies showed higher postoperative pain levels for reciprocating instrumentation. Data on analgesic intake revealed controversial findings. GRADE showed low quality of evidence. In conclusion, hand instrumentation technique induced higher postoperative pain levels when compared to engine-driven techniques. Reciprocating instruments drift to higher postoperative pain levels than rotary techniques. However, given the low quality of evidence and conflicting findings, results should be considered with caution.

Key Words: postoperative pain, root canal preparation, hand instruments, reciprocating instruments, rotary instruments.

Sumário

1 Introdução

Embora a terapia endodôntica bem-sucedida dependa de diversos fatores, um dos passos mais importantes é o preparo mecânico dos canais radiculares. Tal etapa é essencial, pois influencia a eficácia de todos os procedimentos subsequentes. A mesma inclui o desbridamento mecânico, a criação de espaço para a aplicação de medicamentos e de uma configuração geométrica otimizada do canal radicular para permitir uma obturação adequada (PETERS et al., 2004). No entanto, o processo de preparo do canal pode ser bastante demorado e tedioso. Os fatores que dificultam a instrumentação incluem o comprimento do dente, o grau de curvatura e o diâmetro dos canais radiculares (SATHORN et al., 2005). Na tentativa de simplificar o preparo mecânico, além de reduzir o tempo necessário para sua realização e a fadiga do operador, foram desenvolvidos dispositivos motorizados (HÜLSMANN et al., 2005).

A introdução da liga de níquel-titânio (NiTi) na endodontia ocorreu na década de 80 (WALIA et al., 1988) e permitiu o surgimento de sistemas rotatórios seguros e eficientes para o preparo de canais radiculares, especialmente canais curvos (PETERS et al., 2004). Existem evidências clínicas e experimentais de que tais sistemas reduzem a ocorrência de erros operatórios, tais como desvio e transporte apical, devido a sua notável flexibilidade (CHEUNG; LIU, 2009; PETERS; PAQUÉ, 2010). Posteriormente, Yared (2008) demonstrou que o uso de um único instrumento de NiTi em movimento reciprocante aumenta a resistência à fadiga cíclica em comparação ao movimento de rotação contínua. O desenvolvimento de sistemas reciprocantes trouxe outras vantagens potenciais: redução do número de instrumentos, menor custo, menor tempo operatório (NEEKOFAR et al., 2015), melhor capacidade de modelagem e centralização do preparo (BERUTTI et al., 2012), além da eliminação da contaminação cruzada associada a instrumentos de uso único.

Além do sucesso clínico e radiográfico, a comodidade pós-operatória dos pacientes é almejada por profissionais que realizam tratamento endodôntico. A ocorrência de dor pós-operatória relacionada a procedimentos endodônticos é um problema frequente, que vem sendo amplamente estudado (ALVES, 2010; ARIAS et al., 2013; GENET et al., 1986; HARRISON et al., 1983; WALTON; FOUAD, 1992). A

revisão sistemática conduzida por Pak e White (2011) avaliou estudos sobre prevalência de dor antes, durante e após o tratamento endodôntico, encontrando prevalências médias de 40% e 11% após um e sete dias, respectivamente. Tal experiência desagradável resulta de um processo multifatorial complexo, sendo influenciada por aspectos inerentes ao paciente, ao dente a ser tratado e às habilidades e intervenções do cirurgião-dentista (WALTON; FOUAD, 1992).

Dentre os diversos fatores estudados, alguns já demonstraram influência sobre a ocorrência de dor após o tratamento de canal radicular, incluindo: história prévia de dor, presença de microrganismos no sistema de canais radiculares, presença de lesão periapical, extravasamento do agente irrigante, extrusão apical de detritos, alargamento do forame apical, instrumentação e/ou obturação insuficientes (ALVES, 2010; ARIAS et al., 2009; SIQUEIRA, 2003).

Com o desenvolvimento dos instrumentos rotatórios de NiTi, tem sido relatada uma redução na extrusão de debris quando comparada ao uso de limas manuais (TOPÇUOGLU et al., 2014). Mesmo nas técnicas de instrumentação manual, observa-se menor extrusão de debris ao realizar movimentos rotatórios ao invés de movimentos de limagem (REDDY; HICKS, 1998). Tal fato pode interferir na comodidade pós-operatória, visto que o extravasamento de debris durante o preparo químico-mecânico de canais radiculares tende a exacerbar a resposta inflamatória na região perirradicular, podendo provocar sintomatologia dolorosa (CAVIEDES-BUCHELI et al., 2016). Apesar de existirem ensaios clínicos recentes demonstrando menor relato de dor pós-operatória em pacientes onde foi realizada a instrumentação rotatória em relação à manual (ARIAS et al., 2015; SHOKRANEH et al., 2017; TALEBZADEH et al., 2016), outros autores observaram resultados semelhantes para as duas técnicas (AHMED et al., 2002), o que salienta a necessidade de uma revisão detalhada e crítica dos estudos existentes.

A quantidade de debris extravasados com as novas técnicas que utilizam o movimento reciprocante também tem sido extensamente avaliada e comparada com instrumentos de NiTi empregados em rotação contínua (AHN et al., 2016). Os resultados são contraditórios, mas parecem apontar uma maior extrusão de detritos para os instrumentos reciprocantes (CAVIEDES-BUCHELI et al., 2016; AHN et al., 2016). Resultados controversos também são observados nos estudos clínicos relacionados à ocorrência de dor pós-operatória (NEELAKANTAN et al., 2015;

NEKOOFAR et al., 2015; RELVAS et al., 2016), o que novamente chama a atenção da comunidade científica para a necessidade de uma revisão cuidadosa da literatura vigente.

Embora os instrumentos rotatórios e reciprocantes de NiTi tenham papel de destaque na Endodontia atual, apresentando diversas vantagens sobre os instrumentos manuais (PETERS; PAQUÉ, 2010), ainda faltam evidências clínicas conclusivas sobre a ocorrência de dor pós-operatória com as diferentes técnicas de instrumentação. Diante do exposto, esta revisão sistemática da literatura tem como objetivo avaliar a influência das técnicas de instrumentação manual, rotatória e reciprocante na dor pós-operatória em pacientes submetidos a tratamento endodôntico em dentes permanentes, considerando ensaios clínicos randomizados, além de avaliar a qualidade dos estudos existentes.

2 Capítulo 1

Influence of hand, rotary and reciprocating instrumentation techniques on endodontic postoperative pain: A systematic review[1]

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Abstract

Introduction: This systematic review aimed to evaluate the influence of hand, rotary and reciprocating instrumentation techniques on postoperative pain in patients submitted to endodontic treatment in permanent teeth.

Method: Articles were selected for this review according to the following inclusion criteria: randomized clinical trials with patients undergoing endodontic treatment in permanent teeth, comparing instrumentation techniques with different kinematics (hand stainless steel files vs. engine-driven nickel-titanium files or rotary vs. reciprocating engine-driven nickel-titanium files) and their effect on postoperative pain. Data on analgesic intake was also recorded. The electronic search was undertaken in MEDLINE, ISI Web of Science and Scopus databases, in addition to hand searches. Risk of bias was evaluated for each study and GRADE framework was applied for quality of evidence assessment.

Results: Twelve studies and 1659 patients aged between 14 and 73 were included in this review. Five studies compared hand vs. engine-driven (rotary and/or reciprocating) instrumentation techniques. Most results showed higher postoperative pain levels for hand preparation. Seven studies and a dataset from 1 of the 5 previous studies were included in the comparison of rotary vs. reciprocating techniques, with contrasting results. Most studies showed higher postoperative pain levels for reciprocating instrumentation. Data on analgesic intake revealed controversial findings. GRADE showed low quality of evidence.

Conclusions: Hand instrumentation technique induced higher postoperative pain levels when compared to engine-driven techniques. Reciprocating instruments drift to higher postoperative pain levels than rotary techniques. However, given the low quality of evidence and conflicting findings, results should be considered with caution.

Key Words: postoperative pain, root canal preparation, hand instruments, reciprocating instruments, rotary instruments.

Introduction

The success of endodontic treatment depends on the the removal of bacteria and tissue remnants from the root canal system by chemomechanical means (1). Mechanical preparation of root canals undergone drastic changes over the last decades. The introduction of nickel-titanium (NiTi) in endodontics (2) allowed the emergence of safe and efficient rotary systems for cleaning and shaping curved root canals (3) as an alternative to hand stainless steel instruments. Further, Yared (4) showed that the use of a single NiTi file in reciprocating motion increases the fatigue life of an instrument in comparison to continuous rotation motion. The development of reciprocating systems brought other potential advantages: reduced number of instruments, lower cost, shorter preparation time (5), better shaping ability (6) and elimination of cross-contamination associated with single-use instruments.

Pain associated with endodontic therapy is widely feared by patients (7) and has been extensively studied (8-12). The incidence of postoperative pain and flare-up as reported in the literature ranges from 3 to 58% (13). Such unpleasant experience results from a complex multifactorial process, being influenced by inherent aspects of the patient, the tooth to be treated and interventions of the dental operator (14). Several prior endodontic studies have attempted to correlate postoperative pain to intraoperative factors as irrigating solution (15), instrumentation technique (5), intracanal dressing (16), number of visits (13) and obturation technique (17).

Extrusion of root canal contents into the periradicular tissues causes inflammation and may be related to postoperative pain (18, 19). The amount of extruded debris and neuropeptides released in the periodontal ligament differ between instrumentation techniques (20) and it has been indicated as a reason why there are differences in postoperative pain experienced by patients. With the advent of rotary NiTi instruments, a reduction in debris extrusion has been reported when compared to hand instrumentation (21, 22). Recently, a tendency to greater debris extrusion with single-file reciprocating systems compared to multiple-file rotary systems has been reported (20, 23). The reciprocating movement could favor the apical packing of debris pushing them beyond the apical foramen, while continuous rotation improves coronal transportation of dentin chips and infected debris by acting like a screw conveyer (24).

Controversial findings have been described in a recent systematic review of in vitro studies regarding the influence of instrumentation techniques on debris extrusion (23). Results could change in a clinical situation due to the presence of periapical

tissues, which act as a natural barrier providing physical back pressure (25), thus preventing apical extrusion. Contrasting results are also observed in clinical trials addressing postoperative pain (5, 26, 27) and such scenario advocates more attention to the subject. In this context, the aim of this study was to systematically review the literature to determine the influence of hand, rotary and reciprocating instrumentation techniques on postoperative pain in patients submitted to endodontic treatment in permanent teeth.

Materials and Methods

This systematic review was carried out according to recommended guidelines (28). The review protocol was previously recorded (PROSPERO; CRD 42016036587) and the report of this review was based on the PRISMA Statement (29).

Two research questions were formulated according to a PICOS (population, intervention, comparison, outcome, and study type) framework, considering randomized clinical trials (RCTs): (1) In patients receiving endodontic treatment in permanent teeth, do engine-driven instrumentation techniques using NiTi files induce equivalent postoperative pain compared to hand techniques with stainless steel files? (2) In patients receiving endodontic treatment in permanent teeth, considering engine-driven NiTi files, do reciprocating instrumentation techniques induce equivalent postoperative pain compared to rotary techniques?

Eligibility Criteria

RCTs with patients undergoing endodontic treatment in permanent teeth that compared instrumentation techniques with different kinematics (hand stainless steel files vs. engine-driven NiTi files or rotary vs. reciprocating engine-driven NiTi files) and their effect on postoperative pain were included in this review. No age limits or specific pain scales were considered. Observational studies, reviews, case studies, case series, in vitro studies, and those without pain measurement outcomes were excluded. Also, RCTs comparing two techniques with the same kinematics (e.g. two rotary systems) were excluded.

Search Methodology

Searches were conducted in 3 electronic databases (Medline, ISI Web of Science and Scopus), with English language restriction, from 1985 to 2016. Additional

search was performed at www.clinicaltrials.gov. The last search was carried out in December 2016. The search strategy used in the Medline database via PubMed engine search is described in Supplementary Table 1, with a specific filter for RCTs (30). Search words were adjusted for each database. The references of all eligible documents were also hand-searched.

Duplicate search results were excluded (EndNote X7 program, Thompson Reuters, New York, USA) and two independent researchers (ARS and RDM) identified the content of articles first by reviewing titles and abstracts, and the presence of the selection criteria listed above. The articles were classified as: i) include, ii) exclude or iii) uncertain. Full publications of included and uncertain articles were obtained for verification of eligibility by the same two reviewers. Any discrepancies between evaluators were resolved by discussion or by a third party (RSO). In situations where there was missing information or data, authors were contacted by e-mail.

Data Collection Process

A standardized scheme was created for data collection, which was conducted by the same two reviewers. The following data were extracted:

- Publication details: author, year and country of publication.
- General characteristics of the study: age and gender of patients, sample size, group of teeth, pulp and periapical condition, number of operators as well as their clinical experience, number of treatment sessions, irrigating solution, and instrumentation techniques (hand, rotatory and/or reciprocating).
- Pain-related information: period of evaluation, pain scale, analgesic drug, analgesic intake and pain results regarding incidence, intensity and/or duration of pain.

Risk of Bias

The risk of bias of included studies was assessed using the Cochrane risk of bias tool (28) considering the judgment of random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data and selective reporting. The assessment was performed by the same two reviewers independently and verified by a third researcher using the Review Manager Software Version 5.3 (The Cochrane Collaboration, London, UK). Publication bias was not statistically assessed, though searches for unpublished studies were performed to minimize the publication bias.

Data Synthesis

Considerable heterogeneity was verified in the selected studies regarding demographic characteristics of patients, endodontic diagnosis, technical procedures, pain scales and pain assessment periods. Thus, meta-analysis was considered inappropriate and data were summarized descriptively.

Quality of the Body of Evidence

The Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) framework for systematic reviews was applied to the included trials to assign an overall outcome-specific rating for within-study risk of bias (methodological quality), directness of evidence, heterogeneity, precision of effect estimates and risk of publication bias (31). The assessment was performed by one reviewer and discussed with other two researchers to generate a score.

Results

The flowchart for the selection of eligible studies is shown in Figure 1. Initial electronic searches identified 692 manuscripts. The screening of titles and abstracts resulted in 14 manuscripts and 2 additional papers were found by hand-searching. Four papers were excluded after full-text reading since two studies used non-RCT designs (32, 33); one study did not evaluate pain related to instrumentation technique (34); and one study compared hand and rotary techniques for glide-path procedure, not for complete root canal preparation (35). Ten studies registered at www.clinicaltrials.gov were found, 8 in progress and 2 complete investigations. Of these, one did not provide conclusive data (no statistical analysis) and the other was included in the review (27).

In total, 12 studies and 1659 patients aged between 14 and 73 were included in this review (Table 1). Five studies were included in the comparison of hand vs. engine-driven (rotary and/or reciprocating) instrumentation techniques (27, 36-39). Other 7 studies (5, 26, 40-44) and a dataset from 1 (27) of the 5 previous studies were included in the comparison of rotary vs. reciprocating techniques.

Pain-related data of studies comparing hand and engine-driven instrumentation techniques are described in Table 2. In 3 studies, postoperative pain levels were higher with hand files than with engine-driven instruments (27, 36, 38). In the other 2 studies, pain results for hand and engine-driven techniques were similar (37, 39).

Three studies also evaluated analgesic intake by patients (27, 38, 39). In 2 of these investigations, the analgesic intake was higher when using hand files in comparison to engine-driven instruments (27, 38), while in the other study groups had similar results (39).

Pain-related data of studies comparing rotary and reciprocating instrumentation techniques are also shown in Table 2. The 8 included studies revealed contrasting results (5, 26, 27, 40-44).

Four studies demonstrated that postoperative pain intensity is higher with reciprocating instruments (5, 42-44). Two studies reported that postoperative pain intensity is higher with rotary instruments (27, 40). Finally, 2 studies found that postoperative pain is equivalent in both root canal preparation techniques (26, 41).

Five studies also evaluated analgesic consumption (5, 27, 40, 41, 44). Of these, 3 reported that analgesic intake is similar in patients undergoing treatment with rotary and reciprocating techniques (27, 41, 44). In 1 study (5) analgesic intake was higher in the reciprocating group, while in the other (40) it was higher in the rotary group.

Risk of bias evaluation is illustrated in Figure 2. Most studies had unclear risk of bias with regards to the following items: blinding of participants and personnel (58,3%), blinding of outcome assessment (58,3%) and incomplete outcome data (58,3%). Most studies had low risk of bias in terms of random sequence generation (66,6%) and allocation concealment (58,3%). Table 3 shows a summary of the review findings and the quality assessment. Based on the GRADE approach, quality of evidence was classified as low because of limitations in the design, implementation and indirectness of evidence.

Discussion

To the authors' knowledge, this systematic review is the first to summarize and critically analyze the available information about the influence of hand, rotary and reciprocating instrumentation techniques on endodontic postoperative pain. A wide range of pain incidence (Table 3) was observed in the included studies. However, only 1 paper (38) reported a very high pain incidence – over 90% – in the hand preparation group. Other studies reported pain incidence under 50% for all instrumentation techniques. Pain intensity or severity is difficult to summarize due to the different pain scales used in the included studies. Nevertheless, the highest postoperative pain levels were recorded in the early stages after root canal treatment, especially within

the first 24h (5, 26, 27, 39, 41-43). Analogous results were observed in the systematic review conducted by Pak and White (11), in which pain incidence in the first 24 hours was 40%, decreasing acutely thereafter, reaching 11% at 7 days. Likewise, the authors found that pain intensity declined substantially soon after treatment.

Postoperative pain has been associated with the apical extrusion of infected debris, which may occur during any hand or engine-driven instrumentation technique (21, 45, 46). Most studies in this review (27, 36, 38) and others not included herein (35, 47) showed higher postoperative pain levels when hand preparation is used comparatively to rotary techniques. It is important to note that 4 out of 5 studies included in this review (36-39) used hand instruments with a step-back approach. In the step-back or any push-pull filing technique the file acts as a plunger in the apical region and drives debris through the foramen (45); probably exacerbating inflammation and pain. On the contrary, flutes of rotary instruments tend to pull debris back towards the root canal orifice (45, 48).

Comparison of postoperative pain between rotary and reciprocating techniques showed conflicting results in this review, but the use of reciprocating instruments produced higher postoperative pain levels, according to 4 studies (5, 42-44). A recent systematic review and meta-analysis (20) found that multiple-file rotary and single-file reciprocating systems generate apical extrusion of debris in laboratory studies. The authors also reported the expression of neuropeptides released from C-type nerve fibers in the periodontal ligament. They supported the hypothesis that the inflammatory reaction and subsequent pain response in the apical area is not influenced by the number of files but the type of movement and instrument design.

Although the clockwise rotation (noncutting direction) during reciprocating motion had a potential risk of debris extrusion, the reduction in the number of files may lead to a decrease of the apical extrusion of debris (49). The variation observed with respect to debris extrusion and postoperative pain could be attributed to other factors but the kinematics, such as: differences in instrument cross section, cutting-edge design, taper, tip conformation, alloy type, or cutting efficacy (24, 50-52).

Gender has been suggested to play a role in pain studies (14, 53) and may function as a confounding factor in studies comparing instrumentation techniques. Females have shown to experience higher levels of postoperative pain compared to males (14). In the present review, few studies reported a balanced percentage of men and women in their population (5, 27, 40-43), while one study (26) included only male

patients due to insufficient number of female patients during recruitment, which would have resulted in a biased sample.

The presence of preoperative pain may also interfere with postoperative pain (12), so the different diagnoses in the included studies may be another confounding factor. Three studies included only symptomatic teeth (37, 38, 40), while 5 studies selected exclusively asymptomatic cases (5, 26, 27, 39, 43). Other studies elected assorted or undefined samples regarding preoperative pain (36, 41, 42, 44). Additionally, Krithikadatta et al. (42) observed that nonvital teeth experienced more pain compared to vital teeth across rotary and reciprocating groups, probably because the extrusion of infected necrotic tissue triggers an acute inflammatory response in the periapical area with subsequent pain (18).

The clinical experience of operators consists in another potential cause of heterogeneity between studies. Endodontists were reported in 5 papers (26, 27, 40, 41, 44), and final year postgraduate students in one paper (42). Other studies did not inform operators' experience (5, 36-39, 43). Previous investigations reported no significant differences in postoperative pain experience after treatment performed by endodontists vs. generalists (54, 55) but patients' general satisfaction was higher after treatment by specialists (55). A positive impact of an expert operator may emerge from shorter operating time and better communication when dealing with patient stress (44, 54).

The number of endodontic visits is another possible confounding factor to be discussed. In this review, only two studies (5, 42) performed endodontic treatment in 2 clinical sessions; all others finished treatment in a single session. According to Attar et al. (56), patients treated with calcium hydroxide dressing vs. obturation did not differ in postoperative pain levels. Even with conflicting results in the literature, systematic reviews on the subject seem to demonstrate that the number of treatment visits does not affect postoperative pain (57-59).

Although pain symptoms have subjective nature and pain measurement represents a challenge in clinical trials (9, 11), pain scales used in the included studies have been previously validated (60). Most studies (37-44) used the Visual Analogue Scale (VAS) or some of its variations. Other authors used: the Numerical Rating Scale (NRS) (5); the Verbal Rating Scale (VRS) (26); the Heft-Parket VAS (27); and the categorical scale (36). Fortunately, endodontic pain evaluations using different types of pain scale are known to be highly correlated (56).

Analgesic intake findings usually accompanied those of postoperative pain, i.e., if a preparation technique induced higher pain levels, it also promoted higher analgesic consumption. This situation was not observed in some studies (27, 44). This fact may be related to psychological variations regarding pain tolerance and urgency to use pain killers (61). From the 12 studies included in this review, 7 recommended the use of Ibuprofen in case of postoperative pain (5, 27, 38-42). Nonsteroidal anti-inflammatory drugs have been recommended as first-choice medication for postoperative pain management after endodontic therapy, especially ibuprofen (62).

Some limitations of this review should be highlighted: 1) most studies had unclear risk of bias with regards to the blinding of participants and personnel, blinding of outcome assessment and incomplete outcome data; 2) general quality of the body of evidence was classified as low, being justified by limitations in the design, implementation and indirectness of evidence, limiting the extern validation; 3) meta-analysis was not presented due to the heterogeneity in the selected studies regarding demographic characteristics of patients, endodontic diagnosis, technical procedures, pain assessment methods and periods. In this context, the present review points out some orientations regarding the influence of instrumentation techniques on endodontic postoperative pain, but also highlights the need for additional standardized and well-design clinical trials.

Conclusions

Hand instrumentation technique seems to lead to higher postoperative pain levels when compared to engine-driven techniques. Among engine-driven instruments with different kinematics, reciprocating instrumentation seems to cause higher pain levels than rotary files. Given the low quality of evidence and contrasting findings, results should be carefully interpreted.

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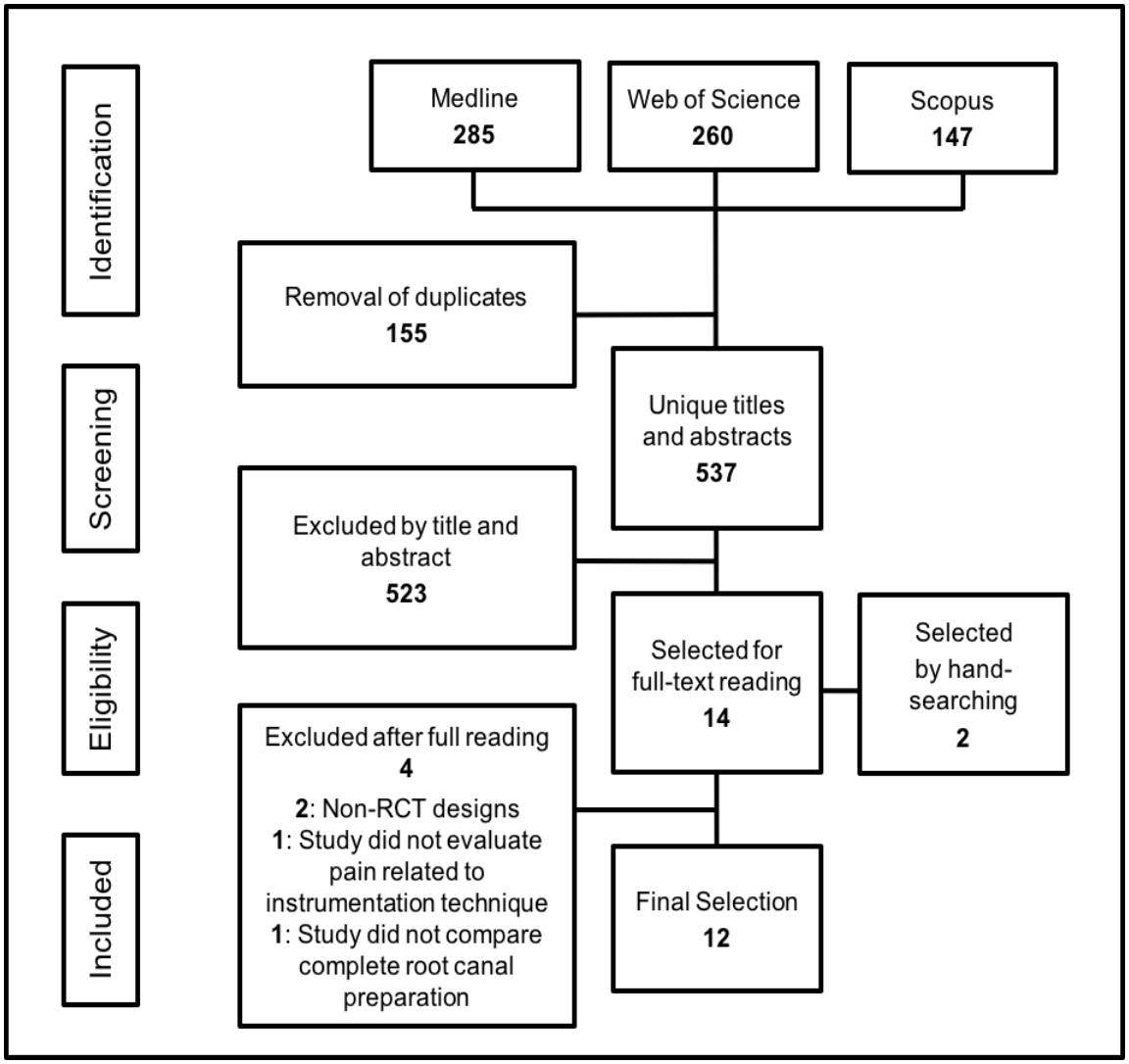

FIGURE 1: Flow diagram of the study according to the PRISMA Statement.

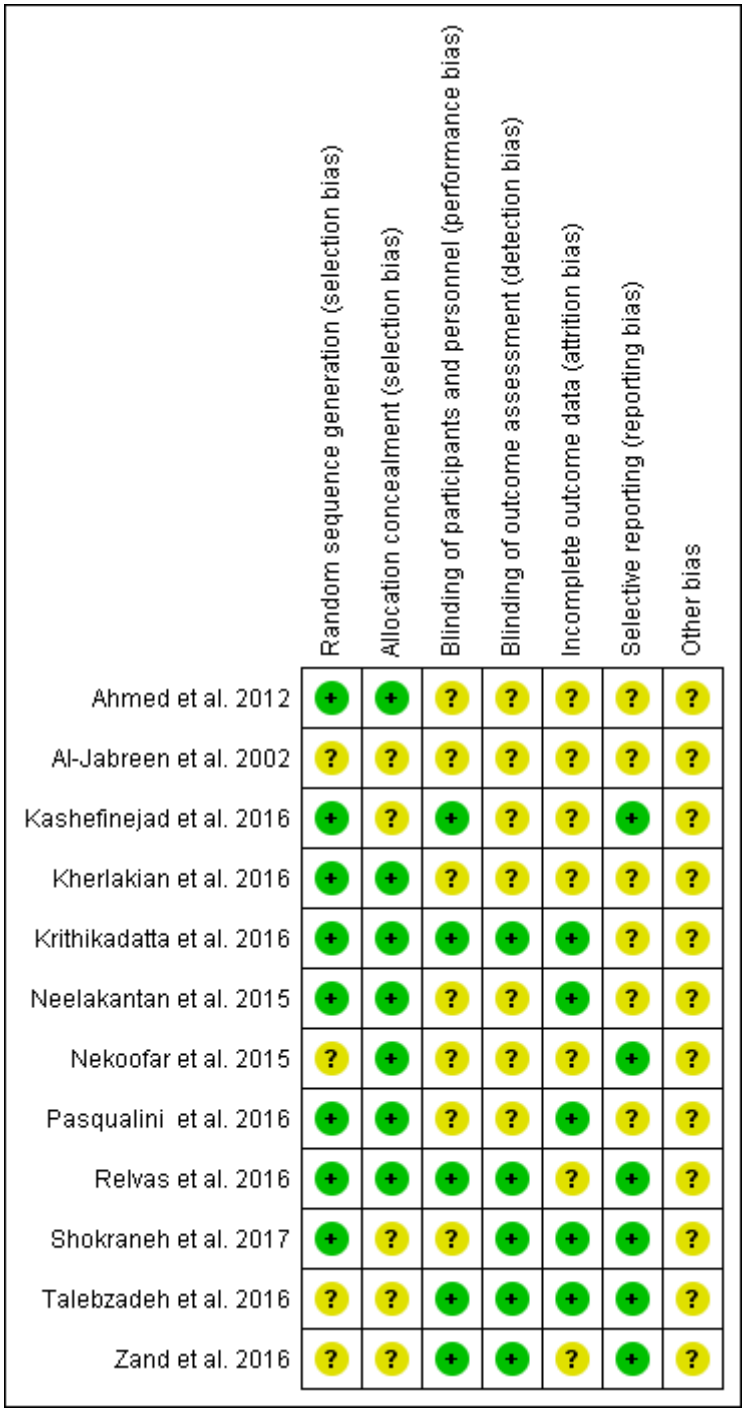

FIGURE 2: Risk of bias evaluation: (+) low; (?) unclear.

TABLE 1. General characteristics of the studies included in the review (N = 12).

Author/year, Country	Age*	Gender (female %)	N (patients)	N (teeth)	Group of teeth	Pulpal/periapical condition	N (operators)	Experience	N (sessions)	Irrigant	Instrumentation technique
Al-Jabreen et al. (2002), Saudi Arabia	18 to 55	n.i.	91	105 35 each	Maxillary central incisors	Pulp necrosis	n.i.	n.i.	1	2.6% NaOCl	HAND (step-back) vs. ROT 1 (Profile 04) vs. ROT 2 (Profile GT)
Ahmed et al. (2012), Pakistan	14 to 60	n.i.	102	102 51 each	Single-rooted teeth	Symptomatic irreversible pulpitis and/or acute apical periodontitis	n.i.	n.i.	1	2.5% NaOCl	HAND (step-back) vs. ROT (ProTaper)
Nekoofar et al. (2015), Iran	15 to 55; 40 ROT 38 REC	52.4% ROT 52.4% REC	42	42 21 each	Premolars and molars	Asymptomatic irreversible pulpitis	1	n.i.	2	2% CHX; 17% EDTA	ROT (ProTaper) vs. REC (WaveOne)
Neelakantan et al. (2015), India	25 to 40; 31 mean	49.6% ROT 49.6% REC	605	1210 605 each	Mandibular molars	Symptomatic irreversible pulpitis	2	Endodontists	1	3% NaOCl; 17% EDTA	ROT (OneShape) vs. REC (Reciproc)
Kashefinejad et al. (2016), Iran	17 to 52; 30.8 HAND 32.5 for ROT	n.i.	53	60 30 each	Single-rooted teeth	Symptomatic irreversible pulpitis	n.i.	n.i.	1	Normal saline	HAND (step-back) vs. ROT (Mtwo)
Kherlakian et al. (2016), Brazil	19 to 73; 47 mean	62.8% ROT 65.7% REC 1 61.4% REC 2	210	210 70 each	Premolars and molars	Vital pulp	5	Endodontists	1	2.5% NaOCl; 17% EDTA	ROT (ProTaper Next) vs. REC 1 (WaveOne) vs. REC 2 (Reciproc)
Krithikadatta et al. (2016), India	18 to 55	46.9% ROT 1 51% ROT 2 61.2% REC NSD	152	152 49 ROT 1 50 ROT 2 49 REC	Premolars and molars	Asymptomatic or symptomatic irreversible pulpitis or pulp necrosis with or without apical periodontitis	4	Final year postgraduate students	2	5% NaOCl; 17% EDTA; final flush 2% CHX	ROT 1 (ProTaper Next) vs. ROT 2 (Mtwo) vs. REC (WaveOne)
Zand et al. (2016), Iran	19 to 59; 33.22 ROT 33.73 REC NSD	60% ROT 48.9% REC NSD	90	90 45 each	Mandibular molars	Asymptomatic pulp necrosis	n.i.	n.i.	1	2.5% NaOCl; 17% EDTA	ROT (RaCe) vs. REC (Reciproc)
Talebzadeh et al. (2016), Iran	Over 18	n.i.	96	96 48 each	Mandibular molars	Asymptomatic irreversible pulpitis	1	n.i.	1	5% NaOCl	HAND (step-back) vs. ROT (RaCe)

Pasqualini et al. (2016), Italy	25%- 16 to 30 33%- 31 to 45 42%- 46 to 60	50%	47	47 23 ROT 24 REC	Single or multi-rooted	Asymptomatic or symptomatic irreversible pulpitis or pulp necrosis	1	Endodontist	1	5% NaOCl; 10% EDTA	ROT (ProTaper) vs. REC (WaveOne)
Relvas et al. (2016), Brazil	18 to 64; 25.9 ROT 25.8 for REC	Only men	78	78 39 each	Mandibular molars	Asymptomatic pulp necrosis	1	Endodontist	1	2.5% NaOCl; 17% EDTA	ROT (ProTaper) vs. REC (Reciproc)
Shokraneh et al. (2017), Iran	20 to 45; 31.7 HAND 29.6 ROT 30.3 REC NSD	50% HAND 51.6% ROT 46.9% REC NSD	93	93 30 HAND 31 ROT 32 REC	Mandibular molars	Asymptomatic pulp necrosis and apical periodontitis	1	Endodontist	1	5.25% NaOCl; 17% EDTA	HAND (crown-down) vs. ROT (ProTaper) vs. REC (WaveOne)

Studies are listed in chronological publication order.

*Age range and mean per group (if informed).

CHX: chlorhexidine; EDTA: ethylenediamine tetraacetic acid; HAND: hand files group; NaOCl: sodium hypochlorite; n.i.: not informed; NSD: no significant difference between groups; REC: reciprocating files group; ROT: rotary files group (continuous rotation motion).

TABLE 2. Pain-related information in the studies comparing hand vs. engine-driven instrumentation techniques (N = 5) and studies comparing rotatory vs. reciprocating instrumentation techniques (N = 8).

Author/year	Period of evaluation	Pain scale	Analgesic drug	Analgesic intake	Pain results
Hand vs. engine-driven techniques					
Al-Jabreen et al. 2002	48h, 7 days	Categorical	n.i.	n.i.	Pain incidence: HAND > ROT
Ahmed et. al. 2012	48h	VAS (0-10)	1mg Paracetamol	n.i.	Pain incidence: HAND = ROT
Kashefinejad et al. 2016	4, 8, 12, 24h	VAS (0-10)	max. 3200mg/day Ibuprofen	HAND > ROT	Pain incidence/intensity: HAND > ROT
Talebzadeh et al. 2016	4, 8, 12, 24, 48h, 7 days	VAS (0-100)	400mg Ibuprofen	HAND = ROT	Pain intensity: HAND = ROT
Shokraneh et al. 2017	6, 12, 18, 24, 48, 72h	Heft-Parket VAS (0-170)	400mg Ibuprofen	HAND > ROT/REC	Pain intensity: HAND > ROT/REC
Rotary vs. reciprocating techniques					
Nekoofar et al. 2015	6, 12, 18, 24, 48, 72h	NRS (0-10)	400mg Ibuprofen (+325mg Paracetamol)	ROT < REC	Pain intensity/duration: ROT < REC
Neelakantan et al. 2015	Up to 7 days	Modified VAS (0-10)	400mg Ibuprofen	ROT > REC	Pain incidence/intensity/duration: ROT > REC
Kherlakian et al. 2016	24, 48, 72h, 7 days	VAS (0-100)	400mg Ibuprofen	ROT = REC	Pain intensity: ROT = REC
Krithikadatta et al. 2016	2, 4, 6, 8, 12, 24, 36, 48h	VAS (0-10)	400mg Ibuprofen	n.i.	Pain intensity: ROT < REC
Zand et al. 2016	4, 12, 24, 48, 72h, 7 days	VAS (0-100)	n.i.	n.i.	Pain intensity: ROT < REC
Pasqualini et al. 2015	7 days	VAS (0-10)	Optional analgesics	ROT = REC	Pain intensity: ROT < REC
Relvas et al. 2016	24, 72h, 7 days	VRS	n.i.	n.i.	Pain intensity: ROT = REC
Shokraneh et al. 2017	6, 12, 18, 24, 48, 72h	Heft-Parket VAS (0-170)	400mg Ibuprofen	ROT = REC	Pain intensity: ROT > REC (first 18h)

HAND: hand files group; n.i.: not informed; NRS: Numerical Rating Scale; REC: reciprocating files group; ROT: rotary files group; VAS: Visual Analogue Scale; VRS: Verbal Rating Scale.

TABLE 3: Summary of findings and quality assessment.

Effects of different instrumentation techniques on postoperative pain				
Clinical situation: Postoperative pain after different instrumentation techniques.				
Population: Patients undergoing endodontic treatment in permanent teeth with different instrumentation techniques.				
Comparison/Intervention: Hand, rotary and/or reciprocating instruments.				
Outcomes	**Pain Incidence* (Range %)**	**Comparison between groups** (Significant difference)**	**Number of participants**	**Quality of evidence (GRADE)**
Pain	Hand: 6.6 - 96.7% Rotary: 0 - 43.3% Reciprocating: 0 - 33.3%	Hand > rotary and reciprocating Reciprocating > Rotary	1659 patients (12 studies)	⨁⨁◯◯ Low

*Periods of pain assessment: 2h to 7 days after treatment. Pain intensity was not summarized since different pain scales were applied in the included studies.

**Results from most studies, regardless of contrasting findings.

SUPPLEMENTAL TABLE 1. Search strategy used in the Medline database.

Search string #1	"Root Canal Preparation"[Mesh] OR "Root Canal Preparation" OR “Canal Preparation, Root” OR “Canal Preparations, Root” OR “Preparation, Root Canal” OR “Preparations, Root Canal” OR “Root Canal Preparations” OR “Root Canal Instrumentation” OR “Hand File” OR “Hand Stainless Steel” OR “Rotary” OR “Rotary File” OR “Rotary Instrument” OR “Rotary Nickel Titanium” OR “Rotary NiTi” OR “Reciprocating File” OR “Reciprocating Instrument” OR “Reciprocating Nickel-Titanium” OR “Reciprocating NiTi”
Search string #2	"Pain"[Mesh] OR "Pain" OR “Pain, Burning” OR “Burning Pain” OR “Burning Pains” OR “Pains, Burning” OR “Suffering, Physical” OR “Physical Suffering” OR “Physical Sufferings” OR “Sufferings, Physical” OR “Pain, Migratory” OR “Migratory Pain” OR “Migratory Pains” OR “Pains, Migratory” OR “Pain, Radiating” OR “Pains, Radiating” OR “Radiating Pain” OR “Radiating Pains” OR “Pain, Splitting” OR “Pains, Splitting” OR “Splitting Pain” OR “Splitting Pains” OR “Ache” OR “Aches” OR “Pain, Crushing” OR “Crushing Pain” OR “Crushing Pains” OR “Pains, Crushing” OR "Pain, Postoperative"[Mesh] OR "Pain, Postoperative" OR “Postoperative Pain” OR “Postoperative Pains” OR "Symptom Flare Up"[Mesh] OR "Symptom Flare Up" OR “Flare Up, Symptom” OR “Flare Ups, Symptom” OR “Symptom Flare Ups” OR “Symptom Flaring Up” OR “Flaring Up, Symptom” OR “Flaring Ups, Symptom” OR “Symptom Flaring Ups” OR “Acute Symptom Flare” OR “Acute Symptom Flares” OR “Flare, Acute Symptom” OR “Flares, Acute Symptom” OR “Symptom Flare, Acute” OR “Symptom Flares, Acute” OR “Symptom Flareup” OR “Flareup, Symptom” OR “Flareups, Symptom” OR “Symptom Flareups” OR “Symptom Flare-up” OR “Flare-up, Symptom” OR “Flare-ups, Symptom” OR “Symptom Flare-ups”
Search string #3	((randomized controlled trial[pt] OR controlled clinical trial[pt] OR randomized controlled trials[mh] OR random allocation[mh] OR double-blind method[mh] OR single-blind method[mh] OR clinical trial[pt] OR clinical trials[mh] OR ("clinical trial"[tw]) OR ((singl*[tw] OR doubl*[tw] OR trebl*[tw] OR tripl*[tw]) OR (mask*[tw] OR blind*[tw])) OR ("latin square"[tw]) OR placebos[mh] OR placebo*[tw] OR random*[tw] OR research design[mh:noexp] OR follow-up studies[mh] OR prospective studies[mh] OR cross-over studies[mh] OR control*[tw] OR prospectiv*[tw] OR volunteer*[tw]) NOT (animal[mh] NOT human[mh]”))
Search string #4	#1 AND #2 #1 AND #2 AND #3
Limits	English language and Custom date range (1985-2016)

3 Considerações finais

Os resultados obtidos pelos estudos revisados demonstram que:

- A técnica de preparo manual com instrumentos de aço inoxidável parece causar maiores níveis de dor pós-operatória quando comparada às técnicas mecanizadas com com instrumentos de níquel-titânio.

- Entre as técnicas mecanizadas com diferentes cinemáticas, a instrumentação reciprocante parece causar maiores níveis de dor pós-operatória quando comparada às técnicas rotatórias.

Tais conclusões devem ser consideradas com cautela, devido à baixa qualidade da evidência existente e alguns resultados contrastantes. Desta forma, futuros ensaios clínicos randomizados bem delineados devem ser encorajados, permitindo a geração de evidências de alta qualidade e uma conclusão mais objetiva em relação à influência das diferentes técnicas de instrumentação de canais radiculares na dor pós-operatória em pacientes submetidos à terapia endodôntica.

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Apêndices

Apêndice A – Nota da Dissertação

Dor pós-operatória em Endodontia: efeitos de diferentes técnicas de instrumentação de canais radiculares.

Postoperative pain in endodontics: effects of different root canal instrumentation techniques.

A presente dissertação de mestrado foi uma revisão sistemática da literatura, que teve por objetivo avaliar a dor pós-operatória em pacientes que realizaram tratamento endodôntico primário em dentes permanentes utilizando diferentes técnicas de instrumentação de canais radiculares, sendo elas: manual, rotatória e reciprocante. Os resultados obtidos neste estudo demonstraram que a técnica manual causa mais dor pós-operatória em comparação as técnicas mecanizadas. Já entre as técnicas mecanizadas, a reciprocante tende a doer mais após o tratamento do que a técnica rotatória. Entretanto, esses resultados foram obtidos de poucos estudos existentes na literatura sobre o tema e alguns autores mostraram achados contrastantes. A qualidade da evidência científica existente foi considerada baixa. Esta dissertação mostrou que mesmo com a grande evolução dos instrumentos endodônticos, ainda não existe um preparo ideal do sistema de canais radiculares e o controle de suas consequências pós-operatórias (como a dor) ainda é um desafio aos cirurgiões-dentistas. Por isso, a importância de estimular novos trabalhos clínicos de alta qualidade.

Área de Conhecimento (CNPq): Odontologia, Endodontia.

Candidata: Andressa Raquel Spohr, Cirurgiã-dentista, graduada pela Universidade Federal de Pelotas (2014).

Data da defesa e horário: 23/02/2017 às 14 horas.

Local: Auditório do Programa de Pós-graduação em Odontologia da Universidade Federal de Pelotas. 5º andar da Faculdade de Odontologia de Pelotas. Rua Gonçalves Chaves, 457.

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Orientador: Profa. Dra. Renata Dornelles Morgental.
Co-orientadores: Profa. Dra. Fernanda Geraldo Pappen e Profa. Dra. Tatiana Pereira Cenci.

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Apêndice B – Súmula do currículo do candidato

Súmula do currículo

Andressa Raquel Spohr nasceu em 18 de Janeiro de 1989, em Três de Maio, Rio Grande do Sul. Completou o ensino fundamental e médio em Escolas privadas em Ijuí. No ano de 2009 ingressou na Faculdade de Odontologia da Universidade Federal de Pelotas (UFPel), tendo sido graduada cirurgiã-dentista em 2014. No ano seguinte ingressou no Curso de Mestrado do Programa de Pós-Graduação em Odontologia da UFPel, área de concentração Dentística, sob orientação da Profª. Drª. Renata Dornelles Morgental. Durante o período de graduação foi voluntária no Programa PET-Saúde e bolsista do Programa PET- Odonto. Durante o período de Mestrado foi bolsista CAPES por um ano e desenvolveu trabalhos na área de Endodontia. Atualmente a candidata é também cirurgiã-dentista concursada da Prefeitura Municipal de Pelotas e realiza Curso de Especialização em Endodontia no IEOM (Instituto Educacional Odontológico do Mercosul), em Pelotas.

Publicações:

Spohr, RA, Menegaz, AM, Favetti M, Flores RZ, Horn T, Benetti T, Bighetti TI. Prevalência de Fluorose Dentária em Adolescentes de Escolas Municipais da Área Urbana do Município de Pelotas/RS, 2010. *Revista da Faculdade de Odontologia de Porto Alegre*. 2010.

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