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Impact of Apical diameter and Irrigation Technique in Disinfection of the Root Canal System: a systematic review

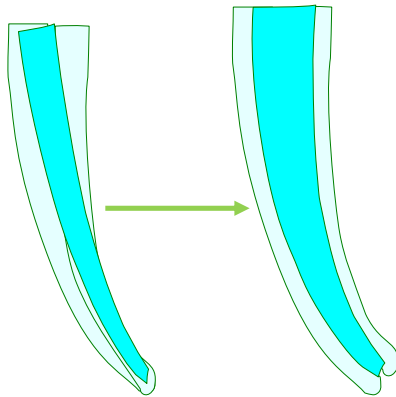
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Cleaning and shaping: Objectives

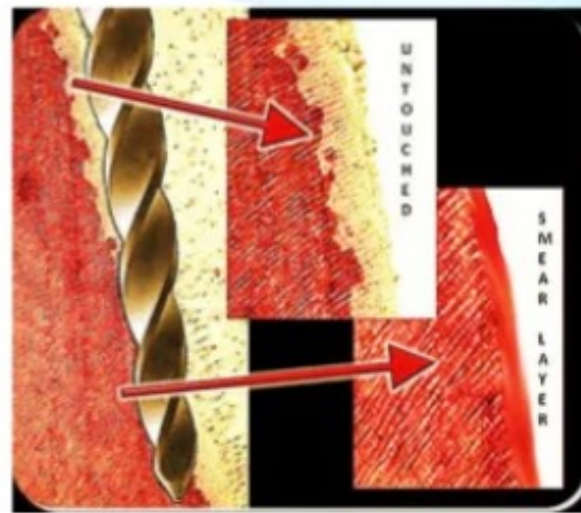
- Shape (mechanical)



- Taper
- Smooth and continuous walls
- Apical constriction
- Permeable foramen
- Respect for the original anatomy

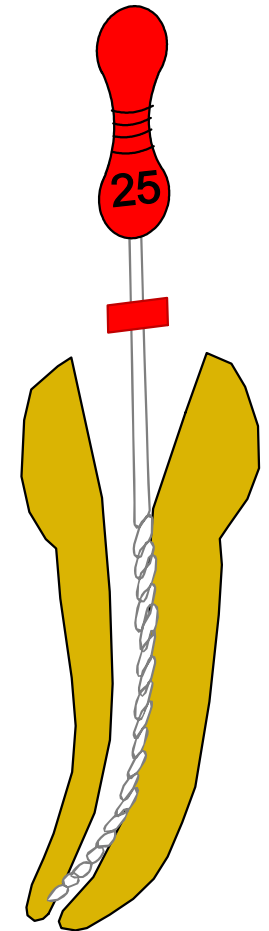
- Disinfection (chemical)

- Irrigation
- Chemical irrigants



Apical Preparation

- Apical preparation is necessary because it facilitates canal irrigation and, consequently, improves canal disinfection.
- Excessive canal instrumentation can also contribute to complications such as perforations or transport of debris to unwanted spaces.
- Disinfection of the apical third is determined by the caliber of the apical preparation, which will influence the needle insertion distance, the irrigation flow and the disinfectant effect.



Fornari VJ, Silva-Sousa YT, Vanni JR, Pécora JD, Versiani MA, Sousa-Neto MD. Histological evaluation of the effectiveness of increased apical enlargement for cleaning the apical third of curved canals. Int Endod J. 2010 Nov;43(11):988–94.

Tziafas D, Alraeesi D, Al Hormoodi R, Ataya M, Fezai H, Aga N. Preparation prerequisites for effective irrigation of apical root canal: A critical review. J Clin Exp Dent. 2017 Oct 1;9(10):e1256-e1263.

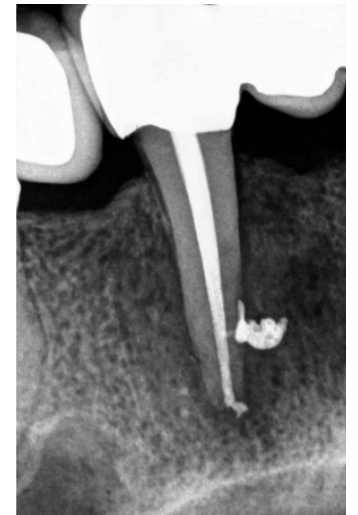
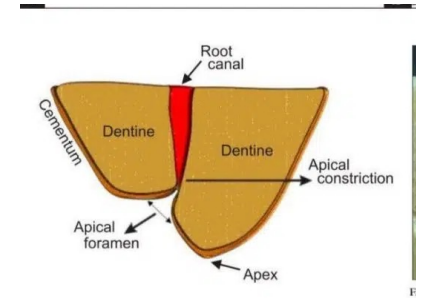
Lin LM, Rosenberg PA, Lin J. Do procedural errors cause endodontic treatment failure? J Am Dent Assoc. 2005 Feb;136(2):187-93

Limit of apical preparation

- The lowest success rate occurred when the working length was less than 2 mm or when the treatment occurred beyond the apex.



Ideally, our root canal instrumentation should be carried out along the entire length of the canal.

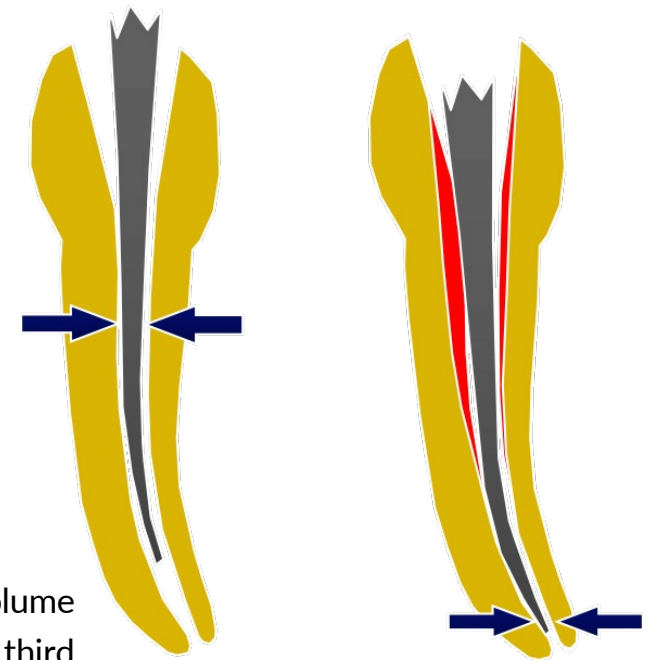


Apical preparation diameter

The final apical diameter should use a file that has a large area of contact with the canal, taking care to respect the canal anatomy and without causing a risk of iatrogenesis.

3 upper ISO than the first apical file

- Root canal volume
- Presence of curvature in what third
 - Instrumentation system



Objective

- This systematic review aims to evaluate the impact of achieving specific apical diameter during the shaping phase of non-surgical endodontic treatment on the disinfection efficacy of the root canal system.



Metodology

The research question, according to the PICO methodology, was the following:

In teeth requiring endodontic treatment (P), what is the ideal diameter (C) of the apical preparation (I) for effective or better disinfection (O) of the root canal system?

Population	Intervention	Comparasion	Outcome
Teeth in need of endodontic treatment	Apical preparation	Diferent apical diameters	Disinfection

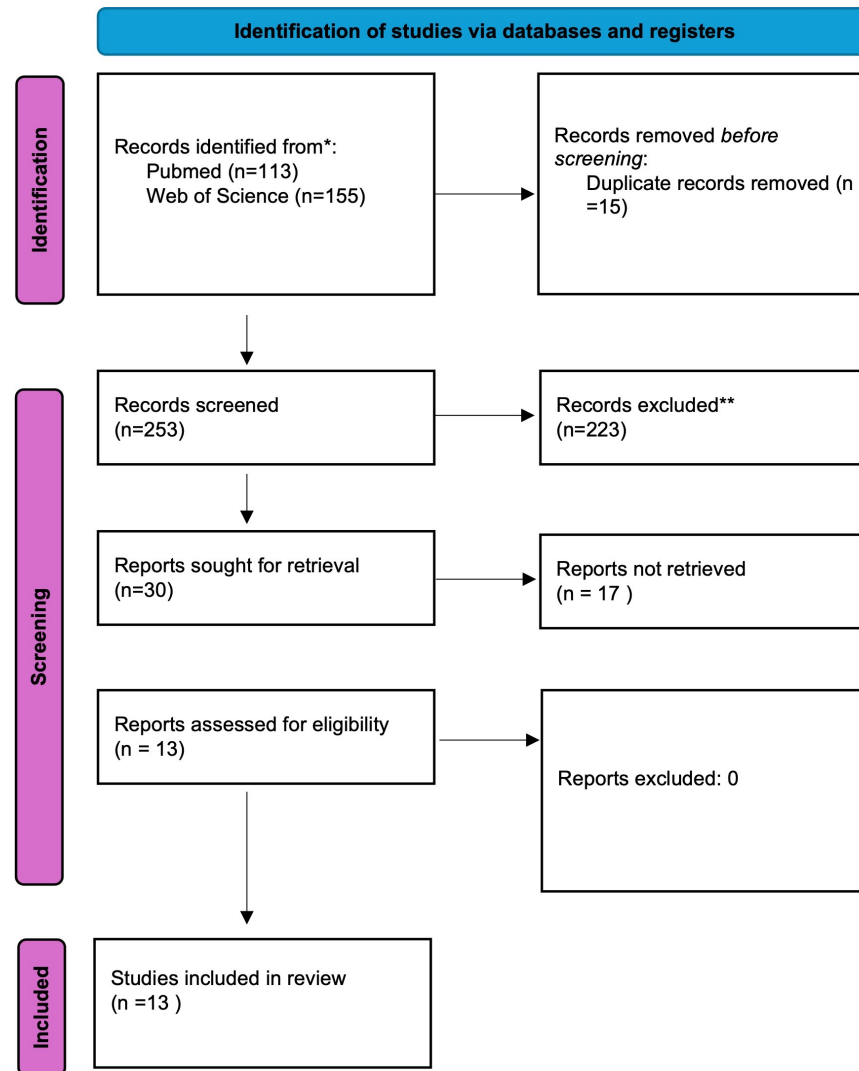
("root canal disinfection") AND ("apical size" OR "apical diameter" OR "apical preparation" OR "apical enlargement")



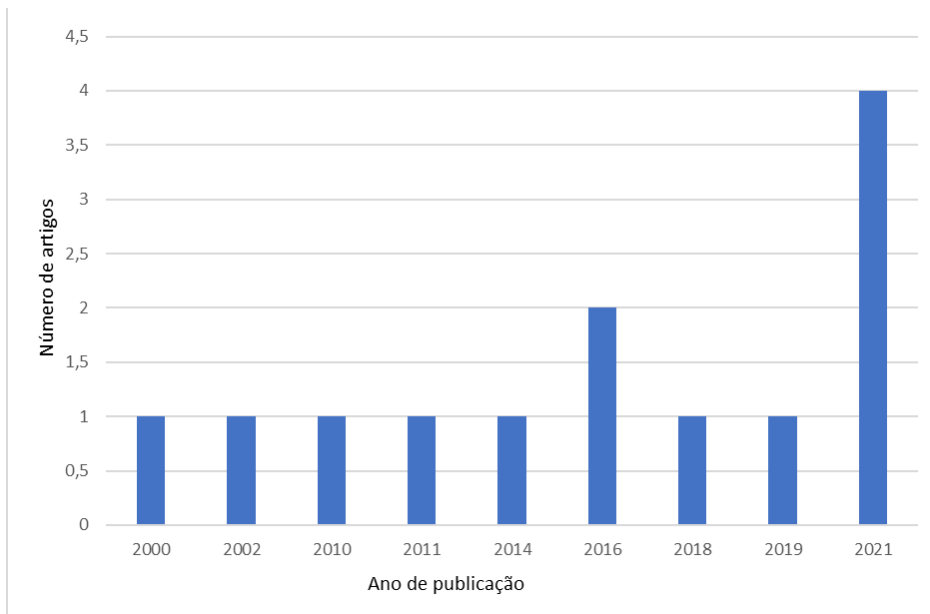
Selection criteria

INCLUSION CRITERIA	EXCLUSION CRITERIA
Papers in English or Portuguese	reviews
Experimental study	Opinions and letters to editor
<i>In vitro</i> study	Study in human
<i>Ex vivo</i> study	Study in animals
Study about influence of apical gauge	Cohort studies
Study about root canal disinfection	

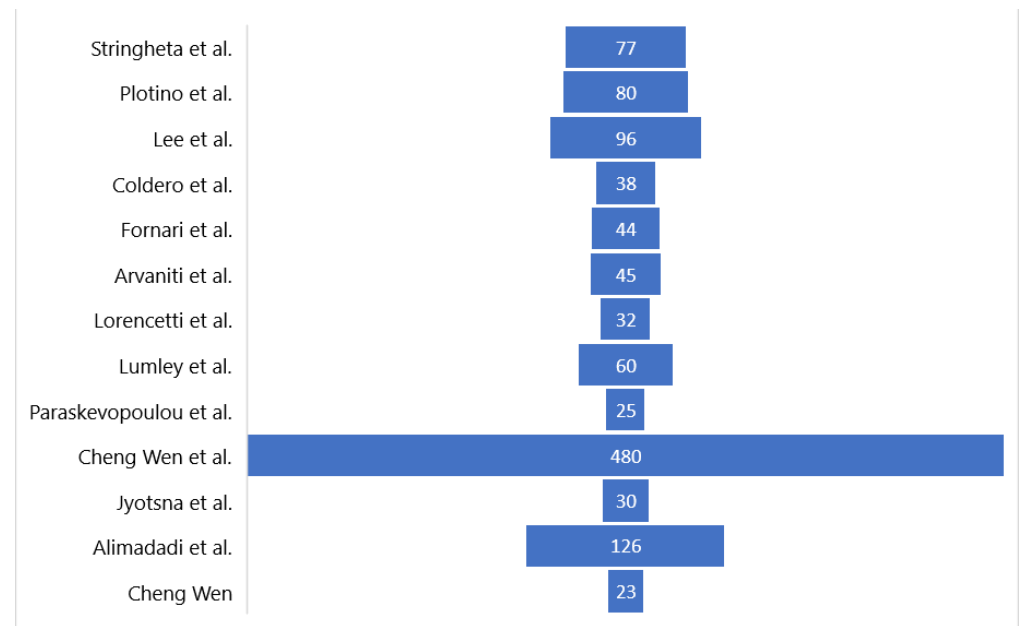
Results



Results

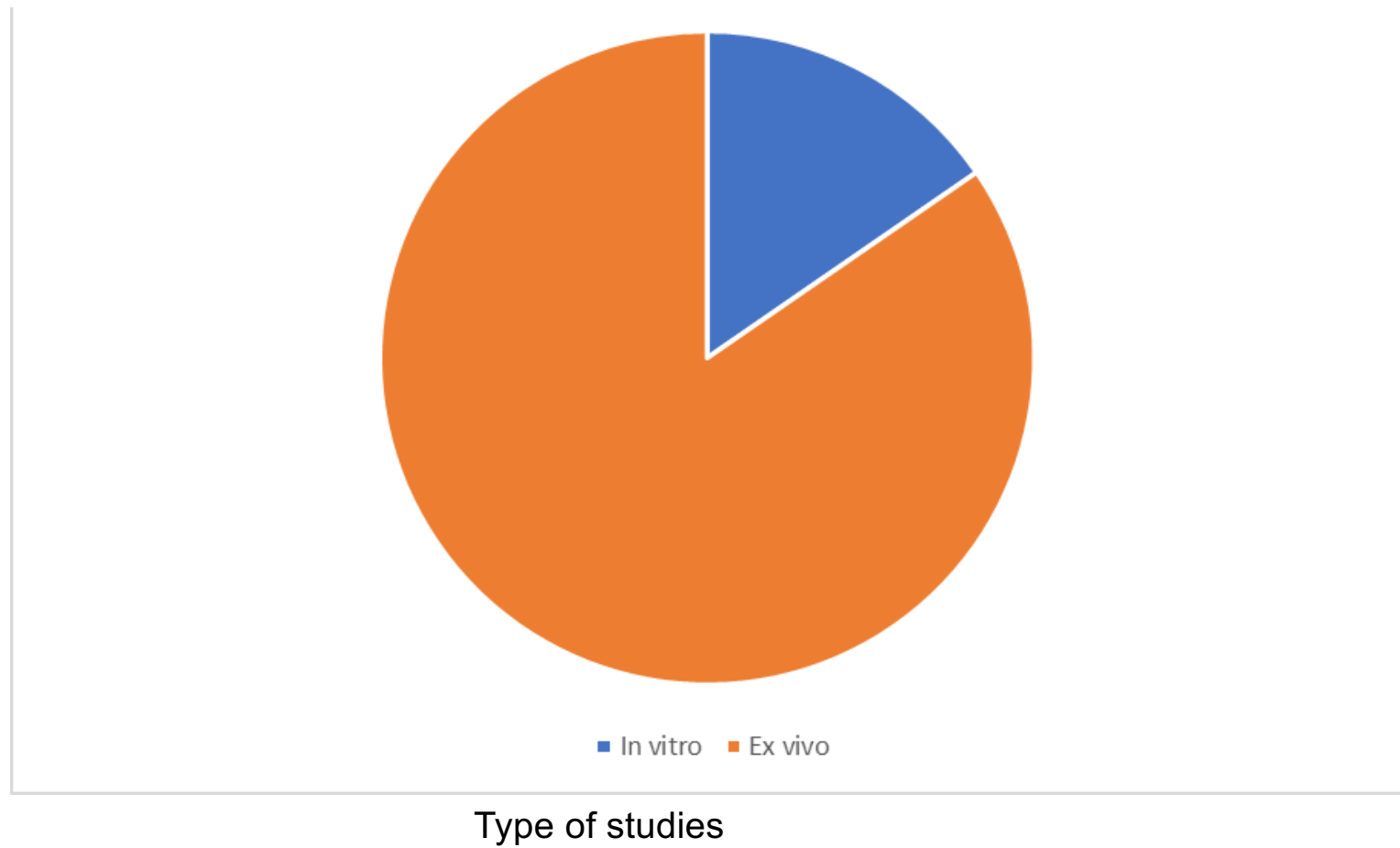


Number of studies and year of publication

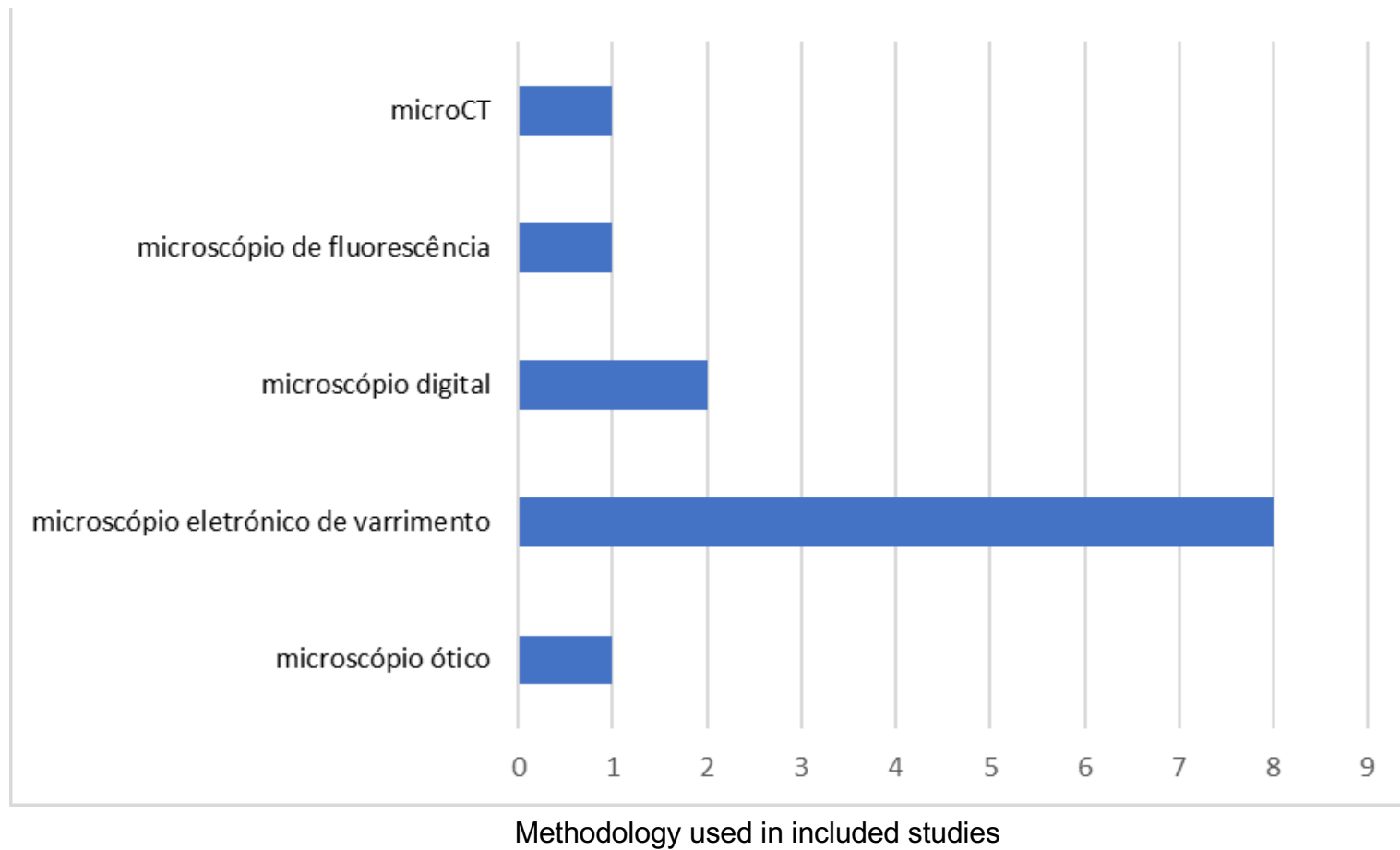


Number of sample by included studies

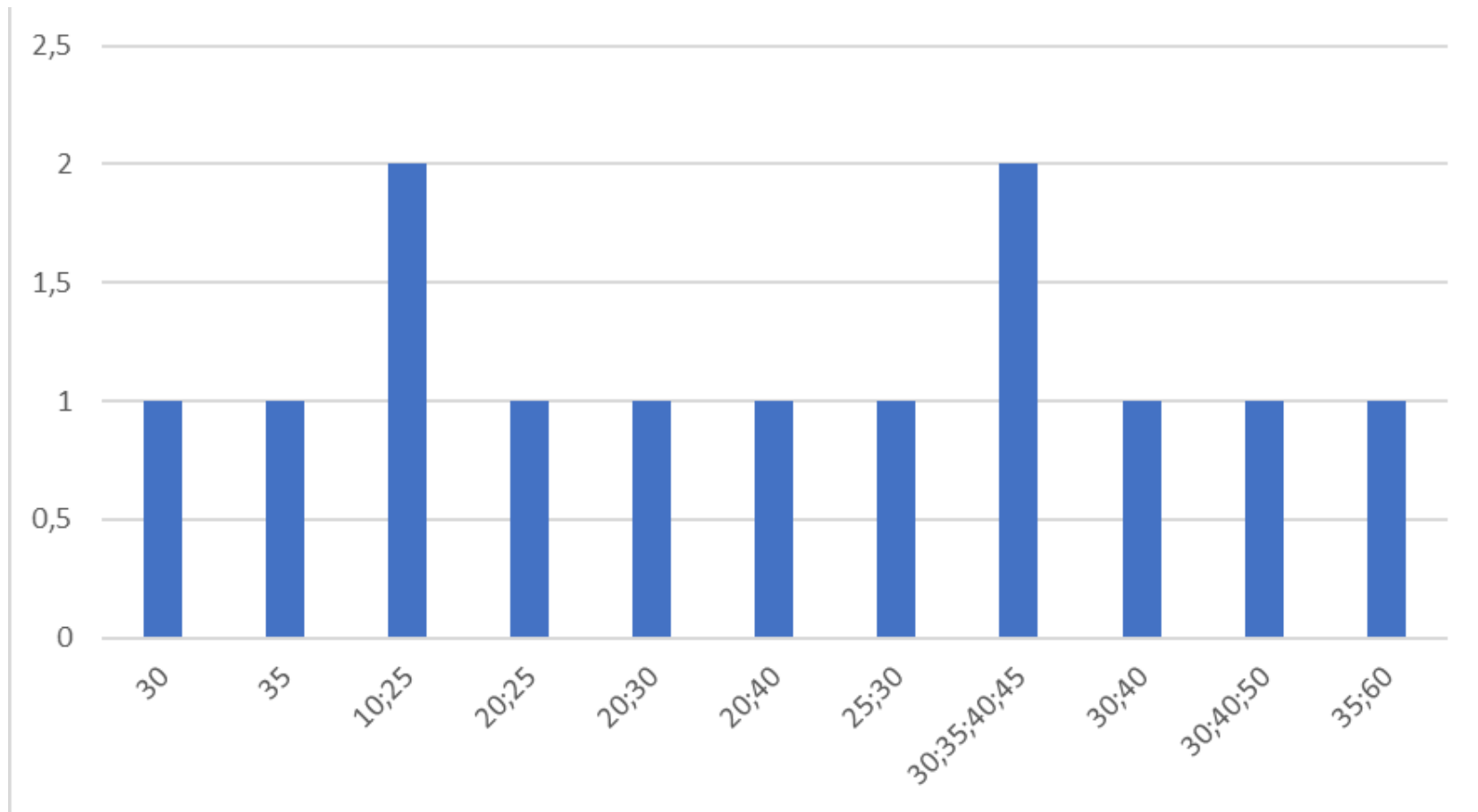
Results



Results

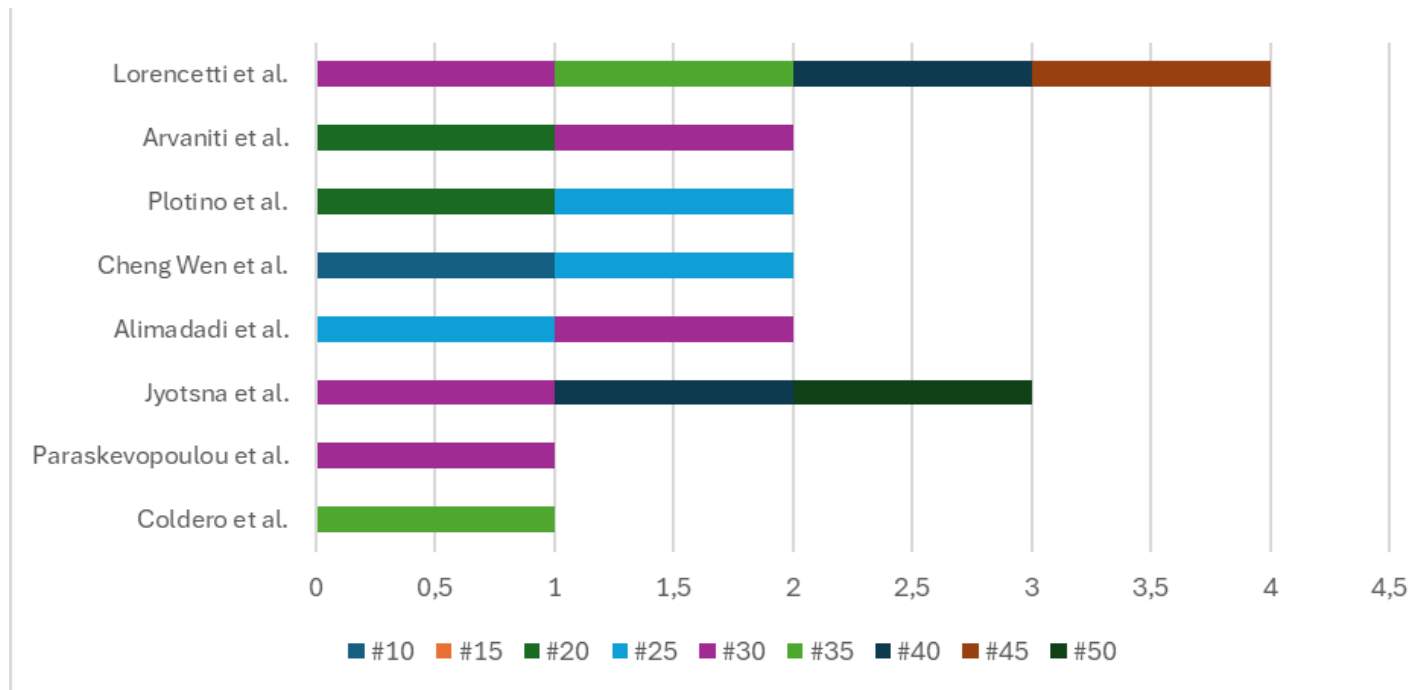


Results



Apical diameter in included studies

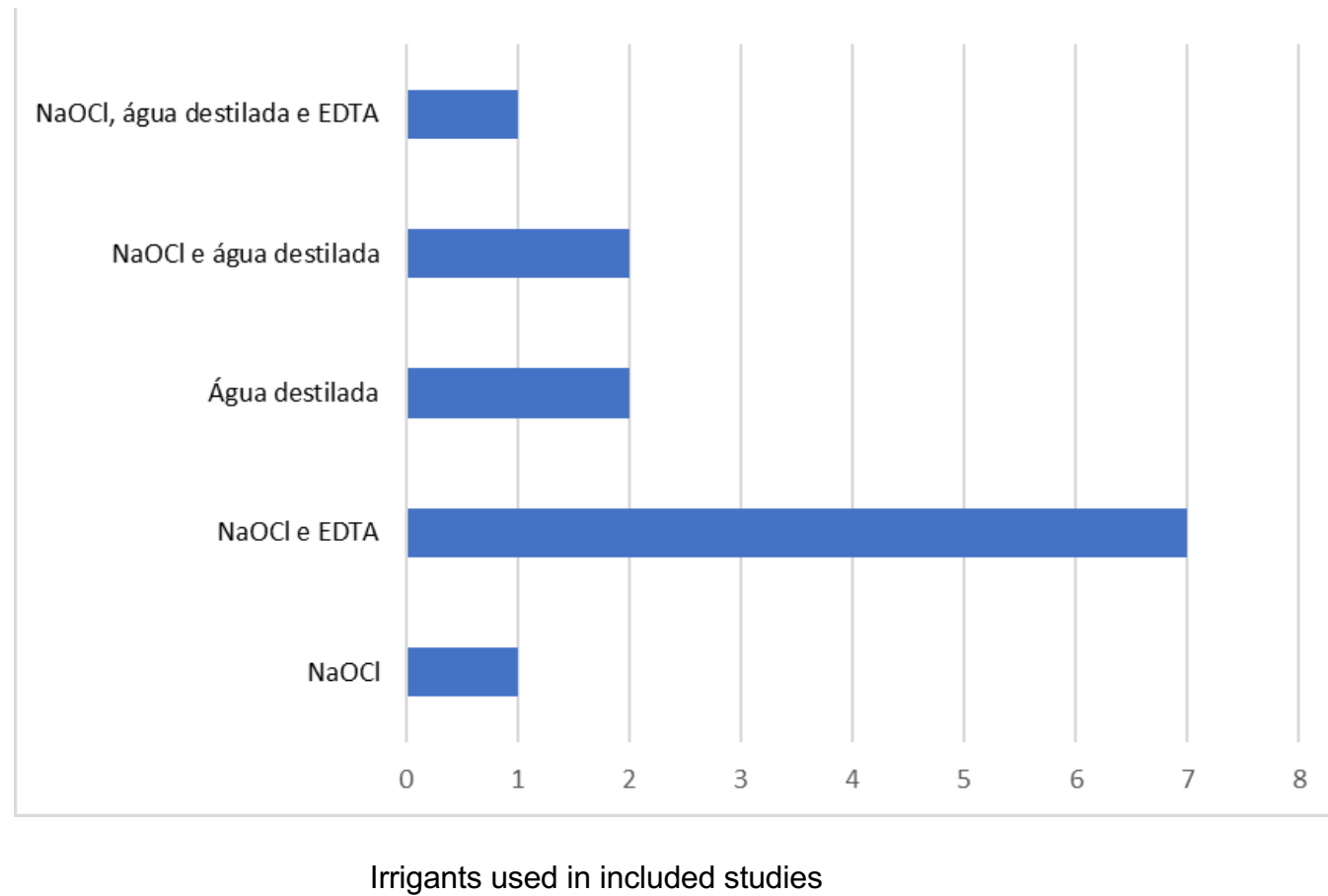
Results



Apical diameter using scanning electron microscope

Results

Rita, tem este esquema em formato editável? Para se traduzir

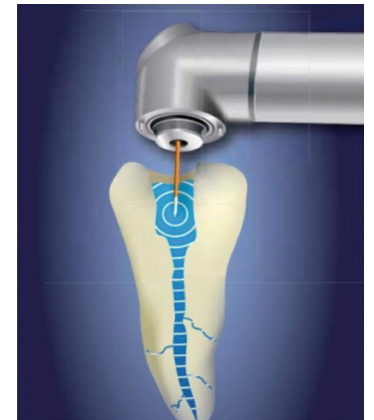


Discussion: apical diameter and level of disinfection

- Studies such as Stringheta et al., Lee et al. and Lumley et al., indicate that larger gauges result in more effective disinfection, with less presence of residues and remaining debris, especially when irrigation is conventional.
- Extremely large gauges may not be necessary when advanced irrigation techniques are used, as indicated in the studies by Cheng Wen et al.
- Stringheta et al., demonstrated that an apical preparation of # ISO40 gauge resulted in lower percentages of untouched channel walls and remaining residues compared to # ISO30 gauge and Lee et al., also indicated that larger gauges (#ISO40) resulted in cleaner root canals than smaller gauges (#ISO20) when using conventional irrigation, but the use of ultrasonic activation leveled out the efficacy between different gauges.

Discussion: irrigation techniques

- Studies by Cheng Wen et al. and Lee *et al.*, demonstrate that techniques such as PIPS and ultrasonically activated irrigation are highly effective, allowing complete disinfection even in smaller gauges, challenging the need for significant apical enlargement.
- Studies such as Stringheta *et al.* and Plotino et al., show that even with conventional techniques, cleaning can be optimized with larger apical gauges, although ultrasonic activation of the irrigant can compensate in smaller ones.
- Cheng Wen *et al.* demonstrated that **PIPS** was more effective than conventional irrigation in small-diameter root canals and, again, Cheng Wen et al., in another study, reinforced the superior efficacy of PIPS in terms of bacterial elimination, regardless of the size and taper of the canal.
- As mentioned in another study by Chrepa *et al.*, the use of adjuvant techniques such as PDT and ultrasonic activation has shown significant potential to improve disinfection in smaller apical preparations, optimizing cleaning without the need for excessive dentin removal, leading to treatment optimization.



Laser activation irrigation

Discussion: taper?

- The studies by Paraskevopoulou *et al.* and Arvaniti *et al.* indicate that greater taper can improve disinfection, but complete removal of the smear layer and debris requires additional techniques.
- Thus, according to the articles by Coldero *et al.*, Cheng Wen *et al.*, and Plotino *et al.*, adequate coronal taper may be sufficient for effective disinfection, especially when advanced irrigation techniques are used.
- Fornari *et al.* and Arvaniti *et al.*, highlighted that different tapers did not significantly affect cleaning, suggesting that the choice of irrigants and activation techniques may be more determinant and additional studies such as the one by Liu *et al.*, also emphasize that the proper combination of irrigants and activation techniques is crucial for efficient disinfection, regardless of the taper of the preparation.

Conclusions

- Although larger apical gauges generally result in better cleaning and debris removal, the effectiveness of root canal disinfection does not depend solely on apical size.
- Irrigation activation techniques, as well as the proper combination of irrigants, play a crucial role in the overall effectiveness of endodontic treatment.
- The most used apical caliber is #ISO30; however, it is not possible to confirm that this is the ideal apical caliber, due to the fact that the papers use different methodologies.
- Nevertheless, it can be concluded that through the activation of irrigants and with a good combination of them, we can achieve good root canal disinfection, preserving more amount of the original root canal anatomy.



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Thank you!
