MedNEXT
Journal of Medical an Health Sciences

REVIEW ARTICLE

DOI: 10.54448/mdnt22S308

Major clinical findings of endodontic retreatment: a concise systematic review

Mariana Amâncio Luccas[1,2]*, Isabella Varolo Silva[1,2], Fábio Pereira Linhares de Castro[1,2]

[1] UNORTE - University Center of Northern São Paulo - Dentistry department, Sao Jose do Rio Preto, Sao Paulo, Brazil.
[2] UNIPOS - Post graduate and continuing education, Dentistry department, Sao Jose do Rio Preto, Sao Paulo, Brazil.

*Corresponding author: Mariana Amâncio Luccas.
Unorte/Unipos - Post graduate and continuing education, Dentistry department, Sao Jose do Rio Preto, Sao Paulo, Brazil.
E-mail: mah.amancio@hotmail.com
DOI: https://doi.org/10.54448/mdnt22S308
Received: 03-11-2022; Revised: 04-25-2022; Accepted: 04-27-2022; Published: 05-10-2022; MedNEXT-id: e22S308

Abstract

Introduction: In the endodontic treatment and retreatment scenario, the primary objective is to eliminate necrotic tissue and infectious bacteria, especially cleaning and shaping. Endodontic retraction is a procedure performed on a tooth that has received a previous attempt at a definitive treatment that has resulted in a condition that requires further endodontic treatment to achieve a successful outcome. The main cause of treatment failure is insufficient cleaning and inadequate filling. **Objective:** The present study carried out a concise systematic review to evaluate the main findings of clinical studies on endodontic retreatments, showing the main techniques, efficacy, and safety. **Methods:** The rules of the Systematic Review-PRISMA Platform. The research was carried out from December 2021 to March 2022 and developed based on Scopus, PubMed, Science Direct, Scielo, and Google Scholar. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. **Results:** A total of 124 articles were found. A total of 74 articles were evaluated in full and 17 were included and evaluated in the present study. Studies have demonstrated the effectiveness of rotational systems in endodontic retreatment but never producing completely obturator-free root canals. Reciproc instruments were associated with significantly higher cyclic fatigue strength than WaveOne instruments. The persistent infection microbiota is polymicrobial with a predominance of *E. faecalis* and *P. gingivalis* in all stages of endodontic retreatment, regardless of the method used for microbial identification. A higher bacterial load and lower lipoteichoic acid level were found in the 2-visit group after the retreatment protocol. Postoperative pain was significantly reduced at 48 and 72 hours after the application of nano-silver and nano-calcium hydroxide alone. **Conclusion:** The results of clinical trials showed that the root canal instrumentation system with rotary files maintains the quality of the root preparation and reduces the number of files needed to obtain a canal, which would consequently reduce the operative time and also considerably reduce the risk of torsion fracture within the root canal, allowing successful endodontic retreatment. Also, a condition for successful endodontic retreatment is the adequate cleaning of the root canals, therefore, special attention must be given to the technique used to remove the filling material.

Keywords: Endodontic treatment. Endodontic retreatment. Techniques. Clinical trials.

Introduction

In the endodontic treatment and retreatment scenario, the primary objective is to eliminate necrotic tissue and infectious bacteria, especially cleaning and shaping [1]. Periapical lesions are of inflammatory origin, as are apical cysts, and should initially be treated with a non-surgical approach. When intra- or extra-radicular infections are persistent and the periapical pathology does not resolve after non-surgical endodontic treatment protocols, only then should a surgical option be considered [2]. Cross-sectional studies from several countries have stated that the prevalence of apical periodontitis and other post-treatment periradicular diseases may transcend 30% of the entire population of filled teeth. These facts recommend a significant requirement for the treatment of this condition. Microsurgical endodontic treatment is better than conventional endodontic treatment and has high success rates [2,3].

Still in this context, the treatment of teeth with

severely calcified canals is a difficult procedure for clinicians. Accidents such as deviation of the drill path or root canal perforation always occur. 3D printed directional guides made using computed tomography and CAD/CAM can help the clinician accurately drill in the original direction of the root canal. In addition, office operating times and excessive loss of tooth structure are reduced and the risk of perforation is avoided [4].

Besides, endodontic retraction is a procedure performed on a tooth that has received a previous attempt at a definitive treatment that has resulted in a condition that requires further endodontic treatment to achieve a successful outcome [5,6]. The main cause of treatment failure is insufficient cleaning and inadequate filling [7]. Endodontic failure is due to the lack of a technical-scientific-biological basis, and the failure rate reaches about 98.0% [8].

In this sense, a condition for successful endodontic retreatment is the adequate cleaning of the root canals, therefore, special attention must be given to the technique used to remove the filling material [9], the most used being cement, pastes, and gutta-percha cones [8,9]. In retreatment, we have to reach the actual working length and completely remove the filling material, clean the root canal, and the final filling. Several techniques are described in endodontic retreatment for the removal of gutta-percha, including rotary instruments, manual instruments, solvents, and their associations [9].

Therefore, the present study carried out a concise systematic review to evaluate the main findings of clinical studies on endodontic retreatments, showing the main techniques, efficacy and safety.

Methods

Study Design

The rules of the Systematic Review-PRISMA Platform (Transparent reporting of systematic reviews and meta-analysis-HTTP://www.prisma-statement.org/) were followed [10].

Data sources and research strategy

The search strategies for this systematic review were based on the keywords (MeSH Terms): "*Endodontic treatment. Endodontic retreatment. Techniques. Clinical trials*". The research was carried out in December 2021 to March 2022 and developed based on Scopus, PubMed, Science Direct, Scielo, and Google Scholar. Also, a combination of the keywords with the booleans "OR", "AND", and the operator "NOT" were used to target the scientific articles of interest.

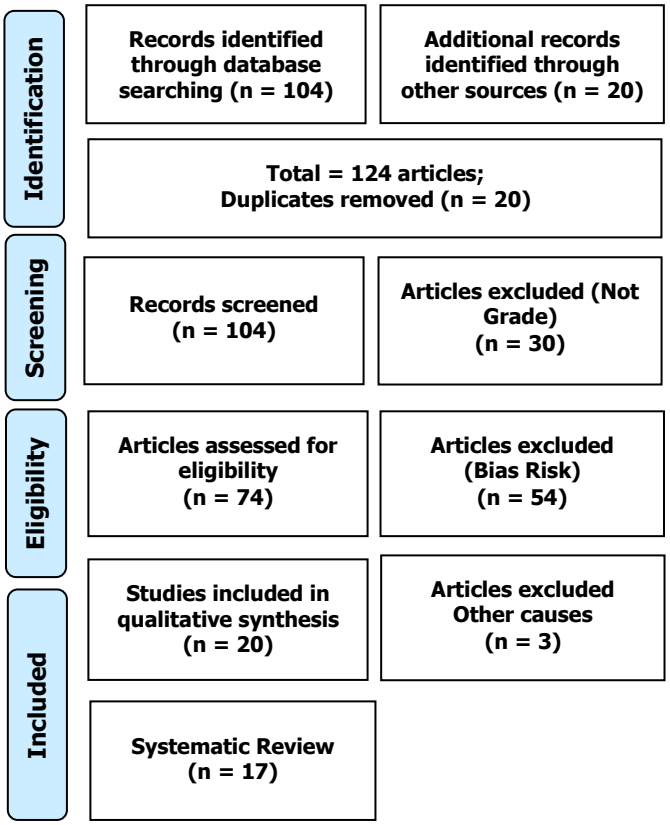
Study Quality and Bias Risk

The quality of the studies was based on the GRADE instrument [11] and the risk of bias was analyzed according to the Cochrane instrument [12].

Results and Discussion

A total of 124 articles were found. Initially, duplication of articles was excluded. After this process, the abstracts were evaluated and a new exclusion was performed, removing articles that did not include the theme of this article. A total of 74 articles were evaluated in full and 17 were included and evaluated in the present study (**Figure 1**). Considering the Cochrane tool for risk of bias, the overall assessment resulted in 3 studies with a high risk of bias, and 2 studies that did not meet the GRADE.

Figure 1. Flow Chart of Study Eligibility.



After the selection and thorough analysis of the clinical findings, it was observed that the authors Schirrmeister et al [13] evaluated the effectiveness of removing gutta-percha in curved canals in retreatments using the manual technique, FlexMaster, Protaper and Race observed that the techniques manual and FlexMaster denote larger areas of obturation remnants and that the Race system presented better results than Protaper due to its cleaning capacity, despite being slower and with a lower risk of fractures. The authors Tasdemir et al [14] evaluated the efficiency of three

different rotary instruments in removing the filling material and concluded that the Protaper system had the lowest means of remaining material on the root canal walls. However, the instruments used were F1, F2, and F3 and not those intended for retreatment.

Still, other authors, when studying the Protaper Universal-Retraction system, concluded that all the techniques tested left between 10.0% and 17.0% of the surface of the canals covered by the filling material. In the middle and apical thirds, samples from the Protaper group for retreatment had the lowest percentage of remnant [15]. In addition, Gergi and Sabbagh [16] evaluated the effectiveness of manual files Hedströen, ProTaper, and R-Endo in removing gutta-percha from severely curved root canals. They noted that all instruments left material within the root canal and that the ProTaper and R-Endo systems are not suitable for the complete removal of seal material. On the other hand, other studies have demonstrated the effectiveness of rotational systems in endodontic retreatment but never producing completely obturator-free root canals.

Also, other authors have examined the cyclic fatigue strength of Reciproc and WaveOne instruments through simulated root canals. Two groups of fifteen NiTi instruments with an identical size of 25.0 mm were organized, with group A composed of Reciproc R25 and group B of WaveOne Primary. All instruments were inspected and the defective one was discarded. Cyclic fatigue tests were performed in an artificial stainless steel channel, reproducing the size and taper of the instruments. The simulated root canal had a 60° angle of curvature and a 5mm radius of curvature. The center of curvature was 5.0 mm from the tip of the instrument and the curved segment of the canal was approximately 5.0 mm long. The Reciproc and WaveOne instruments were activated using each of their pre-specific programs (Reciproc ALL and WaveOne ALL). All instruments were rotated until fracture occurred, fracture time, and fractured tip length recorded and recorded [17]. In addition, fracture time was recorded visually using a stopwatch and associated with the nearest integer. The mean length of the fractured fragment was evaluated regarding the correct positioning of the tested instrument within the canal curvature, with the presence of similar induced stresses. A longer fracture time is caused by greater resistance to cyclic fatigue. As a consequence, there was a statistically significant difference between the instruments. Reciproc R25 was associated with a significant increase in mean fracture time when compared to WaveOne Primary instruments. As a result, Reciproc instruments were associated with significantly higher cyclic fatigue strength than WaveOne instruments [17].

Besides, the authors conducted a study to evaluate the effectiveness of Channel Finder and manual instrumentation in removing gutta-percha during canal retreatment. Sixty teeth were used and divided into three groups. In group I, the teeth was manually re-instrumented with K-files number 15 to 50 (two sizes larger than the root canal preparation). In Group II, the re-instrumentation was performed with the Channel Finder with files of diameter from 15 to 50. In Group III - the channel was instrumented with K-type files, with the reduction technique modified in conjunction with the Channel Finder system. Chloroform was used as a solvent and 0.5% sodium hypochlorite as an irrigation solution. As control of re-instrumentation, a radiograph of each tooth was performed. If the radiograph showed any evidence of clogged material, the tooth was cleaned again until the radiographic examination did not reveal radiopaque material in the canal. The results showed that all the techniques used left residues inside the root canal. The comparative test showed that the manual technique was significantly better than the others in removing the filling material. All techniques caused the extrusion of plug material without statistical significance. The hybrid technique required less time to remove the sealing material. Channel Finder alone was not superior to manual instrumentation [5].

Also, a study characterized the microbiota of teeth with endodontic treatment failure by genetic sequencing (GS) of 16S ribosomal RNA and PCR at different stages of endodontic retreatment and associated the presence of specific bacteria with clinical and radiographic characteristics in teeth with apical periodontitis. Twenty infected root canals from single-rooted teeth were selected. Samples were collected with sterile paper points before chemical-mechanical preparation (CMP) (S1), after CMP (S2), and after 30 days of intracanal medication (S3). Microbial identification was performed by GS and PCR. A total of 89 strains were identified using GS. Sixty-five strains were recovered in S1 and 15 strains in S2, and 9 strains remained in S3. *Enterococcus faecalis* was the most predominant bacterium. Gram-positive cocci bacteria predominated. Gram-negative species were also detected. Using species-specific PCR primers to detect seven species, the most prevalent in all stages of endodontic retreatment were *E. faecalis* and *Porphyromonas gingivalis*. However, *Parvimonas micra* and *P. gingivalis* were associated with prior pain, *P. gingivalis* was associated with percussion sensitivity, and *E. faecalis*, *Fusobacterium nucleatum*, and *P. gingivalis* were associated with periapical lesion > 3 mm. Therefore, the persistent infection microbiota is polymicrobial with a predominance of *E. faecalis* and *P. gingivalis* in all stages of endodontic retreatment, regardless of the method used for microbial

identification. Associations were found between specific bacteria and clinical/radiographic features [18].

In addition, a randomized clinical trial compared the effectiveness of endodontic retreatment of teeth with post-treatment apical periodontitis (PTAP) performed at 1 visit versus 2 visits in reducing cultivable bacteria (CFU), lipopolysaccharides (LPSs), lipoteichoic acid (LTA), and the volume of the periapical lesion (mm^3) after 18 months of follow-up. Forty patients diagnosed with PTAP were selected and randomly divided into 2 groups: retreatment in 1 visit and retreatment in 2 visits with the placement of medication based on calcium hydroxide for 14 days. Cone-beam computed tomography was performed in 2 stages: preoperatively and after 18 months of follow-up. All samples showed baseline values higher than those collected after the retreatment protocol for all parameters investigated. A higher bacterial load and lower LTA level were found in the 2-visit group after the retreatment protocol ($p<0.05$), with no statistical differences between the groups regarding endotoxin levels and periapical lesion volume (mm^3) in the 18-month follow-up analyzed by cone-beam computed tomography image ($p>0.05$) [19].

Finally, another randomized clinical trial evaluated the effect of intracanal drugs of nano-silver and nano-calcium hydroxide during retreatment for their antibacterial effect and their effect on pain and postoperative crises. Sixty-nine patients scheduled for endodontic retreatment were included in this randomized clinical trial and randomly allocated into 3 equal groups (n=23) according to the type of nano-silver and nano-calcium hydroxide used. The first microbial sample (S1) representing the original microbiota was obtained after the removal of the old canal filling. After chemical-mechanical debridement, another sample (S2) was obtained representing the microbial state before nano-silver and nano-calcium hydroxide application. Patients were randomly allocated to receive nano-silver (nano-Ag), nano-calcium hydroxide (nano-CH), or calcium hydroxide (CH) as nano-silver and nano-calcium hydroxide. Patients rated their pain preoperatively and after 6, 12, 24, 48, and 72 h. During the second visit (7 days later), the last microbial sample (S3) was obtained after the removal of the nano-silver and nano-calcium hydroxide. There was a reduction in the total bacterial count, total *E. faecalis* count and in the biofilm formation capacity of the existing microbiota after chemical-mechanical debridement (S1-S2) and after nano-silver and nano-calcium hydroxide application (S3-S2). However, the reduction after cleaning and shaping was significantly more pronounced ($p< 0.001$) in relation to the effect of nano-silver and nano-calcium hydroxide application, with no difference between the 3 nano-silver and nano-calcium hydroxide ($p > 0.05$). Postoperative pain was significantly reduced at 48 and 72 hours after application of nano-Ag and nano-CH alone ($p<0.001$), with no significant difference between these two nano-silver and nano-calcium hydroxide ($p > 0.05$). The incidence of outbreaks in all groups was similar ($p>0.05$) [20].

Conclusion

The results of clinical trials showed that the root canal instrumentation system with rotary files maintains the quality of the root preparation and reduces the number of files needed to obtain a canal, which would consequently reduce the operative time and also considerably reduce the risk of torsion fracture within the root canal, allowing successful endodontic retreatment. Also, a condition for successful endodontic retreatment is the adequate cleaning of the root canals, therefore, special attention must be given to the technique used to remove the filling material.

Acknowledgement

Not applicable.

Funding

Not applicable.

Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

Similarity check

It was applied by Ithenticate@.

References

1. Azarpazhooh A, Khazaei S, Jafarzadeh H, Malkhassian G, Sgro A, Elbarbary M, Cardoso E, Oren A, Kishen A, Shah PS. A Scoping Review of Four Decades of Outcomes in Nonsurgical Root Canal Treatment, Nonsurgical Retreatment, and Apexification Studies: Part 3-A Proposed Framework for Standardized Data Collection and Reporting of Endodontic Outcome Studies. J Endod. 2022 Jan;48(1):40-54. doi:

10.1016/j.joen.2021.09.017. Epub 2021 Oct 22. PMID: 34688792.

2. Abbott PV. Present status and future directions: Managing endodontic emergencies. Int Endod J. 2021 Dec 27. doi: 10.1111/iej.13678. Epub ahead of print. PMID: 34958512.
3. Alghamdi F, Alhaddad AJ, Abuzinadah S. Healing of Periapical Lesions After Surgical Endodontic Retreatment: A Systematic Review. Cureus. 2020 Feb 7;12(2):e6916. doi: 10.7759/cureus.6916. PMID: 32190471; PMCID: PMC7061768.
4. Kim BN, Son SA, Park JK. Endodontic retreatment of a calcified anterior tooth using a 3D-printed endodontic guide. Int J Comput Dent. 2021 Dec 21;24(4):419-427. PMID: 34931777.
5. Imura N, Kato AS, Hata GI, Uemura M, Toda T, Weine F. A comparison of the relative efficacies of four hand and rotary instrumentation techniques during endodontic retreatment. Int Endod J, 2000, v. 33, n. 4, p. 361-6.
6. Carr, G.B. Endodontics at the crossroads. J Calif Dent Assoc, v. 24, n. 12, p. 20-6, 1996.
7. Abou-Rass, M. Evaluation and clinical management of previous endodontic therapy. Journal of Prosthetic Dentistry, 1982,v.47, p. 528–34.
8. De-Deus, G. et al. Extended cyclic fatigue life of F2 ProTaper instruments used in reciprocating movement. Int Endodontic, 2010, v. 43, p. 1063-1068.
9. Imura, N.; Zuolo, M.L.; Ferreira, M.O.F.; Novo, N.F. Effectiveness of the Canal Finder and hand instrumentation in removal of gutta-percha root fillings during root canal retreatment. Int Endod J, 1996, v. 29, p.382-6.
10. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021; 372 doi: https://doi.org/10.1136/bmj.n71
11. H Balshem H, Grade guidelines: 3 ratng the quality of evidence. Journal of Clinical Epidemiology, Maryland Heights, 64 (4) (2011) 401-406.
12. Higgins, S Green, Cochrane Handbook for Systematic Reviews of Interventions. Version 5.1.0 [updated March 2011]. The Cochrane Collaboration; 2011.
13. Schirrmeister JF, Wrbas KT, Meyer KM, Altenburger MJ, Hellwig E. Efficacy of different rotary instruments for gutta-percha removal in root canal retreatment. J Endod 2006; 32(5): 469-472.
14. Tasdemir T Er K, Yildirim T, Çelik D Efficacy of three rotary NiTi instruments in removing gutta-percha from root canals. Int Endodon J 2008, 41,191- 196.
15. Gu LS, Ling JQ, Wei X, Huang XY. Efficacy of Protaper Universal rotary retreatment system for gutta-percha removal from root canals. Int Endodon J. 2007;41:288-295.
16. Gergi R, Sabbagh C. Effectiveness of two nickeltitanium rotary instruments and a hand file for removing gutta-percha in severely curved root canals during retreatment: an ex vivo study. Int Endod J. 2007;40(7):532-7.
17. Plotino, G. et al. Cyclic fatigue of Reciproc and WaveOne reciprocating instruments. International Endodontic Journal, v. 45, n. 7, p. 614-618, 2012.
18. Barbosa-Ribeiro M, Arruda-Vasconcelos R, Louzada LM, Dos Santos DG, Andreote FD, Gomes BPFA. Microbiological analysis of endodontically treated teeth with apical periodontitis before and after endodontic retreatment. Clin Oral Investig. 2021 Apr;25(4):2017-2027. doi: 10.1007/s00784-020-03510-2. Epub 2020 Aug 28. PMID: 32860137.
19. Toia CC, Khoury RD, Corazza BJM, Orozco EIF, Valera MC. Effectiveness of 1-Visit and 2-Visit Endodontic Retreatment of Teeth with Persistent/Secondary Endodontic Infection: A Randomized Clinical Trial with 18 Months of Follow-up. J Endod. 2022 Jan;48(1):4-14. doi: 10.1016/j.joen.2021.09.004. Epub 2021 Sep 20. PMID: 34555421.
20. Fahim MM, Saber SEM, Elkhatib WF, Nagy MM, Schafer E. The antibacterial effect and the incidence of post-operative pain after the application of nano-based intracanal medications during endodontic retreatment: a randomized controlled clinical trial. Clin Oral Investig. 2022 Feb;26(2):2155-2163. doi: 10.1007/s00784-021-04196-w. Epub 2021 Oct 25. PMID: 34697657.