Restor Dent Endod. 2021 Aug;46(3):e46
https://doi.org/10.5395/rde.2021.46.e46
pISSN 2234-7658·eISSN 2234-7666

Restorative Dentistry & Endodontics

Review Article

Check for updates

Traditional and minimally invasive access cavities in endodontics: a literature review

Ioanna Kapetanaki ,[*] **Fotis Dimopoulos** , **Christos Gogos**

Department of Endodontology, School of Dentistry, Aristotle University of Thessaloniki, Thessaloniki, Greece

OPEN ACCESS

Received: Aug 6, 2020
Revised: Mar 25, 2021
Accepted: Mar 25, 2021

Kapetanaki I, Dimopoulos F, Gogos C

***Correspondence to**
Ioanna Kapetanaki, DDS
Dentist, Department of Endodontology, School of Dentistry, Aristotle University of Thessaloniki, Aristotelous 48, Euosmos, 56224 Thessaloniki, Greece.
E-mail: iwannakapetanaki@gmail.com

Conflict of Interest
No potential conflict of interest relevant to this article was reported.

Author Contributions
Conceptualization: Kapetanaki I, Dimopoulos F; Data curation: Kapetanaki I, Dimopoulos F; Formal analysis: Kapetanaki I, Dimopoulos F; Investigation: Kapetanaki I, Dimopoulos F; Methodology: Kapetanaki I, Dimopoulos F, Gogos C; Supervision: Gogos C; Validation: Kapetanaki I, Dimopoulos F, Gogos C; Writing - original draft: Kapetanaki I, Dimopoulos F; Writing - review & editing: Kapetanaki I, Dimopoulos F.

ABSTRACT

The aim of this review was to evaluate the effects of different access cavity designs on endodontic treatment and tooth prognosis. Two independent reviewers conducted an unrestricted search of the relevant literature contained in the following electronic databases: PubMed, Science Direct, Scopus, Web of Science, and OpenGrey. The electronic search was supplemented by a manual search during the same time period. The reference lists of the articles that advanced to second-round screening were hand-searched to identify additional potential articles. Experts were also contacted in an effort to learn about possible unpublished or ongoing studies. The benefits of minimally invasive access (MIA) cavities are not yet fully supported by research data. There is no evidence that this approach can replace the traditional approach of straight-line access cavities. Guided endodontics is a new method for teeth with pulp canal calcification and apical infection, but there have been no cost-benefit investigations or time studies to verify these personal opinions. Although the purpose of MIA cavities is to reflect clinicians' interest in retaining a greater amount of the dental substance, traditional cavities are the safer method for effective instrument operation and the prevention of iatrogenic complications.

Keywords: Conservative endodontic cavity; Endodontic cavity; Fracture resistance; Guided endodontics; Traditional endodontic cavity

INTRODUCTION

One of the most important steps of successful endodontic treatment is to prepare access to the pulp chamber and the root canal system [1]. Furthermore, an appropriate access cavity enables procedures such as localization, measurement, chemo-mechanical preparation, and obturation [2]. Insufficient cavity preparation might hinder the handling of the root canals. It could also lead to instrument fracture, aberration of the original root canal anatomy [3], and other iatrogenic problems. In such cases, the infection perseveres and the treatment fails [2].

The traditional endodontic cavity (TEC) approach has long remained the same, with only a few adjustments [1]. More often than not, the pulp chamber anatomy of the tooth to be treated marks the shape of the access cavity [2]. To be able to locate all orifices of the

ORCID iDs
Ioanna Kapetanaki
https://orcid.org/0000-0003-0413-5781
Fotis Dimopoulos
https://orcid.org/0000-0002-9724-5703
Christos Gogos
https://orcid.org/0000-0003-2790-4264

root canals and ensure direct access to the apical foramen, removal of the roof of the pulp chamber and cervical dentin protrusions and widening of the canal orifice are imperative [3]. In addition, modification of the shape of the access cavity may be required to enable direct access for endodontic files into the coronal third of the root canal. Iatrogenic problems can be prevented by straight-line access, which also allows the unimpeded insertion of rotary nickel–titanium instruments. However, despite the flexibility of these instruments, there is still a chance that they may be distorted and finally separated because of cyclic fatigue if the straight-line access is inadequate [3]. This access cavity type focuses on a conservative shape of the access cavity, conserving more tooth tissue and avoiding iatrogenic errors [4,5].

However, certain authors have argued that this type of cavity damages a large amount of dentin, which weakens the structure of the tooth and reduces fracture resistance [2]. Silva *et al.* [2], in their systematic review, mentioned studies according to which insufficient restoration of the dental structure of the endodontically treated teeth leads to extraction. Therefore, to improve the prognosis of endodontically treated teeth, it is essential that healthy dental substance be preserved [6].

An alternative approach to TEC, minimally invasive access (MIA) cavities have recently been proposed. These cavity types focus on retaining dental substance [7]. In conservative endodontic cavities (CECs), a type of MIA cavities, there is an emphasis on preserving an adequate part of the pulp chamber roof and pericervical dentin [8]. Furthermore, the truss cavity obtains direct access from the occlusal surface to reveal the mesial and distal canal orifices, and the intervening dentin remains intact [9]. From an ultra-conservative point of view, point endodontic cavities and ninja endodontic cavities (NECs) have been suggested. These access cavities are opened by removing the minimum amount of substance necessary to approach root canals [6]. Some authors have reported that this radical approach led to considerable improvements in tooth resistance to fracture and decreased the need for complex, more expensive prosthodontic restorations [1,9].

In recent years, guided endodontics emerged as a novel method for the treatment of calcified teeth and periapical pathosis. Seeking obliterated root canals is quite interesting and challenging [10]. Accessing and treating root canals in which the pulp chamber has been eliminated can often be difficult and time-consuming [11]. These challenges explain the frequent failure to provide success and an adequate prognosis [10]. In the above-described process of preparing root canals, there may be complications like the formation of an overextended access cavity and incorrect alignment of the access cavity, potentially leading to root perforation and fracture of files [12]. Non-invasive access cavity preparation have been developed to analyze the anatomy of the root canal in 3 dimensions. These imaging modalities can be a useful tool for clinicians to evaluate and treat teeth with calcification [13].

The use of special software, combined with cone-beam computed tomography (CBCT) and a surface scan, permits the virtual planning of an ideal access cavity. A 3-dimensional printer is used to produce a template that guides a minimally invasive drill to the calcified root canal. According to the guidelines of the European Society of Endodontology, a CBCT scan with a limited field of view and high resolution can be performed to clarify teeth apical pathosis or pulp canal calcification and provide a detailed view of the complex teeth anatomy [14]. The purpose of this review was to evaluate the effects of different access cavity preparations on endodontic treatment and tooth prognosis.

MATERIALS AND METHODS

Two independent reviewers performed searches without restrictions in the electronic databases PubMed, Science Direct, Scopus, Web of Science, and OpenGrey in the year 2020. Detailed individual search strategies for each database were carried out using the following Medical Subject Heading terms (MeSH) or text words (tw) and their combinations: 'endodontic cavity' (tw), 'traditional endodontic cavity' (tw), 'conservative endodontic cavity' (tw), 'minimally invasive endodontics' (tw), 'stress fracture' (MeSH), 'fatigue' (MeSH), 'strength to fracture' (tw), 'resistance to fracture' (tw), 'fracture strength' (tw) 'fracture resistance' (tw), 'guided endodontics' (tw) and 'ninja access cavity' (tw). After the electronic search, a supplementary manual search was conducted of the issues from the same time period of the following journals: *Journal of Endodontics*, *International Endodontic Journal*, and *Australian Endodontic Journal*. The reference lists of articles that advanced to the second-round screening were hand-searched to identify additional potential articles.

RESULTS

The majority of the included studies evaluated the influence of more contracted access cavity preparation according to a recent data survey. The studies analyzed different teeth categories, and the sample sizes presented discrepancies. Moreover, it was observed that there were differences in the methodological protocols of the *in vitro* studies. The total number of studies was 22. There were 3 researches [3,8,15], 4 case reports [4,10,13,22], 1 systematic review [2], 2 observational study [11,12] and 12 *in vitro* studies [1,5-7,9,16-21,23]. The parameter of fracture resistance in teeth with different access cavity designs was evaluated in 9 of the studies [1,5,7,9,16-20]. Other parameters that were analyzed included the instrumentation efficacy and the chemo-mechanical preparation [5,19-21], as well as the effectiveness of root canal detection [5-7]. Five of the included studies dealt with guided endodontic access cavities [10,11,13,22,23], 11 compared minimal and traditional endodontic cavities [1,2,4-6,9,17-21], 2 analyzed the new theories of contracted access cavities [8,15] and 1 dealt with the traditional approach [3].

DISCUSSION

The exploration and identification of pulp chamber and root canal anatomy have attracted keen interest among researchers and are of considerable importance for the outcomes of endodontic treatment [15]. Furthermore, according to the European Society of Endodontology, treatment and prevention of apical periodontitis remain the most important goals of root canal treatment and can be accomplished by cleaning and shaping root canals to eliminate microbes. The first invasive step includes preparing a cavity to gain access to the root canals [11]. Chemo-mechanical preparation and finally root obturation should then be done. Concurrently, adequate dental structure should be left for tooth functionality and fracture resistance [15], which are crucial for the outcomes, stability, and longevity of the tooth [11]. Straight-line access to the orifices of the root canals is recommended to facilitate disinfection and complete debridement [11]. However, it has been suggested that the long-term subsistence of endodontically treated teeth depends on retaining as much of the dental structure as possible (**Table 1**) [9].

Table 1. Summary of the descriptive characteristics of the included studies

Article	Research type	Methodology	Results
Plotino *et al*. [1]	*Ex vivo*	- Extracted, intact human teeth - Preparation of TEC, CEC, or NEC - Load to fracture in a mechanical material testing machine (maximum load at fracture and fracture pattern)	- CEC and NEC access showed a reduction of the fracture risk of endodontically treated teeth. - Teeth with these accesses revealed similar fracture strength, which was higher than that of teeth with traditional endodontic access.
Silva *et al*. [2]	Systematic review	- A literature search without restrictions was conducted by two independent reviewers. The evaluation of the selected studies' quality was classified as a low, moderate, or high risk of bias	- There was no scientific evidence suggesting the use of CECs over TECs to increase fracture resistance in human teeth.
Patel and Rhodes [3]	Bibliographic review	- A review of the current literature on the applications and limitations of CBCT in the management of endodontic problems	- CBCT prevailed most of the limitations of intra-oral radiography. - CBCT enabled more precise diagnoses and better decision making for the management of complex endodontic problems.
Auswin and Ramesh [4]	Case report	- 27-year-old female patient - First molar - Truss access cavity (use of an Endo access bur parallel to the long tooth axis to gain access to the roof of pulp chamber from the occlusal surface)	- The truss access approach emphasized the maintenance of the healthy dental tissue with the minimally invasive approach. - No need for conventionally placed crowns.
Rover *et al*. [5]	*Ex vivo*	- 30 extracted intact maxillary first molars - Specimen were scanned with micro-computed tomography, assigned to the CEC or TEC group, and accessed accordingly - Root canal preparation - The specimens were scanned again - Root canal filling and cavity restoration - Fracture resistance test	- No additional benefits were associated with CECs, with no increase in fracture resistance.
Saygili *et al*. [6]	*Ex vivo*	- 60 roots of extracted human maxillary first molars - Point EAC, conservative EAC and traditional EAC access cavities - Calculation of preoperative and postoperative tooth weight using a precise scale	- CEAC seems reasonable in terms of detecting secondary mesiobuccal canals in upper molars and removing hard tissue.
Moezizadeh and Mokhtari [7]	*Ex vivo*	- 84 human premolars - Group 1 (control): intact teeth - Group 2: endodontically treated teeth, restored with direct onlays using Z250 composite resin - Groups 3 and 4: similar to group 2, but subjected to 1 and 2 million fatigue load cycles, respectively - Groups 5, 6, and 7 were similar to groups 2, 3, and 4, but in these groups Tetric Ceram was used as the restorative material - Fracture resistance test by a universal testing machine	- There were no statistically significant differences in fracture strength showed between sound teeth and composite onlays that were subjected to 1 and 2 million fatigue load cycles.
Clark *et al*. [8]	Case series	- 6 cases were presented in the article - Every case was evaluated on the endo-restorative principles that form the basis of the modern endo-endo-restorative–prosthodontic continuum. Endo-restorative needs should, whenever possible, trump previous notions of endodontic needs	- Introduction of criteria that guide the clinician in treatment decisions to maintain optimal functionality of the tooth and lead to better decisions on the treatment prognosis.
Abou-Elnaga *et al*. [9]	*Ex vivo*	- Mandibular first molars - 4 access cavities (4 groups): traditional access cavity, artificial truss restoration, truss access cavity, and control groups - Instrumentation, irrigation, and obturation of the root canals - Permanent restoration with composite resin - Fracture resistance test (vertical occlusal force)	- Improved fracture resistance of teeth with the truss access cavity (mesio-occluso-distal cavities). - No better results with artificial truss restoration.
Connert *et al*. [10]	Case report	- Mandibular central incisors - Positive percussion and yellowish discoloration - Radiographs revealed severe pulp canal calcifications and signs of periapical periodontitis - Microguided endodontics method using CBCT and an intra-oral surface scan with special software	- The preparation of calcified root canals was feasible with the presented microguided endodontics technique using miniaturized instruments.
Buchgreitz *et al*. [11]	Observation study	- Inclusion criteria: (i) pulp space obliteration associated with signs of apical periodontitis (PAI score > 3 or sensitive to percussion, (ii) teeth with pulp space calcification in need of a post, and (iii) a surgical intervention was not justified	- Guided root canal treatment was associated with a precision that in all cases led to the location and negotiation of the root canal and completion of the treatment.
Andreasen *et al*. [12]	Observation study	- 637 concussed, subluxated, extruded, laterally luxated, and intruded permanent incisors - Estimation of factors influencing the development of PCO after injury.	- PCO is a sequela of revascularization and/or reinnervation of a damaged pulp after injury.

(continued to the next page)

Table 1. (Continued) Summary of the descriptive characteristics of the included studies

Article	Research type	Methodology	Results
Torres *et al*. [13]	Case report	- Maxillary central incisor with - No complaints, no percussion pain or sinus tract - Radiographs revealed obliterated root canal with an apical radiolucency - Diagnosis of asymptomatic apical periodontitis - Microguided endodontic treatment was performed with the help of a 3D-printed guide	- The microguided endodontic technique was a valuable tool for the management of pulp canal calcification, reducing work time and the risk of iatrogenic error.
Gluskin *et al*. [15]	Review	- This review addressed current clinical and laboratory data to provide an overview of this new endodontic paradigm.	- An alternative approach is to minimize structural changes during root canal therapy, which may result in a new strategy that can be labeled "minimally invasive endodontics."
Tan *et al*. [16]	*In vitro*	- Extracted intact maxillary human central incisors - Five groups with different dentin margins - Fracture resistance test using a universal testing machine with the application of a static load that was recorded at failure	- Central incisors restored with cast dowel/core and crowns with a 2-mm uniform ferrule were revealed to be more fracture-resistant than central incisors with nonuniform ferrule heights. - Both the 2-mm ferrule and nonuniform ferrule groups were more fracture-resistant than the group that lacked a ferrule.
Allen *et al*. [17]	*Ex vivo*	- Extracted mandibular first molar - Group A: control group, group B: MIA cavity, group C: TEC cavity - Permanent restoration with composite access fillings with or without a simulated gold crown - Application of an occlusal load of 100 N	- TEC cavities may render teeth more susceptible to fracture than MIA cavity designs.
Jiang *et al*. [18]	*In vitro*	- Maxillary first molar - Three different types of endodontic cavities: CEC, TEC, EEC - Each sample was subjected to 3 different force loads directed at the occlusal surface.	- CEC, TEC, and EEC showed similar peak stress values on the occlusal surface. - The CEC model, which preserved a higher amount of coronal hard tissue, preserved better fracture resistance. - The stresses were more concentrated in the cervical region of all models, as the volume of the cavity increased. As a result, the CEC could reduce stress distribution on the cervical structure.
Krishan *et al*. [19]	*Ex vivo*	- Extracted maxillary incisors, mandibular premolars and molars - The specimens were imaged with micro-CT and assigned to CEC or TEC groups - Minimal CECs were plotted on scanned images	- CEC was associated with a risk of compromised canal instrumentation in the distal canals of molars. - However, CEC showed conservation of coronal dentin in the 3 tooth types and increased resistance to fracture in the mandibular molars and premolars.
Moore *et al*. [20]	*Ex vivo*	- Extracted, non-carious, mature, intact, maxillary molars - Micro-computed tomographic imaging was performed, and teeth were assigned to CEC or TEC groups and accessed accordingly - Canals were instrumented and reimaged, and the proportion of the modified canal wall was determined - All samples showed cyclic fatigue and were subsequently loaded to failure	- CECs showed no impact on instrumentation efficacy and biomechanical responses compared with TECs.
Eaton *et al*. [21]	*In vitro*	- Calcified human mandibular molars - All specimens were examined by micro–computed tomographic imaging - Three-dimensional volume reconstructions were made, root canal system landmarks were identified and plotted: canal orifices, canal position at the furcation level, and pulp horn location. Every landmark was separately projected onto the occlusal surface - Three access designs were used: (1) minimally invasive, (2) straight-line furcation, and (3) straight-line radicular	- The use of varying landmarks to establish access outline designs affected the primary angle of curvature in relatively calcified teeth.
Krastl *et al*. [22]	Case report	- Upper right central incisor - Signs of apical periodontitis - Calcification and location of the root canal were associated with a high risk of root perforation - CBCT and an intra-oral surface scan were performed and matched using software for virtual implant planning - A virtual template was designed, and the data were exported as an STL file and sent to a 3D printer for template fabrication	- The guided endodontic method was a safe, clinically feasible procedure to locate root canals and prevent root perforation in teeth with PCC.
Zehnder *et al*. [23]	*Ex vivo*	- Extracted human teeth were located in 6 maxillary jaw models - Preoperative CBCT scans were matched with intra-oral scans - Access cavities and templates for guidance were virtually planned and finally produced by a 3D printer	- The guided endodontic model permitted precise access cavity preparation up to the apical third of the root using guiding printed templates. All root canals were accessible after preparation.

TEC, traditional endodontic cavity; CEC, conservative endodontic cavity; NEC, ninja endodontic cavity; CBCT, cone-beam computed tomography; EAC, endodontic access cavity; PAI, periapical index; PCO, pulp canal obliteration; MIA, minimally invasive access; EEC, extended endodontic cavity; PCC, pulp canal calcification.

For a traditional cavity, straight-line access to the root canal is recommended, with the goal of effective instrument operation and the prevention of iatrogenic complications. Notwithstanding, further removal of the coronal dental substance of the pulp chamber, along the chamber walls and around the canal orifices, weakens the architecture of the teeth. The removal of a large amount of dental tissue from the strategically important internal structure of the tooth poses a risk to its integrity and increases the probability of fracture [8]. Tan *et al.* [16] found that the ferrule dimensions affected the fracture resistance of endodontically treated teeth. To avoid these complications, contracted access cavity designs have recently been suggested [16].

The purpose of MIA cavities is to reflect researchers' interest in retaining a greater amount of the dental substance [17]. According to some authors, the modification of traditional endodontic therapy with accurate access cavities, which protect the structure of the crucial dentin, may benefit the functional integrity, fracture resistance, and overall prognosis of teeth [18]. It has been argued that this approach may prevent the contingency of crown construction for endodontically treated teeth, as the restoration type depends on the remaining dental tissue [4]. As a result, the importance of conserving pericervical dentin, which is located about 4 mm above and below the alveolar crest, has recently been articulated. To achieve longevity and functionality of teeth, this section of dentin needs to be protected and maintained [15]. Conservative endodontic cavities have been suggested as a way to achieve the above-mentioned goals. Moreover, it has been suggested that MIA cavities limit the need for complicated and expensive prosthodontic restorations, while improving fracture resistance [18]. However, this clinical scenario is limited to a small proportion of teeth intended for endodontic therapy on the condition that they must be intact [1].

The included studies showed variability in the fracture resistance values of endodontically treated teeth with different access cavities. The speculative advantage that CECs may have better fracture resistance than TECs was presented in 4 of the included studies [1,17-19]. Jiang *et al.* [18] compared the biomechanical properties of first maxillary molars with different endodontic cavities through finite element analysis. They concluded that CECs, which maintained a larger amount of coronal hard tissue, could reduce stress distribution on cervical structures and provide better fracture resistance. They also showed a dramatic stress increase on the pericervical dentin when the access cavity became larger [18]. Krishan *et al.* [19] also found that CECs for mandibular molars and premolars may improve fracture resistance. However, the fracture resistance of the teeth was tested without filling and restoration. In another study, Plotino *et al.* [1] reached a similar conclusion that TECs showed lower fracture strength than CECs and NECs in maxillary and mandibular premolars and molars. They also added that NECs do not differ from CECs in terms of fracture resistance. Furthermore, some authors have claimed that TECs are responsible for endodontic treatment failure [17]. However, those were *in vitro* studies that could not simulate all intraoral conditions. From a methodological aspect, the effect of occlusal forces which cause strain on the root walls have not been fully identified [1].

On the contrary, CECs in comparison with TECs did not improve fracture resistance according to other studies [2,20]. Rover *et al.* [5] and Moore *et al.* [20] evaluated the influence of CECs in maxillary molars and they showed no statistically significant differences between TECs and CECs in terms of fracture resistance. In accordance with those studies, Silva *et al.* [2] conducted a systematic review of *in vitro* studies evaluating the impact of CECs on fracture resistance and found no proof that supports the use of CECs over TECs. They concluded that the influence of access cavity design on fracture resistance remains a controversial issue. The

 https://doi.org/10.5395/rde.2021.46.e46

variability of the research methodology and the limited number of studies could account for the conflicting data in the literature.

An ideal endodontic access cavity should enable efficient chemo-mechanical preparation, instrumentation efficacy, and localization of the entirety of root canals, while minimizing procedural errors [3]. Biofilms can migrate into non-instrumented canals, with undesirable results [5]. Some authors have suggested that CECs endanger the treatment outcomes and long-term prognosis of endodontically treated teeth because some root canal orifices are missed and CECs have a negative effect on instrumentation efficacy; both of these factors may result in areas of greater microbial retention [2,5,19].

In a study published in 2016, Eaton *et al.* [21] concluded that CECs led to the maintenance of the original canal curvature, which represented a high level of difficulty, as assessed using the American Association of Endodontists case difficulty assessment form. In addition, they found that mesial lingual (ML) canals required greater excision of dental tissue than mesial buccal canals to ensure similar reductions in canal curvature when establishing a TEC access design [21]. Furthermore, Krishian *et al.* [19] found that CECs compromised the efficacy of canal instrumentation in the distal canals of mandibular first molars. On the contrary, according to Rover *et al.* [5] and Moore *et al.* [19], the endodontic access cavity design had no impact on the instrumentation efficacy.

In other studies, the risks of bacterial infection and omission of the root canal were found to be higher when the access cavity was reduced [1,2]. Rover *et al.* [5] found that CECs in maxillary molars resulted in less root canal detection with no use of ultrasonic or optical microscopes. In contrast, Saygili *et al.* [6] evaluated the correlation between endodontic access cavity types and the detection of secondary mesiobuccal (MB2) canals in 60 extracted human maxillary first molars and reached the conclusion that it is not necessary to prepare a TEC in order to detect MB2 canals. However, they also pointed out that the preparation of upper first molars should be completed according to the tooth anatomy to identify MB2 root canals.

In many cases, endodontic treatment is challenging because of pulp space obliteration. In these cases, tertiary dentin formation may occur as a pulpal response to carious lesions and coronal restorations, as well as after vital pulp therapy procedures or tooth restoration [10]. Additionally, pulp space calcification occurs in teeth with open apices that undergo luxation injuries, such as lateral luxation, intrusion, and avulsion. The deposition of secondary dentin over time may also lead to a severe obliteration of the root canal system in older patients. Further, pulp canal calcification presumably arises from unfavorable orthodontic forces, which have been demonstrated to interfere with pulpal blood supply [13]. This inflammatory process often results in pulp chamber shape changes and the distortion of useful anatomical signs [11].

Some authors have argued that guided endodontics can be applied in such difficult cases, with advantages such as greater preservation of dental tissue, a reduced danger of perforation, and a shorter operating time. It is said that this technique constitutes a miniaturized and minimally invasive treatment approach for locating root canals in teeth with pulp calcification that cannot be predictably accessed via traditional endodontic therapy [11]. Burchgreitz *et al.* [11] suggested that aside from teeth with pulp canal calcification, guided procedures in endodontics may help easily and precisely access and treat specific areas of the root that are hampered due to resorptions, perforations, or fractured endodontic instruments. However, guided procedures should be used in straight root canals or the direct part of distorted canals [10]. Furthermore, natural morphological changes of the root canal are unavoidable while using the leading drill [21]. Another disadvantage of this technique is the possible formation of cracks on the root while opening the closed root canal. Further drawbacks are the likely increase of the root surface temperature, resulting in damage of the periodontal ligament, and the amount of radiation involved in the CBCT examination [10]. Nevertheless, there are only a few studies about this new method and the majority are case reports.

Considering all the above, this study concludes that TEC is the first choice for preparing access to the pulp chamber, as it constitutes a safe method that enables efficient chemo-mechanical preparation of the root canal system. The TEC method has been more widely applied in daily clinical practice, as it is a more suitable access cavity preparation type than MIA cavities, which are not as viable an option. This review analyzed the advantages and disadvantages of all access cavity types, giving clinicians the opportunity to choose an appropriate method for completing the first step of endodontic treatment. Therefore, the knowledge of different access cavity designs is of the utmost importance, as the access cavity constitutes an integral and crucial part of endodontic treatment.

CONCLUSIONS

It is concluded that the effectiveness of MIA cavities has not yet been well established by research data and that MIA cavities cannot replace the traditional straight-line access design. There is no scientific evidence that supports the use of MIA cavities over TECs. Although *in vitro* studies offer initial significant information about new types of access cavities, they have limitations in clinical practice.

More *in vitro* studies must be carried out before planning clinical studies. Furthermore, randomized controlled trials and retrospective and prospective studies need to be conducted before these new methods are widely accepted.

REFERENCES

1. Plotino G, Grande NM, Isufi A, Ioppolo P, Pedullà E, Bedini R, Gambarini G, Testarelli L. Fracture strength of endodontically treated teeth with different access cavity designs. J Endod 2017;43:995-1000.
PUBMED | CROSSREF
2. Silva EJNL, Rover G, Belladonna FG, De-Deus G, da Silveira Teixeira C, da Silva Fidalgo TK. Impact of contracted endodontic cavities on fracture resistance of endodontically treated teeth: a systematic review of *in vitro* studies. Clin Oral Investig 2018;22:109-118.
PUBMED | CROSSREF
3. Patel S, Rhodes J. A practical guide to endodontic access cavity preparation in molar teeth. Br Dent J 2007;203:133-140.
PUBMED | CROSSREF
4. Auswin MK, Ramesh S. Truss access new conservative approach on access opening of a lower molar: a case report. J Adv Pharm Educ Res 2017;7:344-347.
5. 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;43:1657-1662.
PUBMED | CROSSREF
6. 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;18:121.
PUBMED | CROSSREF

7. Moezizadeh M, Mokhtari N. Fracture resistance of endodontically treated premolars with direct composite restorations. J Conserv Dent 2011;14:277-281.
PUBMED | CROSSREF

8. Clark D, Khademi J. Modern molar endodontic access and directed dentin conservation. Dent Clin North Am 2010;54:249-273.
PUBMED | CROSSREF

9. Abou-Elnaga MY, Alkhawas MAM, Kim HC, Refai AS. Effect of truss access and artificial truss restoration on the fracture resistance of endodontically treated mandibular first molars. J Endod 2019;45:813-817.
PUBMED | CROSSREF

10. Connert T, Zehnder MS, Amato M, Weiger R, Kühl S, Krastl G. Microguided Endodontics: a method to achieve minimally invasive access cavity preparation and root canal location in mandibular incisors using a novel computer-guided technique. Int Endod J 2018;51:247-255.
PUBMED | CROSSREF

11. Buchgreitz J, Buchgreitz M, Bjørndal L. Guided root canal preparation using cone beam computed tomography and optical surface scans - an observational study of pulp space obliteration and drill path depth in 50 patients. Int Endod J 2019;52:559-568.
PUBMED | CROSSREF

12. Andreasen FM, Zhijie Y, Thomsen BL, Andersen PK. Occurrence of pulp canal obliteration after luxation injuries in the permanent dentition. Endod Dent Traumatol 1987;3:103-115.
PUBMED | CROSSREF

13. Torres A, Shaheen E, Lambrechts P, Politis C, Jacobs R. Microguided Endodontics: a case report of a maxillary lateral incisor with pulp canal obliteration and apical periodontitis. Int Endod J 2019;52:540-549.
PUBMED | CROSSREF

14. European Society of Endodontology, Patel S, Durack C, Abella F, Roig M, Shemesh H, Lambrechts P, Lemberg K. European Society of Endodontology position statement: the use of CBCT in endodontics. Int Endod J 2014;47:502-504.
PUBMED | CROSSREF

15. Gluskin AH, Peters CI, Peters OA. Minimally invasive endodontics: challenging prevailing paradigms. Br Dent J 2014;216:347-353.
PUBMED | CROSSREF

16. Tan PL, Aquilino SA, Gratton DG, Stanford CM, Tan SC, Johnson WT, Dawson D. *In vitro* fracture resistance of endodontically treated central incisors with varying ferrule heights and configurations. J Prosthet Dent 2005;93:331-336.
PUBMED | CROSSREF

17. Allen C, Meyer CA, Yoo E, Vargas JA, Liu Y, Jalali P. Stress distribution in a tooth treated through minimally invasive access compared to one treated through traditional access: a finite element analysis study. J Conserv Dent 2018;21:505-509.
PUBMED | CROSSREF

18. Jiang Q, Huang Y, Tu X, Li Z, He Y, Yang X. biomechanical properties of first maxillary molars with different endodontic cavities: a finite element analysis. J Endod 2018;44:1283-1288.
PUBMED | CROSSREF

19. 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;40:1160-1166.
PUBMED | CROSSREF

20. 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;42:1779-1783.
PUBMED | 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;41:1888-1891.
PUBMED | CROSSREF

22. Krastl G, Zehnder MS, Connert T, Weiger R, Kühl S. Guided Endodontics: a novel treatment approach for teeth with pulp canal calcification and apical pathology. Dent Traumatol 2016;32:240-246.
PUBMED | CROSSREF

23. Zehnder MS, Connert T, Weiger R, Krastl G, Kühl S. Guided endodontics: accuracy of a novel method for guided access cavity preparation and root canal location. Int Endod J 2016;49:966-972.
PUBMED | CROSSREF