Review Article

Minimally invasive access cavities in endodontics

Lubna A. Abdulrazaq[1*], Ahmed H. Ali[2], Federico Foschi[3]

1. Master student, Aesthetic and restorative dentistry department, College of Dentistry, University of Baghdad, Baghdad, Iraq.
2. Assistant Professor, Aesthetic and restorative dentistry department, College of Dentistry, University of Baghdad, Baghdad, Iraq.
3. Program Director MSc in Endodontics, Honorary senior clinical lecturer, Faculty of Dentistry, Oral & Craniofacial Sciences, King's College London, Guy's Hospital, Tower Wing, Floor 22, London, UK.

* Correspondence email; Lobna.Abdulwahab1204a@codental.uobaghdad.edu.iq

Received date: 06-03-2023
Accepted date: 06-04-2923
Published date: 15-06-2023

https://doi.org/10.26477/jbcd.v35i2.3406

Abstract: Background: The access cavity is a critical stage in root canal therapy and it may influence the subsequent steps of the treatment. The new minimally invasive endodontic access cavity preparation concept aims to preserve sound tooth structure by conserving as much intact dentine as possible including the pulp chamber's roof, to keep the teeth from fracturing during and after endodontic treatment. While there is great interest in such access opening designs in numerous publications, still there is a lack of scientific evidence to support the application of such modern access cavity designs in clinical practice. This review aims to critically examine the literature on minimal access cavity preparations, explain the effect of minimally invasive access cavity designs on various aspects of root canal treatment, and identify areas where additional research is required. Data: An electronic search for English-language articles was performed using the following databases: Google Scholar, PubMed, and Research Gate. The following keywords were used: "minimally invasive access cavity", "conservative endodontic cavity ", and "classification of access cavity". Study selection: 64 papers that were the most relevant to the topics in this review were selected between 1969 to 26 February 2022. Conclusions: Minimally invasive access cavities can be classified into conservative, ultraconservative, truss access, caries and restorative-driven cavities. There is a deficiency of proof that a minimally invasive access cavity maintains the resistance to fracture of endodontically treated teeth greater than traditional access cavities. There was no difference in the percentage of untouched walls and debris removal in teeth with conservative vs traditional access cavities, however, truss and ultraconservative access cavities resulted in poor irrigation efficacy compared to traditional ones. Also, the lower cyclic fatigue resistance of rotary instruments and root canal obturation with voids were associated with minimally invasive access cavities. The studies about minimally invasive access cavities still have a wide range of methodological disadvantages or register unsatisfactory or inconclusive results. Therefore, further research on this topic is needed especially with the everyday advancement of techniques and armamentarium used in endodontics.

Keywords: Conservative access cavity; fracture strength of endodontically treated teeth; minimally invasive access cavity; truss access.

Introduction

One of the most critical steps of root canal therapy is access cavity (AC) preparation [(1)], as it will influence the subsequent steps and the outcome of the treatment. Residues of pulp tissue that can serve as a substrate for microorganisms should be cleaned through proper access cavities [(2)]. Also, coronal interference elimination enables the detection of the orifices of root canals [(3)] and serves as a pathway for irrigation solutions to get a better effect of instrumentation and avoid accidents [(4)]. The new philosophy of the preparation of minimally invasive access cavities seeks to conserve sound dentin by retaining as much as possible of the pulp chamber's roof [(5)].

This shift was enabled by the availability of improved endodontic tools such as cone beam computed tomography (CBCT), operating microscopes, and ultrasonic equipment [(6)]. Advocates of these approaches think that minimally invasive access cavities would aid in the long-term survival of endodontically treated teeth by minimizing unnecessary dentine removal, hence improving the fracture resistance of endodontically treated teeth [5, 7]. While the claim of avoiding tooth fracture has yet to be clinically proven, there have been concerns raised about the possible disadvantages of minimally invasive access cavity techniques. A limited access cavity design, for example, presents issues in future procedural stages such as an impaired vision of the pulp chamber and canal, decreased efficacy and efficiency in canal instrumentation and disinfection, and loss of orientation [8, 9] in addition to the morphology of the root canal system which is diverge and unpredictable and associated with clinical complications that have a direct impact on treatment outcome [10].

While there is considerable interest in such access opening design techniques in many articles published on this topic, to date, there is a lack of scientific proof to back up the implementation of these modern access cavity designs in clinical practice for the present time [11]. At the same time, clinicians are increasingly favoring access cavity designs that adopt minimally invasive principles [12]. Although the necessity of conserving tooth structure is self-evident, the entire shift to minimally invasive access cavities has yet to be confirmed [13]. This review aims to provide an overview of the different designs of the minimally invasive access cavities in endodontics, summarize the research investigating their effects on the various aspects of endodontic treatment to date, and identify areas where additional research is required.

Methods

A comprehensive search has been performed on electronically published resources in the English language using Google Scholar, Pub Med, and Research Gate databases from 1969 to February 2022 by using the keywords: "minimally invasive access cavity", "conservative endodontic cavity", and "classification of access cavity". Sixty-four papers were included in this review. The studies were selected according to the following criteria: No social media sources were included, articles, literature reviews, in vitro studies, micro CT studies, finite element studies, retrospective studies, and cross-sectional studies that are related to the minimally invasive access cavities in root canal treatment. The filtering process included selecting the studies based on their relevance to the topics in this review.

Classification of access cavity designs

Traditional access cavity (Trad AC)

Carried out over the past decades, seeking to allow straight-line access to the apex by removing the coronal interference [14, 15]. Complete removal of the pulp chamber roof in posterior teeth, followed by straight-line access to the canal orifices with smoothly divergent axial walls, allowing all orifices to be visible and apparent within the outline shape. Straight-line access is achieved in anterior teeth by removing the pulp chamber roof, pulp horns, and the lingual shoulder of the dentine, as well as extending the access cavity to the incisal edge [16].

Conservative access cavity (Cons AC)

Such a design of access cavity was proposed by Clark and Khademi in 2010. Preparation of posterior teeth usually begins at the occlusal surface's central fossa. It expands with axial walls that are smoothly convergent only to the degree required to expose the canal orifices, retaining part of the roof of the pulp chamber [5]. This form of access can also be performed by divergent walls (Cons AC, DW) [17]. In anterior teeth, the strategy includes transferring the place of entry from the cingulum on the lingual or palatal surface to the incisal edge by forming a narrow triangular or oval-shaped cavity retaining the horns of pulp and the full peri-cervical dentin [18], as shown in figures 1 and 2.

Ultra conservative access cavity (Ultra AC)

Such cavities begin as stated in the Cons AC but with no additional expansions, preserving as great of the roof of the pulp chamber as feasible [7]. When the lingual region of the crown has attrition or a significant concavity of an anterior tooth, the incisal edge can be accessed in the center, parallel to the tooth's long access, as shown in Figures 1 and 2.

Truss Access Cavity (Truss AC)

This type of access cavity design aims to keep the dentinal bridge between two or more tiny cavities that are created to access the canal orifice in each root of multi-rooted teeth. To access the mesial and distal canals, two or three separate cavities might be created in mandibular molars, for example [19], as shown in Figures 1 and 2.

Caries-driven Access Cavity (Caries AC)

Access to the pulp chamber is gained in this design by eliminating caries while conserving all remaining dental structures, including the soft structure described as the underside of an architectural feature such as the ceiling, ceiling corner, or wall [20], as shown in Figures 1 and 2.

Restorative-driven Access Cavity (Resto AC)

Access to the pulp chamber is gained in a restored tooth with no caries by removing all or part of the existing restorations while conserving the remaining tooth structures [11], as shown in Figures 1 and 2.

Straight-Line-Furcation (SLF) and Straight-Line-Radicular (SLR)

Because the outlines of SLF and SLR are formed from the pulp space landmarks projected onto the occlusal surface of the teeth, they differ from other types of access designs. The reference of the Straight Line Radicular (SLR) access is related to the pulp horn position, but the Straight Line Furcation design (SLF) is based on the placement of the center of each canal at the level of furcation [21]. SLF and SLR are not included in the new proposed classifications, but they have lately been used in clinics with the idea of dynamic CT–guided endodontic access treatments [22].

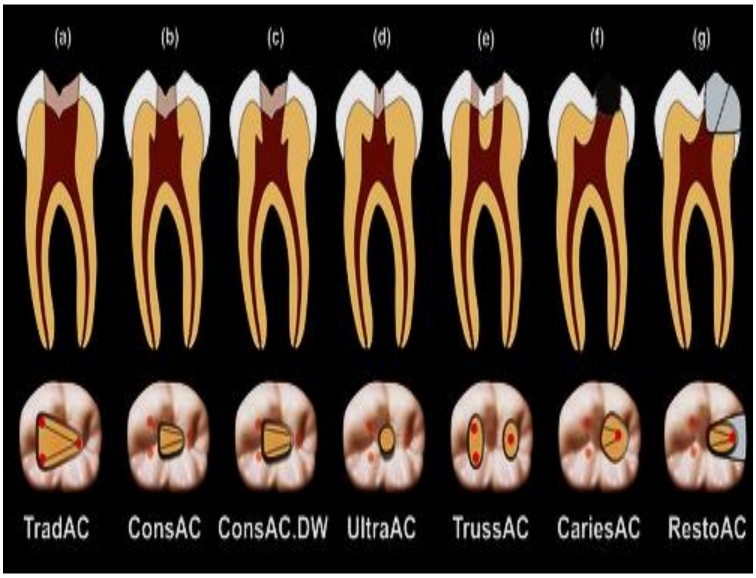

Figure 1: Classification of different types of access cavity designs of posterior teeth **[11]**.

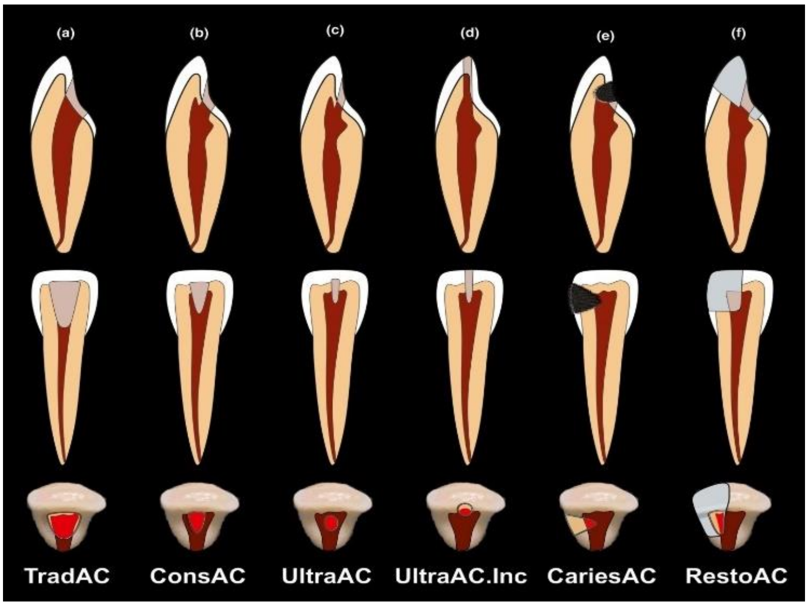

Figure 2: Classification of different types of access cavity designs of anterior teeth **(11)**.

Influence of minimally invasive access cavity on aspects of root canal treatment:

The strength of the remaining tooth structure

The causes of fractures in endodontically treated teeth include iatrogenic causes (tooth structure loss, effect of chemicals and intracanal medicament, effect of restoration and restorative procedures), and non-iatrogenic causes (primary, which includes a history of recurrent pathology and anatomical position of the tooth, and a secondary effect of aging of dental tissue) (23).

The loss of tooth structure is the most common cause of fracture in root-filled teeth. The preparation of the endodontic access cavity after the Trad AC principles were considered the second largest cause of loss of tooth structure (24). Therefore, an endodontically treated tooth's prognosis might be improved with a correct and minimized endodontic access cavity design (25). Compared to traditional access cavities, less invasive access cavities may improve the fracture resistance of interproximal repaired teeth (26). With minimally invasive access preparations, fourteen studies estimated the fracture resistance of extracted teeth. While the fracture resistance of teeth with Cons AC was greater than that of teeth with Trad AC in five studies (27), no difference was seen in the remaining nine investigations (28). Of the 14 studies, two studies did not specify how specimens were chosen (29), and there is a reduction in the anatomical matching of the samples (30). At the same time, the thickness of the pulp chamber and magnitude of the remaining tooth structure affect the tooth resistance to fracture also the age of the patient and extraction technique are not reported well (29, 31, 32). According to Augusto et al. (2020), ultraconservative access cavities in endodontic treatment did not provide any advantages in fracture resistance of mandibular molars when compared to traditional endodontic access cavities (8). Maske et al. (2021) assess if the access cavity design affects the fracture strength of endodontically treated and repaired molars, and they found that the kind of access cavity preparation does not affect endodontically treated teeth fracture strength (33). Also, Saberi et al. (2020) find that under thermal stress, the truss endodontic access cavity improves the fracture strength of endodontically treated teeth (34).

In conclusion, according to the results of these studies, the impact of access cavity preparation on tooth strength is at best uncertain (11). There is insufficient information to make a definitive judgment about whether ConsAC is better than TradAC in terms of fracture resistance (35). Therefore, more research is required to have a better judgment on whether the minimally invasive access cavity designs may preserve the fracture resistance of the endodontically treated teeth.

Chemomechanical root canal preparation

A suitably prepared access cavity is critical for the successful instrumentation and administration of irrigation solution into the root canal system (36). For evaluation of different designs of access cavity on chemomechanical canal preparation in endodontics, Krishan, Paque, and colleagues (2014) found a higher percentage of untouched walls after using Cons AC in the mandibular first molar's distal canal preparation as compared with Trad AC (27). By comparing Trad AC to Cons AC (37) in maxillary molars, Trad AC to Cons AC in mandibular incisors (18), and Trad AC to Ultra AC in maxillary premolars (11), no differences in the percentage of the untouched walls after shaping the root canals of maxillary molars (37), mandibular incisors (18) and maxillary premolars (11), were observed. These results demonstrate that a tiny access cavity may not jeopardize the proportion of untouched walls during root canal preparation.

For the impact of different access cavity designs on the amount of accumulated debris, Rover et al. (2017) found no difference when comparing maxillary molars with Cons AC or Trad AC (37), while Silva et al. (2020) found that the preparation of maxillary premolar's canal with Ultra AC was associated with a higher percentage of the debris when compared to Cons AC and Trad AC. It's also known that restricted penetration of irrigant, wedging of the needle, the effect of Vapour Lock, and issues related to sonic/ultra-sonic/negative apical pressure irrigation are well-documented drawbacks of irrigating minimally enlarged canals (36).

Following the chemomechanical process using the rotary instrument in addition to irrigation with a traditional syringe, Neelakantan et al. (2018) found a significant amount of pulp tissue remanent holdover in the mandibular molars' pulp chamber with Truss AC as compared with Trad AC (19), which will impair the disinfection procedure by contaminated pulp tissue remnants which act as a source of infection and diseases after treatment (2). The data suggest that there is no difference between the Trad AC and Cons AC in terms of hard tissue debris collection and untouched canal walls after preparation. However, teeth with the Trad AC had more canal transportation than the Cons AC (11). Furthermore, the tiniest access cavities, such as Truss AC and Ultra AC, were linked to worse irrigation efficiency due to the retention of more pulp tissue and hard tissue debris after shaping treatment (11). However, the effect of the type of access cavity on bacterial decline is unknown, and more research is needed.

Augusto et al. (2020) found that in comparison to typical endodontic access cavities, ultraconservative endodontic access cavities did not give any advantages in the capacity to shape canals or the resistance to fracture of mandibular molars (8). While comparing the effects of Cons AC and Truss AC on the capacity for shaping and filling root canals, microbial decrease in canals, and pulp chamber cleaning during root canal therapy on mandibular molars, Barbosa et al. (2020) found no significant differences in microbial decrease, while in comparison to Cons AC, Trad AC had a much smaller percentage of unprepared surface area and also, there were no variations in the proportion of dentine removed (38). Also, Xia et al. (2020) found that in single-rooted premolars, the untouched canal wall following instrumentation for Trad AC was substantially lower than the untouched canal wall for Cons AC (39). On the other hand, Peng et al. (2022) found that after instrumentation using Pro Glider and Wave One Gold files, the Cons AC had no significant negative effect on the efficacy of instrumentation as compared to the Trad AC (40). Doing a very small access cavity might compromise the stage of endodontic treatment by complicating or/and preventing the canal orifice detection and chemomechanical instrumentation and obturation processes (41). The potential for other complications, such as missed canal, deviation, and/or instrument fracture, may also be increased (41).

The results of the studies are controversial on whether minimal invasive access cavities will impair the chemomechanical process or not. However, the Ultra AC, was associated with a higher percentage of debris and untouched canal walls after preparation.

Obturation and retreatment

To evaluate the effect of access cavity design on root canal filling, Niemi et al. (2016) estimated the consistency of the oval-shaped canal filling of mandibular premolars following Cons AC or Trad AC using radiographic image analysis (42). The smaller dimension of minimally invasive access impeded gutta-percha cone adaptation and holds the accomplishment of the continuous condensation wave process. Therefore, Niemi et al. (2016), reported that a single cone approach and Warm Lateral Compaction (WLC) would be the best option for canal filling in a tooth with minimally invasive access preparation (42). Silva et al. (2020) compared the proportion of voids generated next to the root canal filling of two rooted maxillary premolars with round cross-sectional shapes in both Ultra AC and Trad AC teeth (9). According to the authors, the filling of the canal was not affected by access designs; however, even with an ultrasonic tip, magnification, and more treatment time, the operator was unable to remove the filling remnants from the chamber of the pulp before the restoration of teeth with Ultra AC (11).

The sectioning approach was utilized by Niemi et al. (2016) to assess the performance of rotary systems in removing the substance of root filling from the oval-shaped canals of single-rooted mandibular premolars. They found that teeth with Cons AC had a greater remnant of filling material on the wall of the root canal than teeth with Trad AC (42). Rover et al. (2020) found more voids in root canal filling in the minimally invasive group than in the traditional one, and the percentage of canal filling remnant material in the chamber of the pulp after the cleaning process was not significantly different among these groups (traditional and minimally invasive access cavities) (43).

Therefore, the minimally invasive access cavities were more likely to be associated with voids in root canal filling and a higher percentage of canal filling remnant material in the chamber of the pulp than the traditional ones, and more research is needed to confirm these results.

Restoration of endodontically treated teeth

Resin composites are the most common alternative for endodontically treated tooth restoration, especially in minimally invasive access cavities. They are more esthetic, faster, cheaper, and less invasive than indirect restorations (44). The small dimensions of minimally invasive access cavities combined with the retention of the pulp chamber roof complicate the incremental build-up restorative procedure and may result in adhesion failure and/or voids at the point where the restorative material meets cavity walls (45). Silva et al. (2020) examined the effect of ultraconservative endodontic access cavities (Ultra AC) on establishing gaps and voids in resin composite restorations; however, gaps and voids were seen in every specimen. There was considerable disparity in the creation of voids among the access cavity designs, with the Ultra AC producing significantly higher voids. The creation of gaps was not significantly different between the Trad AC and the Ultra AC (46). Boscatto et al. (2022) investigated the effect of endodontic access cavity design and restorative technique on hard tissue removal in mandibular premolars. In comparison to ConsAC, TradAC resulted in a 14% increase in hard tissue removal after endodontic treatment (47). The results of studies are controversial on whether the minimally invasive access cavity is associated with more voids and gaps in the resin composite restorations than traditional access or not, therefore future studies are required to investigate this point.

Tooth discoloration induced by endodontic materials and treatments is a concern in clinical practice, causing cosmetic issues and discomfort for both patients and professionals, especially in the anterior teeth (48). Even with magnification, using an ultrasonic tip, and more treatment time, the operators were unable to bring out residues of filling substances from the chamber of pulp before restoration in teeth with Ultra AC. This prolonged operating technique may cause fatigue in both the patient and the dentist, and the remnants of the filling may affect aesthetics by discoloring the dental crown over time (49, 50).

Cyclic fatigue of endodontic instruments

Torsion failure and cyclic fatigue are two causes of endodontic instrument separation. When the instrument's tip becomes lodged in the dentin and the instrument continues moving, a torsion fracture occurs [51, 52]. On the contrary, cyclic fatigue occurs when the forces of tension compression exceed the elastic limit of the instrument in the canal of the curved root [53]. Reduced access cavities might lead to a higher access inclination of the file into the root canals [4], in addition to anatomic curvature; it induces extra curvature [54]. Recent investigations have shown that inserting the file into the canal with a more inclined angle reduces the endodontic instruments' cyclic fatigue resistance [55, 56]. In Trad AC and Ultra AC endodontically accessed canals, Silva et al. (2020) compared the cyclic fatigue resistance of Reciproc size 25 (R25) and Reciproc blue size 25 (R25B) instruments; R25 and R25B in UltraAC demonstrated much-reduced cycle fatigue resistance [57]. Also, Spicciarelli et al. (2020) found that in endodontically treated teeth using Cons AC, the cyclic fatigue resistance of Reciproc blue R25 was drastically reduced compared to Trad AC [58]. Also, when Corsentino et al. (2021) compared conservative and truss access cavities, they discovered that the truss access cavity produces higher fatigue of Reciproc blue R25 than the conservative access cavity [59].

The studies included in this review showed that minimal invasive access cavities were associated with lower fatigue resistance of endodontic instruments than traditional access cavities. More studies are required to assess new NiTi rotary instruments' fatigue.

Effect on the cuspal deflection

The loss of tooth structure caused by caries and restorative therapies, rather than the endodontic operations themselves, weakens endodontically treated teeth [60]. The extent of cusp displacement during resin composite repair is determined by several parameters, including the restorative material's characteristics, the cavity's size and structure, and the bonding mechanism [61, 62]. Taha et al. (2009) conducted research on tooth strain, cuspal deflection, marginal leakage, and gap development induced by polymerization shrinkage through direct resin composite restoration of endodontically treated premolars [63], and they found that cuspal deflection and strain were increased as a result of loss of axial walls through endodontic access. González-López et al. (2006) examined the influence of each consecutive cavity formation process on premolar cuspal deflection (including endodontic access). The cavity preparations were performed in the following order: unmodified tooth, conservative MO cavity preparation, extensive MO preparation, MO preparation with endodontic access, and MOD preparation with endodontic access. They found that cuspal deflection increased statistically significantly after MOD cavity preparation with endodontic access and concluded that progressive removal of dental tissue increased cuspal deflection [64].

As a result, it is critical to keep the tooth structure intact wherever possible during the preparation of the access cavity. Further studies are needed to discover whether minimal invasive access cavities will decrease the cuspal deflection or if there will be no difference between traditional and minimally invasive access cavity designs.

Conclusion

Various acronyms suggested to describe the new minimally invasive access cavity preparation have seriously undermined the articles' comprehension and readability, and new nomenclature is suggested based on self-explanatory abbreviations. According to the collected scientific data, there is a deficiency of solid proof to back up the consideration that a minimally invasive access cavity preserves the resistance to fracture of endodontically treated teeth greater than a traditional access cavity. The studies about minimally invasive access cavities still have a wide range of methodological disadvantages or have registered unsatisfactory or inconclusive results. In addition, the truss access cavity and ultra-conservative access cavity are more conservative types of access cavity that badly influence the irrigation process and canal transportation and, especially in necrotic teeth, aren't recommended.

In considering that more additional research is needed to give comprehensive and conclusive evidence about all these topics, it may be considered that there is a lack of proof for supporting and introducing the concept of minimally invasive access cavity preparation in daily clinical practice and also for training the students and post-graduates. Although the necessity of conserving tooth structure is self-evident, the entire shift to minimally invasive access cavities has yet to be confirmed. Minimally invasive access cavities are yet to be adequately proven by data from research, and they will not be able to take the place of typical straight-line access designs. Before clinical trials can be planned, more in-vitro investigations must be completed. Furthermore, before these new methods are generally adopted, randomized controlled trials, as well as retrospective and prospective investigations, must be performed.

Conflict of interest: None.

Refferences

1. Yahata Y, Masuda Y, Komabayashi T. Comparison of apical centring ability between incisal-shifted access and traditional lingual access for maxillary anterior teeth. Aust Endod J. 2017;43(3):123-128. (Crossref)

2. Siqueira Jr JF, Rôças IN. Clinical implications and microbiology of bacterial persistence after treatment procedures. J Endod. 2008;34(11):1291-1301. e1293. (Crossref)

3. Saygili G, Uysal B, Omar B, Ertas ET, Ertas H. Evaluation of relationship between endodontic access cavity types and secondary mesiobuccal canal detection. BMC Oral Health. 2018;18(1):1-6. (Crossref)

4. Alovisi M, Pasqualini D, Musso E, Bobbio E, Giuliano C, Mancino D, et al. Influence of contracted endodontic access on root canal geometry: an in vitro study. J Endod. 2018;44(4):614-620. (Crossref)

5. Clark D, Khademi J. Modern molar endodontic access and directed dentin conservation. Dent Clinics. 2010;54(2):249-273. (Crossref)

6. Gambarini G, Krastl G, Chaniotis A, ElAyouti A, Franco V. Clinical challenges and current trends in access cavity design and working length determination: First European Society of Endodontology (ESE) clinical meeting: ACTA, Amsterdam, The Netherlands, 27th October 2018. p. 397-399. (Crossref)

7. Plotino G, Grande NM, Isufi A, Ioppolo P, Pedullà E, Bedini R, et al. Fracture strength of endodontically treated teeth with different access cavity designs. J Endod. 2017;43(6):995-1000. (Crossref)

8. Augusto C, Barbosa A, Guimarães C, Lima C, Ferreira C, Sassone L, et al. A laboratory study of the impact of ultraconservative access cavities and minimal root canal tapers on the ability to shape canals in extracted mandibular molars and their fracture resistance. Int Endod J. 2020;53(11):1516-1529. (Crossref)

9. Silva A, Belladonna F, Rover G, Lopes R, Moreira E, De-Deus G, et al. Does ultraconservative access affect the efficacy of root canal treatment and the fracture resistance of two-rooted maxillary premolars? Int Endod J. 2020;53(2):265-275. (Crossref)

10. Shihab D, Mahdee A. Root and Root Canal Morphology : Study Methods and Classification. J Baghdad Coll Dent. 2021.;33 (4):11-19. (Crossref)

11. Silva E, Pinto K, Ferreira C, Belladonna F, De-Deus G, Dummer P, et al. Current status on minimal access cavity preparations: a critical analysis and a proposal for a universal nomenclature. Int Endod J. 2020;53(12):1618-1635. (Crossref)

12. Tsotsis P, Dunlap C, Scott R, Arias A, Peters OA. A survey of current trends in root canal treatment: Access cavity design and cleaning and shaping practices. Aust Endod J. 2021;47(1):27-33. (Crossref)

13. Chan MYC, Cheung V, Lee AHC, Zhang C. A Literature Review of Minimally Invasive Endodontic Access Cavities-Past, Present and Future. Eur Endod J. 2022 Mar 1;7:1-0. (Crossref)

14. Patel S, Rhodes J. A practical guide to endodontic access cavity preparation in molar teeth. Br Dent J. 2007;203(3):133-140. (Crossref)

15. Corsentino G, Pedullà E, Castelli L, Liguori M, Spicciarelli V, Martignoni M, et al. Influence of access cavity preparation and remaining tooth substance on fracture strength of endodontically treated teeth. J Endod. 2018;44(9):1416-1421. (Crossref)

16. Levin H. Access cavities. Dent Clin N Am. 1967:701-710. (Crossref)

17. Roperto R, Sousa YT, Dias T, Machado R, Perreira RD, Leoni GB, et al. Biomechanical behavior of maxillary premolars with conservative and traditional endodontic cavities. Quintessence Int. 2019;50(5):350-356. (Crossref)

18. Vieira GC, Pérez AR, Alves FR, Provenzano JC, Mdala I, Siqueira Jr JF, et al. Impact of contracted endodontic cavities on root canal disinfection and shaping. J Endod. 2020;46(5):655-661. (Crossref)

19. Neelakantan P, Khan K, Ng GPH, Yip CY, Zhang C, Cheung GSP. Does the orifice-directed dentin conservation access design debride pulp chamber and mesial root canal systems of mandibular molars similar to a traditional access design? J Endod. 2018;44(2):274-279. (Crossref)

20. Clark D, Khademi J, Herbranson E. The new science of strong endo teeth. Dent today. 2013;32(4):112-117. (Crossref)

21. Eaton JA, Clement DJ, Lloyd A, Marchesan MA. Micro–computed tomographic evaluation of the influence of root canal system landmarks on access outline forms and canal curvatures in mandibular molars. J Endod. 2015;41(11):1888-1891. (Crossref)

22. Gambarini G, Galli M, Morese A, Stefanelli LV, Abduljabbar F, Giovarruscio M, et al. Precision of dynamic navigation to perform endodontic ultraconservative access cavities: a preliminary in vitro analysis. J Endod. 2020;46(9):1286-1290. (Crossref)

23. Kishen A. Mechanisms and risk factors for fracture predilection in endodontically treated teeth. Endod topics. 2006;13(1):57-83. (Crossref)

24. Dastjerdi MR, Chaijan KA, Tavanafar S. Fracture resistance of upper central incisors restored with different posts and cores. Restor Dent Endod. 2015;40(3):229-235. (Crossref)

25. Ikram O, Patel S, Sauro S, Mannocci F. Micro-computed tomography of tooth tissue volume changes following endodontic procedures and post space preparation. Int Endod J. 2009;42(12):1071-1076. (Crossref)

26. Lin F, Ordinola-Zapata R, Fok AS, Lee R. Influence of minimally invasive endodontic access cavities and bonding status of resin composites on the mechanical property of endodontically-treated teeth: A finite element study. Dent Mater. 2022;38(2):242-250. (Crossref)

27. Krishan R, Paqué F, Ossareh A, Kishen A, Dao T, Friedman S. Impacts of conservative endodontic cavity on root canal instrumentation efficacy and resistance to fracture assessed in incisors, premolars, and molars. J Endod. 2014;40(8):1160-1166. (Crossref)

28. Moore B, Verdelis K, Kishen A, Dao T, Friedman S. Impacts of contracted endodontic cavities on instrumentation efficacy and biomechanical responses in maxillary molars. J Endod. 2016;42(12):1779-1783. (Crossref)

29. Chlup Z, Žižka R, Kania J, Přibyl M. Fracture behaviour of teeth with conventional and mini-invasive access cavity designs. J Eur Ceram Soc. 2017;37(14):4423-4429. (Crossref)

30. De-Deus G, Silva EJNL, Vieira VTL, Belladonna FG, Elias CN, Plotino G, et al. Blue thermomechanical treatment optimizes fatigue resistance and flexibility of the Reciproc files. J Endod. 2017;43(3):462-466. (Crossref)

31. Arola D, Reprogel R. Effects of aging on the mechanical behavior of human dentin. Biomaterials. 2005;26(18):4051-4061. (Crossref)

32. A. Versiani M, Souza E, De-Deus G. Critical appraisal of studies on dentinal radicular microcracks in endodontics: methodological issues, contemporary concepts, and future perspectives. Endod Topics. 2015;33(1):87-156. (Crossref)

33. Maske A, Weschenfelder VM, Soares Grecca Vilella F, Burnett Junior LH, de Melo TAF. Influence of access cavity design on fracture strength of endodontically treated lower molars. Aust Endod J. 2021;47(1):5-10. (Crossref)

34. Saberi EA, Pirhaji A, Zabetiyan F. Effects of endodontic access cavity design and thermocycling on fracture strength of endodontically treated teeth. Clin Cosmet Investig Dent. 2020;12:149. (Crossref)

35. Saeed M, Al-Obadi M, Salim A, Alsawaf AY, Hadi K. Impact of Access Cavity Design on Fracture Resistance of Endodontically Treated Molars: A Systematic Review. Clin Cosmet Investig Dent. 2021;13:1. (Crossref)

36. Bóveda C, Kishen A. Contracted endodontic cavities: the foundation for less invasive alternatives in the management of apical periodontitis. Endod Topics. 2015;33(1):169-186. (Crossref)

37. Rover G, Belladonna FG, Bortoluzzi EA, De-Deus G, Silva EJNL, Teixeira CS. Influence of access cavity design on root canal detection, instrumentation efficacy, and fracture resistance assessed in maxillary molars. J Endod . 2017;43(10):1657-1662. (Crossref)

38. Barbosa A, Silva E, Coelho B, Ferreira C, Lima C, Sassone L. The influence of endodontic access cavity design on the efficacy of canal instrumentation, microbial reduction, root canal filling and fracture resistance in mandibular molars. Int Endod J. 2020;53(12):1666-1679. (Crossref)

39. Xia J, Wang W, Li Z, Lin B, Zhang Q, Jiang Q, et al. Impacts of contracted endodontic cavities compared to traditional endodontic cavities in premolars. BMC oral health. 2020;20(1):1-8. (Crossref)

40. Peng W, Zhou X, Gao Y, Xu X. Effect of access cavity preparation on dentin preservation, biomechanical property and instrumentation efficacy: a Micro-CT study. . J Endod . 2022. (Crossref)

41. Gluskin AH, Peters CI, Peters OA. Minimally invasive endodontics: challenging prevailing paradigms. Br Dent J. 2014;216(6):347-353. (Crossref)

42. Niemi TK, Marchesan MA, Lloyd A, Seltzer RJ. Effect of instrument design and access outlines on the removal of root canal obturation materials in oval-shaped canals. . J Endod . 2016;42(10):1550-1554. (Crossref)

43. Rover G, de Lima C, Belladonna F, Garcia L, Bortoluzzi E, Silva E, et al. Influence of minimally invasive endodontic access cavities on root canal shaping and filling ability, pulp chamber cleaning and fracture resistance of extracted human mandibular incisors. Int Endod J. 2020;53(11):1530-1539. (Crossref)

44. Dammaschke T, Nykiel K, Sagheri D, Schäfer E. Influence of coronal restorations on the fracture resistance of root canal-treated premolar and molar teeth: A retrospective study. Aust Endod J. 2013;39(2):48-56. (Crossref)

45. van Dijken JW, Pallesen U. A randomized controlled three year evaluation of "bulk-filled" posterior resin restorations based on stress decreasing resin technology. Dent Mater. 2014;30(9):e245-e251. (Crossref)

46. Silva E, Oliveira V, Silva A, Belladonna F, Prado M, Antunes H, et al. Effect of access cavity design on gaps and void formation in resin composite restorations following root canal treatment on extracted teeth. Int Endod J. 2020;53(11):1540-1548. (Crossref)

47. Boscatto RH, Prado M, Silva EJNL, de Lima CO, de-Jesus-Soares A, Frozoni M. Influence of the endodontic access cavity design and restorative technique on hard tissue removal and fracture resistance of mandibular premolars. Res Soc Dev. 2022;11(1). (Crossref)

48. Bosenbecker J, Barbon FJ, de Souza Ferreira N, Morgental RD, Boscato N. Tooth discoloration caused by endodontic treatment: A cross-sectional study. J Esthet Restor Dent. 2020;32(6):569-574. (Crossref)

49. Lenherr P, Allgayer N, Weiger R, Filippi A, Attin T, Krastl G. Tooth discoloration induced by endodontic materials: a laboratory study. Int Endod J. 2012;45(10):942-949. (Crossref)

50. Marchesan MA, James CM, Lloyd A, Morrow BR, García-Godoy F. Effect of access design on intracoronal bleaching of endodontically treated teeth: an ex vivo study. J Esthet Restor Dent . 2018;30(2):E61-E67. (Crossref)

51. Peters OA, Barbakow F. Dynamic torque and apical forces of ProFile. 04 rotary instruments during preparation of curved canals. Int Endod J. 2002;35(4):379-389. (Crossref)

52. Walia H, Brantley WA, Gerstein H. An initial investigation of the bending and torsional properties of Nitinol root canal files. J Endod. 1988;14(7):346-351. (Crossref)

53. Parashos P, Messer HH. Rotary NiTi instrument fracture and its consequences. J Endod. 2006;32(11):1031-1043. (Crossref)

54. Bahcall JK, Carp S, Miner M, Skidmore L. The causes, prevention, and clinical management of broken endodontic rotary files. Dent Today. 2005;24(11):74, 76, 78-80; quiz 80. (Crossref)

55. Pedullà E, La Rosa GRM, Boninelli S, Rinaldi OG, Rapisarda E, Kim H-C. Influence of different angles of file access on cyclic fatigue resistance of Reciproc and Reciproc Blue instruments. . J Endod. 2018;44(12):1849-1855. (Crossref)

56. Pedullà E, La Rosa GRM, Virgillito C, Rapisarda E, Kim H-C, Generali L. Cyclic fatigue resistance of nickel-titanium rotary instruments according to the angle of file access and radius of root canal. . J Endod. 2020;46(3):431-436. (Crossref)

57. Silva EJNL, Attademo RS, da Silva MCD, Pinto KP, Antunes HdS, Vieira VTL. Does the type of endodontic access influence in the cyclic fatigue resistance of reciprocating instruments? Clin Oral Investig. 2021;25(6):3691-3698. (Crossref)

58. Spicciarelli V, Marruganti C, Marzocco D, Martignoni M, Ounsi H, Grandini S. Influence of Endodontic Access Cavity Design on Fracture Strength of Maxillary Incisors and Premolars and on Fatigue Resistance of Reciprocating Instruments. Front Dent Med. 2020:11. (Crossref)

59. Corsentino G. Influence of Access Cavity Design on Fatigue Resistance of Reciproc Blue: Conservative vs. Truss Access. Int J Oral Dent Health. 2021;7:125. (Crossref)

60. Reeh ES, Messer HH, Douglas WH. Reduction in tooth stiffness as a result of endodontic and restorative procedures. . J Endod. 1989;15(11):512-516. (Crossref)

61. Tantbirojn D, Versluis A, Pintado MR, DeLong R, Douglas WH. Tooth deformation patterns in molars after composite restoration. Dent Mater. 2004;20(6):535-542. (Crossref)

62. Palin WM, Fleming GJ, Nathwani H, Burke FT, Randall RC. In vitro cuspal deflection and microleakage of maxillary premolars restored with novel low-shrink dental composites. Dent Mater. 2005;21(4):324-335. (Crossref)

63. Taha NA, Palamara JE, Messer HH. Cuspal deflection, strain and microleakage of endodontically treated premolar teeth restored with direct resin composites. J Dent. 2009;37(9):724-730. (Crossref)

64. González-López S, De Haro-Gasquet F, Vílchez-Díaz M, Ceballos L, Bravo M. Effect of restorative procedures and occlusal loading on cuspal deflection. Oper Dent. 2006;31(1):33-38. (Crossref)

العنوان: تجاويف الوصول طفيفة التوغل في علاج جذور الأسنان

الباحثون: لبنى عبد الوهاب عبد الرزاق ، أحمد حامد علي , Federico Foschi

المستخلص:

الخلفية: يعتبر تجويف المدخل مرحلة حرجة في علاج قناة الجذر وقد يؤثر على الخطوات اللاحقة للعلاج. يهدف المفهوم الجديد لتحضير تجويف اللبية طفيف التوغل إلى الحفاظ على بنية الأسنان السليمة من خلال الحفاظ على عاج الأسنان السليم قدر الإمكان بما في ذلك سقف حجرة اللب ، للحفاظ على الأسنان من الكسر أثناء وبعد المعالجة اللبية. في حين أن هناك اهتمامًا كبيرًا بمثل هذه التصاميم الافتتاحية للقبول في العديد من المنشورات ، لا يزال هناك نقص في الأدلة العلمية لدعم تطبيق تصاميم تجويف الوصول الحديثة في الممارسة السريرية. تهدف إعادة العرض هذه إلى فحص الأدبيات الخاصة بالحد الأدنى من تحضيرات تجويف الوصول بشكل نقدي ، وإبراز تأثير تصميمات تجويف الوصول طفيفة التوغل على جوانب مختلفة من معالجة قناة الجذر ، وتحديد المجالات التي تتطلب بحثًا إضافيًا.

البيانات: تم إجراء بحث إلكتروني عن مقالات باللغة الإنجليزية باستخدام قواعد البيانات التالية Google Scholar :و PubMed و .Research Gate تم استخدام الكلمات الرئيسية التالية: "تجويف الوصول الأقل بضعاً" ، "تجويف اللبية المحافظ" ، و "تصنيف تجويف الوصول."

اختيار الدراسة: تم اختيار 64 ورقة بحثية كانت الأكثر صلة بالموضوعات في هذه المراجعة بين عامي 1969 و 26 فبراير 2022.

الاستنتاجات: يمكن تصنيف تجاويف الوصول طفيفة التوغل إلى تجاويف محافظة ، شديدة التحفظ ، وصول تروس ، تسوس ، تجاويف مدفوعة تصالحية. هناك نقص في الدليل على أن تجويف الوصول طفيف التوغل يحافظ على مقاومة الكسر في الأسنان المعالجة بشكل أسنان أكبر من تجاويف الوصول التقليدية. لم يكن هناك فرق في النسبة المئوية للجدران التي لم تمسها وإزالة الحطام في الأسنان ذات التجاويف المحافظة مقابل التجاويف التقليدية ، ومع ذلك ، نتج عن تجاويف تروس وتجاويف الوصول شديدة التحفظ ضعف كفاءة الري مقارنة بالآليات التقليدية. أيضًا ، ارتبطت مقاومة الإجهاد الدوري السفلية للأدوات الدوارة وسد قناة الجذر بالفراغات بتجاويف وصول طفيفة التوغل. لا تزال الدراسات حول تجاويف الوصول طفيفة التوغل تحتوي على مجموعة واسعة من العيوب المنهجية أو تسجل نتائج غير مرضية أو غير قاطعة. لذلك ، هناك حاجة إلى مزيد من البحث حول هذا الموضوع خاصة مع التقدم اليومي للتقنيات والأسلحة المستخدمة في علاج جذور الأسنان.