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The comparison between Traditional endodontic Access Cavity (TAC) and Conservative endodontic Access Cavity (CAC) on fracture resistance in endodontically treated teeth: an integrative review.

Noan Vetu Marin

Dissertação conducente ao **Grau de Mestre** em **Medicina Dentária (Ciclo Integrado)**

—

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Trabalho realizado sob a Orientação de
" Professor. Doutor. Pedro Bernadino"

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ABSTRACT

Introduction : In general, endodontically treated teeth have a higher risk of fracture than vital teeth. One of the most important steps in successful endodontic treatment is the preparation of the access cavity. In contrast to TAC, the preparation of the CAC consists of preserving as much of the tooth structure as possible.

Objective: This study aims to compare whether there is a difference in fracture resistance between TAC and CAC on endodontically treated teeth

Materials and Methods: Bibliographic search of articles in the PubMed and Sciencedirect database. After implementation of the inclusion criteria, 11 articles were selected.

Results: 6 articles state that CAC is the most resistant technique, 4 articles show no difference between the 2 techniques and 1 article favours the use of TAC.

Discussion: The main advantage of TAC is that it provides a direct view of the root canal orifice, but removes a large amount of tooth structure. CAC preserves more tooth tissue: the roof of the pulp chamber and the peri-cervical dentine. Disadvantages are limitations in irrigation, instrumentation, and root canal obturation.

Conclusion: The results of our study indicate that the CAC preparation offers better results in terms of fracture resistance. However difficulties instrumentation or irrigation with CAC are a challenge for endodontics. In the meanwhile new technologies continue to advance and make CAC a promising method.

Keywords: “fracture resistance” OR “fracture strength” AND “endodontic access cavity” AND “conservative access cavity”.

RESUMO

Introdução : Em geral, os dentes tratados endodonticamente têm um risco de fractura mais elevado do que os dentes vitais. Um dos passos mais importantes para um tratamento endodôntico bem sucedido é a preparação da cavidade de acesso. Ao contrário do TEC, a preparação do CEC consiste em preservar o máximo possível da estrutura do dente.

Objectivo: Este estudo visa comparar se existe uma diferença na resistência à fractura entre TEC e CEC nos dentes com tratamento endodôntico.

Materiais e Métodos: Pesquisa bibliográfica de artigos na base de dados PubMed e Sciencedirect. Após a implementação dos critérios de inclusão, foram seleccionados 11 artigos.

Resultados : 6 artigos afirmam que a CEC é a técnica mais resistente, 4 artigos não mostram qualquer diferença entre as 2 técnicas e 1 artigo favorece a utilização da TEC.

Discussão: A principal vantagem do TEC é que proporciona uma visão directa do orifício do canal radicular, mas remove uma grande quantidade de estrutura dentária. O CEC preserva mais tecido dentário: o telhado da câmara da polpa e a dentina peri-cervical. As desvantagens são limitações na irrigação, instrumentação, e obturação do canal radicular.

Conclusão: Após a revisão dos artigos, o nosso estudo indica que que a preparação da CEC oferece melhores resultados na resistência à fractura. As dificuldades de instrumentação ou irrigação com CEC são um desafio para a endodontia. No entanto, as novas tecnologias continuam a progredir e fazem da CEC um método promissor.

Palavras Chaves : “fracture resistance” OR “fracture strength” AND “endodontic access cavity” AND “conservative access cavity”.

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INDEX OF ABBREVIATIONS

TAC : Traditional Access Cavity

CAC : Conservative Access Cavity

TRAC: Truss Access Cavity

MAC: Minimal Access Cavity

CBCT : Cone Beam Computed Tomografy

ECJ : Enamel–Cement Junction

XFEM : Extended Finite Element Method

1.INTRODUCTION

An endodontic treatment plan (1) aims to save a tooth from extraction, while protecting the patient from the spread of infection. However, endodontically treated teeth are at greater risk of fracture than untreated teeth.
Studies have revealed that the susceptibility of endodontically treated teeth to fracture is strongly associated with loss of tooth structure due to caries, tooth wear, endodontic procedures such as access cavity and canal instrumentation(2).

For this reason, one of the most important steps for a successful endodontic treatment is the preparation of the access cavity (3). The endodontic access cavity is one of the first steps to be performed during an endodontic treatment and its objectives have been established and defined for several decades, namely the elimination of all caries as well as the pulp chamber, the location of all root canal orifices and the establishment of direct access to the canals while preserving the remaining tooth structure (4).
There are different methods for preparing these cavities that are more or less conservative; the Traditional Endodontic Access Cavity (TAC), the Conservative Endodontic Access Cavity (CAC) (5).

TAC corresponds to a coronal access guided by the projection of the canals, in a straight line. Its main advantage is that it allows a direct view of the root canal openings, which facilitates canal preparation and obturation(6).
Moreover, this access cavity technique can prevent iatrogenic complications, such as deviation from the original root canal anatomy during instrumentation and fracture of endodontic instruments (7). However, more tooth structure is removed. This preparation involves the loss of tooth structure, anatomical structures such as ridges, cusps and the complete roof of the pulp chamber (8).
Furthermore, the extensive access cavity preparation results in a significant reduction of healthy dentin and increases the deformability of the tooth, which compromises the fracture resistance of the tooth part (3).

In contrast, CAC is a minimally invasive procedure proposed by Clark and Khademi (2010). This procedure involves preserving healthy dentin by keeping as much of the pulp chamber roof and pericervical dentin as possible, on the basis that preserving these structures will improve the fracture resistance of teeth after root canal treatment (7). According to Clark, keeping 0.5 to 3 mm from the pulp chamber roof is the safest approach to avoid damaging this dentin, which will reduce cusp removal and therefore the fracture rate of the tooth(6).

However, too little access may compromise and/or complicate certain steps of endodontic treatment, such as locating root canal holes, cleaning procedures, shaping and obturation of the canal (2). In addition, the retention of the pulp chamber ceiling, may hinder the removal of pulp remnants, dentinal debris, blood, filling materials and other debris, which may cause tooth discoloration, promote microbial growth and have a negative impact on the preservation of the endodontically treated tooth(9).

It seems essential to study whether one of these techniques favours fracture resistance and therefore treatment durability, as well as patient comfort.

2.OBJETIVES AND HYPOTHESES

The objectives of this integrative systematic review are:

- Main objective : Compare whether there is a difference in fracture resistance between TAC and CAC preparations.

- Secundary objective : Describe the concept of access cavity.

The null hypothesis is that there is no difference between the traditional cavity and the conservative one, regarding the resistance of the tooth to fracture.

3.MATERIALS AND METHODS

3.1. Protocol

The review protocol used was the one described in PRISMA (Preferred Reporting Items for Systematic and Meta-Analyses) recommendations.

3.2. Eligibility Criteria

This work was based on the Cochrane recommendations in response to PICO.

Table 1 : PICO

P (Population)	I (Intervention)	C (Comparison)	O (Outcome)
Patients/teeth with endodontic treatment	traditional access cavities (TAC)	conservative access cavities (CAC)	Fracture resistance

Two groups were formed to rank the eligibility criteria:

-Inclusion

-Exclusion

Table 2: ELIGIBILITY CRITERIA

Inclusion criteria	Exclusion criteria
Articles published in the last 10 years	Articles without full text
Articles in English, Portuguese, and French	Duplicates
Studies about endodontic access cavities	systematic review, review
Studies about conservative access cavities	Irrelevant articles
Studies about fracture resistance of endodontically treated teeth	article about the fracture of incisors, canines and premolars
Clinical studies, randomized controlled trials	

3.3. Information sources and search strategy

The following scientific MeSH terms were searched in Pubmed and Sciencedirect (the National Library of Medicine) between January 2023 and March 2023 : “endodontic access cavity“ AND “conservative access cavity“ AND “ fracture resistance” OR “ “Fracture strength”.

Additional articles for the introduction and discussion were obtained with a free manual search.

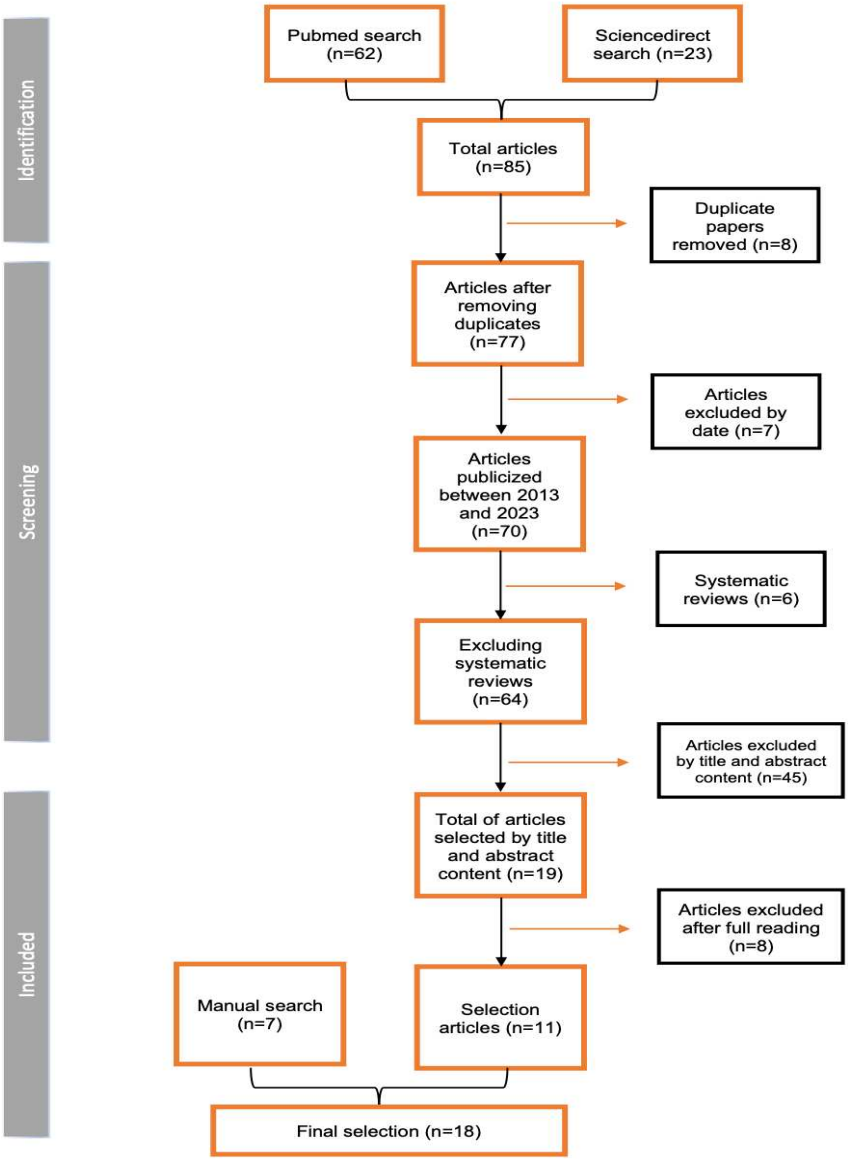

Figure 1: PRISMA FLOW DIAGRAM OF THE SEARCH STRATEGIY

4. RESULTS

4.1. SELECTION OF ARTICLES

Pubmed and Sciencedirect were the databases used to search for articles. In total, by combining the mesh terms, 85 articles were found. After applying the exclusion criteria, reading the titles and contexts, 19 articles were selected. After reading these articles, 11 were included.

With the free manual search, 7 articles were added to complete the introduction and discussion.

4.2. YEARS OF PUBLICATIONS

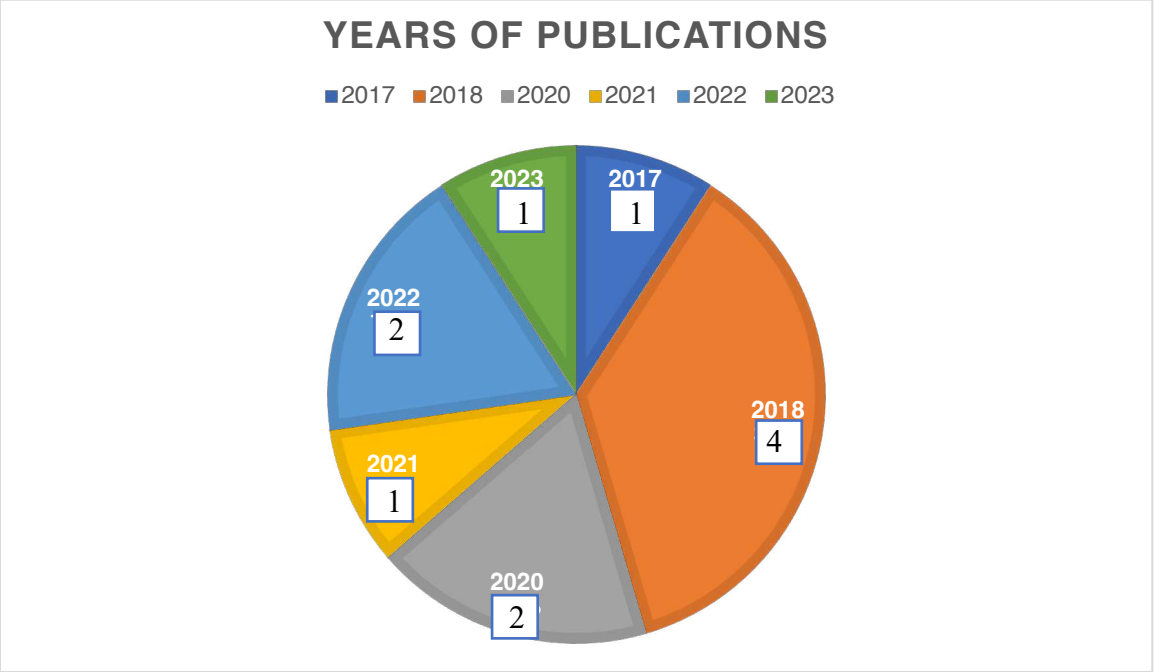

Figure 2 : DISTRIBUTION BY YEAR OF PUBLICATION OF THE ARTICLES INCLUDED

The majority of the articles reviewed for this integrative review were published in 2018.

4.3. TYPE OF STUDIES

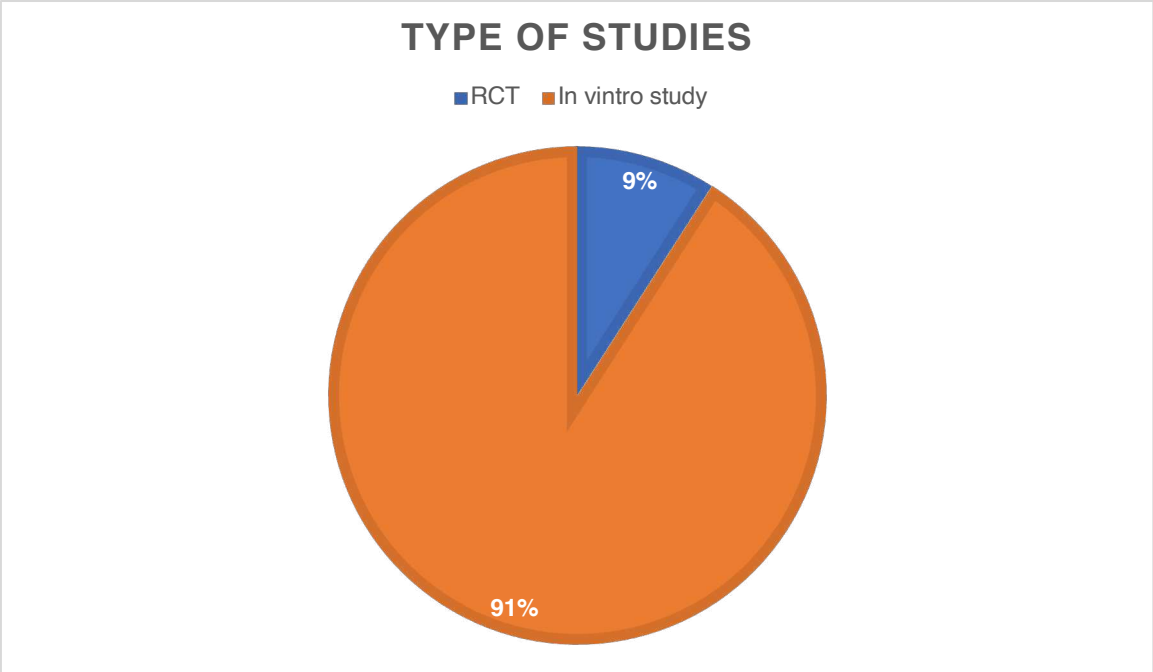

Figure 3 : DISTRIBUTION BY THE TYPE OF STUDY

Mostly, the articles used are in vitro studies. Indeed, the teeth tested had been extracted.

4.4. TYPE OF MOLARS

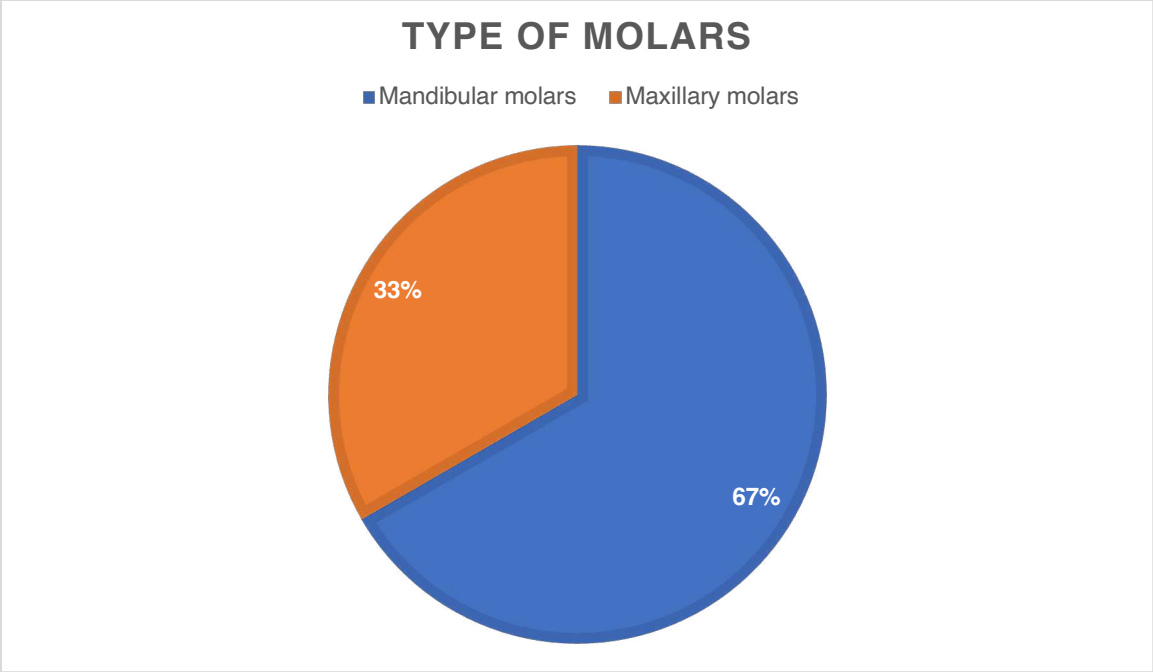

Figure 4 : TYPE OF MOLARS

It can be observed that there is a predominance of articles that used mandibular molars.

4.5. RESULTS OF STUDIES

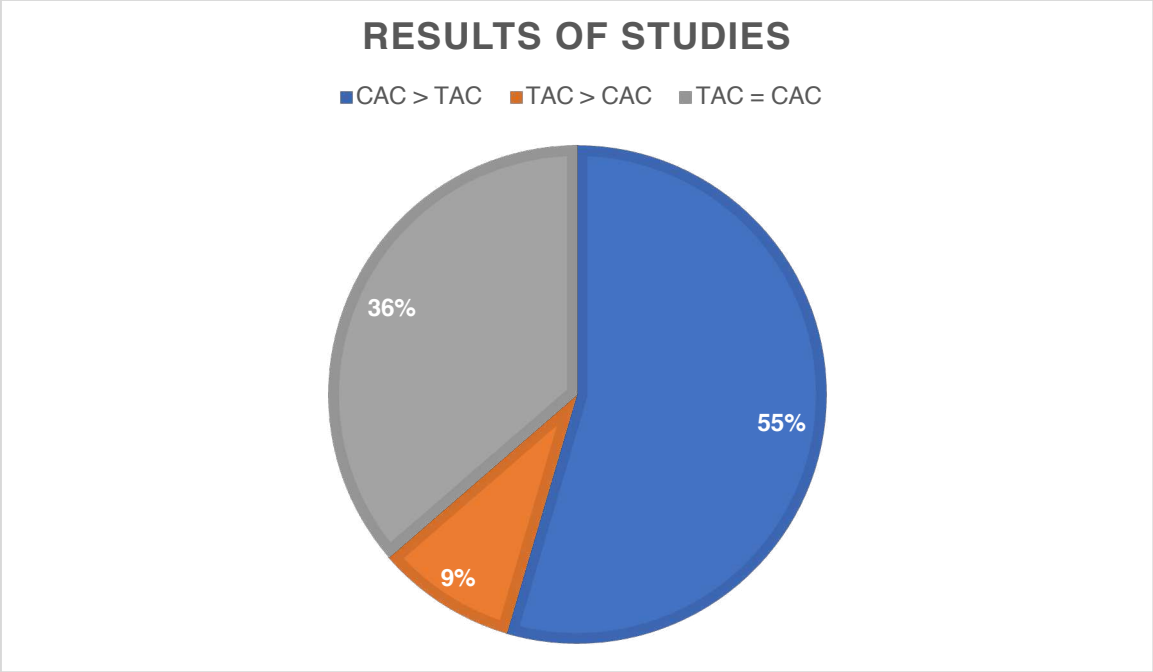

Figure 5 : DISTRIBUTION OF STUDY RESULTS

We can observe that the majority of articles show that the conservative method allows a better resistance to the fracture (55%).

4.6. TABLE OF RESULTS

Table 3 : RELEVANT DATA GATHERED FROM THE SELECTED STUDIES

Title/Authors/Years	Type of study	Population	Objective	Materials and Methods	Conclusion
« Fracture Strength of Endodontically Treated Teeth with Different Access Cavity Designs » Plotino G et al. 2017	In vitro study	Maxillary and mandibular premolars (PM) and molars (M) that have been extracted. the teeth were intact, without caries or restorations.	To study the fracture resistance of endodontically treated teeth with a TAC, CAC or NAC access cavity.	40 maxillary 1°M with 3 separate roots, 40 mandibular 1°M with 2 separate roots, 40 maxillary 1°PM with 2 separate roots and 40 mandibular 1°PM with a single root. The teeth were divided into 4 groups for each tooth type : -Group A: the control group -Group B: the TEC group -Group C : the CEC group	The TAC group showed significantly lower fracture resistance compared to the CAC and NAC groups. However, there was no significant difference between the NAC and CAC groups in fracture resistance.

				-Group D : the NEC group	
« The Effects of Endodontic Access Cavity Preparation Design on the Fracture Strength of Endodontically Treated Teeth: Traditional Versus Conservative Preparation » Ozyuek T et al. 2018	In vitro study	Mandibular M of patients aged 40-60 years	Compare the fracture strength of mandibular molars prepared using traditional and conservative (class II) access methods and restored with SDR and EverX Posterior base composites	The teeth were randomly divided into 5 groups (n = 20/each group) : 1°) Control group (no treatment) 2°) Group with TEC access cavity, EverX Posterior as base material and the final restoration was done with Filtek Z250 composite resin 3°) Group with CEC access cavity, EverX Posterior as base material and the final restoration was made with Filtek Z250 composite resin. 4°) group with TEC access cavity, SDR as base material and the	There was no significant difference between TAC and CAC (class II) in fracture strength. However, the fracture resistance of teeth restored with SDR bulk filling composite was higher than that of teeth restored with EverX Posterior

				final restoration was made with Filtek Z250 composite resin. 5°) group with CEC access cavity, SDR as base material	
« Influence of Access Cavity Preparation and Remaining Tooth Substance on Fracture Strength of Endodontically Treated Teeth » Giacomo C et al. 2018	In vitro study	Intact human mandibular molars with fully formed apices that were extracted. Exclusion criteria: presence of caries, previous restoration or visible fracture lines or fissures.	To evaluate the influence of mesial wall loss or mesial and distal wall loss with TAC, CAC and TRAC preparations on the fracture resistance of endodontically treated teeth.	100 mandibular 1°M and 2°M. The teeth were divided into 9 groups and a control group (n = 10/each group) and each group has the same number of 1°M and 2°M : 1°)Control group (intact teeth) 2°) TAC Group 3°) CAC group 4°) TRAC Group 5°) TAC + 3 residual walls (removal of mesial walls)	Regarding the comparison between TAC and CAC on fracture strength, no significant difference was demonstrated.

				6°) CAC + 3 residual walls (removal of mesial wall) 7°) TRAC + 3 residual walls (removal of mesial wall) 8°) TAC + 2 residual walls (removal of mesial and distal walls) 9°) CAC + 2 residual walls (removal of mesial and distal walls) 10°) TRAC + 2 residual walls (removal of both mesial and distal walls).	
« Impact of Access Cavity Design and Root Canal Taper on Fracture Resistance of Endodontically Treated Teeth: An Ex Vivo Investigation » Sabeti M and al. 2018	In vitro study	1°M and 2°M intact human maxillary with fully formed apices, which were extracted for periodontal reasons.	To evaluate and compare the fracture resistance of 2 different access cavities preparations and 3 different root canal preparations.	-48 intact 1M and 2M maxillary were randomly divided into 3 groups (n = 16) to compare different cavity preparations: intact teeth, traditional access cavity (TAC)	Increasing the taper of the root canal preparation promotes fracture resistance. However, the conservative access cavity did not show significant fracture resistance compared

				and conservative access cavity (CAC). -30 healthy distobuccal maxillary molar roots were randomly divided into 3 groups (n = 10): 0.04, 0.06 or 0.08 cone	to the traditional access cavity.
« The Effect of Endodontic Access Cavities on Fracture Resistance of First Maxillary Molar Using the Extended Finite Element Method » Zhang Y and al. 2018	In vitro study	1°M maxillary intact and without caries.	To study the influence of TAC, CAC and MAC access cavities on the fracture resistance of endodontically treated teeth with XFEM.	4 1°M maxillary teeth were used : 1°) control tooth (without treatment) 2°) tooth with an access cavity CAC 3°) tooth with the TAC access cavity 4°) tooth with the MAC access cavity.	The CEC access cavity showed better fracture resistance than the TEC and MEC cavities.
« The effect of access cavities and canal enlargement on biomechanics of endodontically treated teeth: a finite element analysis »	In vitro study	1°M maxillary intact, which have been extracted for periodontal reasons	To study the fracture resistance of different preparations of the access cavity and different preparations of the root canal.	8 models with different access cavities (TEC and ECC) and different prepared canal cones (0.02, 0.04, 0.06, 0.08).	Preservation of more dentin as the CAC access cavity would increase fracture resistance.

Wang Q and al. 2020					
« The influence of endodontic access cavity design on the efficacy of canal instrumentation, microbial reduction, root canal filling and fracture resistance in mandibular molars » Barbosa and al. 2020	In vitro study	Intact mandibular molars	To compare TRAC, CAC and TAC access cavities taking into account various criteria: canal preparation, filling capacity, microbial reduction, pulp chamber cleanliness and tooth fracture resistance after coronal restoration.	30 intact mandibular molars with similar anatomical features were assigned to the TAC, CAC or TRAC groups (n=10).	CAC and TRAC showed no advantage over TAC, regardless of the parameter considered. Conservative access cavities showed a larger area of unprepared root canal and a larger volume of root filling material in the pulp chamber.
« Influence of Minimally Invasive Access Cavity Designs on the Fracture Resistance of Endodontically Treated Mandibular Molars Subjected to Thermocycling and	Randomized Clinical Trial	Intact mandibular 1°M and 2°M with fully formed apices	O assess the fracture resistance of mandibular molars that have been prepared and restored in a minimally invasive manner and subjected to thermocycling and dynamic loading.	40 mandibular first and second molars were divided into 4 random groups (n = 10/group) as follows: -Group 1 : control -Group 2 : TAC -Group 3 : CAC -Group 4 : TRAC	CAC and TRAC preparations showed better results in fracture resistance than the TAC preparation.

Dynamic Loading » Senha S and al. 2021					
« Comparison of Fracture Resistance of Endodontically Treated Teeth With Traditional Endodontic Access Cavity, Conservative Endodontic Access Cavity, Truss Endodontic Access Cavity, and Ninja Endodontic Access Cavity Designs: An In Vitro Study » Prasad P 2022	In vitro study	Intact mandibular molars, which were extracted for periodontal reasons	To compare the fracture resistance of different access cavities; TAC, CAC, NAC and TRAC on endodontically treated teeth.	50 intact mandibular molars with similar anatomical features were assigned to the groups : 1) control group 2) TAC group 3) CAC group 4) NAC group 5) TRAC group	The TAC access cavity shows better results in terms of fracture resistance than the CEC access cavity.
« Influence of Access Cavity Design on the Fracture Strength of Endodontically Treated Teeth	In vitro study	Intact mandibular molars	To evaluate the influence of TAC, CAC, NAC and TRAC access cavities on the fracture resistance of	90 intact mandibular molars with similar anatomical features were assigned to the groups :	The preservation of peri-cervical dentin in CAC, NAC and TRAC access cavities showed better fracture

Restored Using Short Fiber-Reinforced Composite and High Strength Posterior Glass Ionomer Cement » Vaddempudi D and al 2022			endodontically treated teeth restored with GC everX Posterior and GC Gold Label IX.	1) control group (n=10) 2 TAC group (n=20) 3) CAC group (n=20) 4) NAC group (n=20) 5) TRAC group(n=20)	resistance. However, further clinical research is needed to examine the effectiveness of the instruments, the difficulties encountered during endodontic treatment.
« The effect of different endodontic access cavity designs in combination with WaveOne Gold and TruNatomy on the fracture resistance of mandibular first molars: A nonlinear finite element analysis » Vorster M and al. 2023	In vitro study	Intact human mandibular molars (with 3 canals very visible on the X-rays), which were extracted for periodontal reasons.	To assess the fracture resistance of endodontically treated mandibular molars when pericervical dentin is preserved during access cavity preparation	4 mandibular molars were divided into 4 groups : -Group 1 : TAC/WOG (Wave One Gold) -Group 2 : CAC/WOG -Group 3 : TAC/TN (TruNatomy) -Group 4 : CAC/TN	the type of instrumentation (WOG VS TN) shows no difference in fracture resistance. Preservation of pericervical dentin during CAC preparation seems to improve fracture resistance, however many factors have to be taken into consideration when choosing the access cavity.

5. DISCUSSION

5.1. CAVITY PREPARATION

5.1.1. PRE-TREATMENT EVALUATION

Before starting an endodontic treatment, it is fundamental to evaluate certain parameters. The carious lesions as well as the existing restorations must be analysed, in order to determine the quantity of dental structure that must be removed and therefore, the quantity of remaining structure. This remaining structure will allow us to define, firstly, the type of access cavity to be made and, secondly, the most appropriate and functional restoration for the patient (10).

In order to design a suitable access cavity, it is therefore important to analyse the remaining tooth structure but also the tooth angulation and/or rotation, as these are factors that can influence this stage of endodontic treatment. Analysis of the ECJ and furcation allows mental visualization of the level of the pulp floor and the likely location of root canal entries (10).

During the endodontic pre-treatment assessment, careful radiographic analysis is essential and beneficial. Periapical radiographs are taken to avoid any deformities. When necessary, angled periapical radiographs can be taken as a supplement for better visualization of the roots when they overlap (10). These radiographs provide valuable information about the tooth, such as its size, the number of roots and the degree of curvature of the canals, but also precise information about the pulp chamber, such as the shape, depth and position of the pulp horns.

5.1.2. TOOTH PREPARATION

A number of instruments are required for endodontic treatment. There are different types of instrument : manual and rotary.
Manual instruments are used to locate the canal orifices and remove the cameral pulp (Figure 6) (10) , while rotary instruments are used to remove the enamel and dentine (11) (Figure 7).
To optimise the treatment process, the practitioner can use an optical magnifier (Figure 8) (10).

Before starting the treatment, the tooth to be treated must be completely sanitized, to avoid any contamination. This means that bacterial plaque, caries and infiltrated restorations must be removed. In addition, during an endodontic procedure, it is essential to work with absolute isolation, as this will isolate the tooth from saliva and also protect the patient from the irritating chemicals used (e.g. irrigation) (10).

During the removal of existing caries or restorations, cracks may appear on several tooth walls. This event can unfortunately have consequences on the endodontic treatment as well as on the post-treatment restoration and thus on the prognosis of the tooth's survival (10).
In some situations, when the amount of remaining tooth structure is insufficient, after the removal of carious lesions or restorations, it is preferable to make a provisional restoration in order to stabilise the dam as much as possible and thus favour isolation, but also to limit the risks of leakage during irrigation (10).

Once the tooth has been sanitised, the trepanation of the pulp chamber roof is performed, better known as the access cavity, this step is performed on the oclusal surface of the posterior teeth (10).
A ball bur is used to reach the pulp chamber, and normally a tactile sensation of emptiness informs us of the entry into the pulp chamber. To protect the floor of

the pulp chamber, an endo Z (Zekrya) bur, which is non-cutting, is then used to remove the entire ceiling of the pulp chamber (10).
However, if the tooth being treated has a crown, it is important to inform the patient that there is a risk that the crown may be irreversibly damaged and that it may need to be replaced later (10).

For identification of canals in molars, dark lines connecting the canal entrances can be seen on the floor of the pulp chamber **(Figure 8)**.

Subsequently, once the location of the canals has been achieved, it is sometimes essential to modify the shape of the access cavity to facilitate straight-line access for endodontic files.
Straight access reduces iatrogenic problems and facilitates instrumentation, irrigation and filling of the tooth (11)**.**

Figure 6 : A DG16 ENDODONTIC PROBE

(Reference : hufriedygroup.eu)

Figure 7 : BUR BALL AND ENDO Z

(Reference : dentaltix.com)

Figure 8 : OPTICAL MAGNIFIER

(Reference : eye-resolution.fr)

Figure 9 : ACCESS CAVITY OF A LOWER FIRST MOLAR; NOTE THE THREE CANAL ORIFICES ARE CONNECTED BY DEVELOPMENTAL LINES.

(Reference : Biorendal)

5.2. TAC and CAC

The TAC access cavity is recognised as the second most important cause of tooth structure loss (3). Indeed, this traditional preparation involves the removal of the entire pulp chamber roof (8).
The advantage of this traditional cavity is that it allows an optimization of the endodontic treatment with its rectilinear access to the canal entrances (**Figure 9).** This straight access provides safety and ease of instrumentation and irrigation (6) and also reduces the risk of iatrogenic complications (7).
However, by removing the peri-cervical dentin, the TAC preparation can have a negative effect mechanically and biologically, with increased stress on the crown and roots (6,13).

Nowadays, improvements in various fields, including technology, allow and help clinicians to implement new, more conservative methods (4).

In this study we will focus on the CAC cavity but there are several; MAC, NAC and TRAC.

The CAC preparation consists in preserving a part of the pulp chamber roof as well as the peri-cervical dentin, in other words it aims at preserving a significant amount of tooth structure (3) (**Figure 10).**
On the other hand, the preservation of these structures can/could compromise certain steps during root canal treatment, such as the location of canals, instrumentation (deviations and/or fracture of the instrument), or irrigation. In addition, the preservation of part of the pulp chamber roof could lead to consequences during treatment but also post treatment (discoloration of the tooth and negative impact on materials and composites) (9)**.**

However, as mentioned earlier, technological developments have risen to the challenge and provided solutions to integrate CAC preparation into routine clinical practice.

Improvements in instruments, microscopes and imaging have been noted. For example, the microscope allows better visibility, and facilitates the search for canals, without having to enlarge the access cavity.

For progress in instrumentation, new ultraflexible instruments allow channel preparation without the need for straight line access to the channels (2).

Also the activation of the irrigation, allows the debridement and disinfection of difficult to access or even inaccessible areas of the root canal system, again without the need to enlarge the access cavity.

In the field of imaging, CBCT has become an indispensable tool in modern dentistry, regardless of the discipline. As conventional radiography has its limitations, three-dimensional radiography makes it possible to refine the diagnostic and anatomical elements with the aim of optimising the establishment of the treatment plan and thus the subsequent treatment. In the field of endodontics and especially in the field of conservative cavities, CBCT will allow the detection of extra canals, inclinations and complex anatomical variations (4,13) **(Figure 11).**

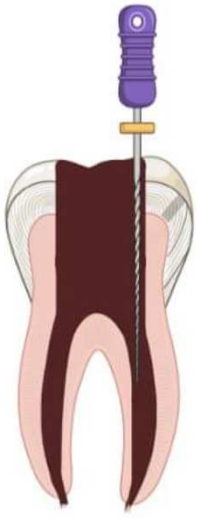

Figure 10 : STRAIGHT LINE ACCESS INTO THE ROOT CANAL

(Reference : Biorender)

Figure 11 : ACCESS CAVITY PREPARATION ; (A) TAC, (B) CAC

(Reference : Biorendal)

Figure 12 : CBCT IMAGES IDENTIFYINGTHE BASELINE PLANE OF A RIGHT MAXILLARY FIRST MOLAR FOR SUBSEQUENT MEASUREMENTS OF ANATOMICAL LANDMARKS

(Reference : *Sui H and al* (13))

5.3. FRACTURE RESISTANCE

In endodontics, tooth fracture is one of the most undesirable problems of treated teeth and usually results in tooth extraction (2). In fact, restored teeth regain about 72% of their original fracture resistance. Fracture of endodontically treated teeth is strongly related to the loss of tooth structure due to caries, wear/ageing of the teeth, but also to access cavities made during endodontic treatment. (5).

Several studies have been conducted to investigate the relationship between access cavity type and fracture toughness.

In the studies used for this integrative review, there is a predominance of articles that indicate that CAC preparations have a higher fracture resistance than TAC preparations.

As mentioned earlier, more conservative cavities preserve more tooth tissue and are therefore less invasive, resulting in greater strength.

The authors *Plotino G et al, and Sui H and al,* stated that fracture resistance was significantly greater in the CAC group than in the TAC group.
In the study of *Plotino G et al*, the specimens were divided into four groups; control group, TAC group, CAC group and NAC group. CBCT was performed prior to treatment to visualise the access cavities or to analyse whether the tooth is tilted.
In the study of *Sui H et al,* the nine-rectangle grid concept was used. This concept influences the preparation of access cavities, as it avoids excessive removal of dental tissue and increases fracture resistance. (3,13).

The authors *Zhang Y et al,* also stated that the CAC group showed better fracture resistance compared to the TAC group. Indeed, these authors compared the fracture resistance using the extended finite element method (XFEM).

XFEM has many advantages in the study of complex dental biomechanics. The technique was used to calculate the distribution of forces and to simulate the initiation and expansion of cracks in enamel and dentin on maxillary first molars. At maximum intercuspidation, a maxillary first molar has a force of approximately 665 N and can reach 800 N in case of bruxism. In these studies, a force of 80 N to 800 N was applied to the teeth tested. It was found that the maximum principal stress was on the mesiobuccal root. However, this maximum principal stress was significantly reduced in the CAC models compared to the TAC models. The authors *Zhang et al* and *Wang Q and al* concluded the study by explaining that the preservation of dentin in the access cavity decreased the stress concentration and therefore increased the fracture resistance. (8,14)

In the article by *Sneha S et al,* before the fracture resistance test was performed, the teeth were subjected to thermocycling.
Thermocycling was performed to simulate approximately 6 months of thermal changes occurring in the oral cavity; 35°C for 28 seconds, 15°C for 2 seconds, 35°C for 28 seconds and 45°C for 2 seconds for 5000 cycles. After this step, the teeth were subjected to dynamic and static loading to test their resistance.
The results of this study showed that the conservative method offered better resistance (15).

In agreement with the previous authors, the review of *Obada A et al,* indicated that a conservative approach improved fracture resistance. Indeed, in this article it was shown that traditional access had a higher proportion of irreparable tooth fractures. This result is related to the fact that in traditional preparation, a greater amount of tooth structure is removed.(16).

In contrast, Kapetanaki I et al, stated that the TAC preparation remains the best option for the time being and that it is preferable to use a TAC preparation in a multi-root treatment.

This study analysed the advantages and disadvantages of different types of access sockets. The major advantage of conservative preparation is the same as in the previous articles, i.e. the preservation of a large amount of dentine.
However, the disadvantages are numerous; difficulties and risks during instrumentation when the canals are not straight, the formation of cracks on the roots when opening closed root canals, a rise in temperature at the root surface, which can damage the periodontal ligament, and finally, the amount of radiation involved in the CBCT examination.
According to this study, more studies on conservative access are needed before it can be integrated into routine clinical practice (7).

There are also articles that showed that there was no significant difference between the TAC and CAC groups for the parameter evaluated in this integrative review. This is the case of the author *Corsentino G et al, Barbosa et al* and *Sabeti M et al* (2,5,17).
In these different studies, the results do not value one method more than the other and this could be related to various factors such as; the type of teeth evaluated, different methodological design, the type of restorative material, and also, the design of the fracture test.

In addition, some studies have been carried out to see if there is a link between canal preparation and fracture resistance.
Vorster M et al, compared the WaveOne Gold and TruNatomy systems for canal preparation. The authors concluded that the instrument systems used did not impact the increase in fracture toughness. However, the CAC groups showed better fracture resistance than the TAC groups (18).

In contrast to the previous study, *Sabeti M et al* found a link between canal instrumentation and fracture toughness.
In this study, maxillary molars were randomly divided into 3 groups with different conicity (0.04, 0.06, 0.08). Root canal preparations were performed with the Twisted Files rotary system. The results obtained are as follows:

- An increase in the taper of the root canal preparation could negatively influence the fracture resistance of the tooth.
- The CAC and TAC groups showed no significant difference in fracture resistance (2).

5.4. LIMITATIONS

Regarding the impact of access cavity preparation on fracture toughness, it should be remembered that most studies have an inherent limitation.
Fracture strength was assessed using a universal testing machine, the teeth were loaded at an angle of 30° to the long axis of the tooth at the central fossa and continuous pressure was applied, until fracture (1,5) **(Figure 12).**

This is because the load applied to the teeth during the experiments is static and continuous, i.e. it is a single load. It is therefore a test, where the external validity is less compared to a cyclic load, which is more representative of masticatory forces (4).

In addition, the teeth used in the various studies were free of caries and restorations with fully formed apices. From a clinical point of view, a tooth requiring endodontic treatment is rarely intact (3).

Figure 13 : FRACTURE RESISTANCE TEST UNDER A TESTING MACHINE

(Reference : Biorendal)

6. CONCLUSION

In this work, the main objective, as already mentioned, was to establish the link between these two access cavities in the resistance to dental fractures.

After reviewing the articles, the null hypothesis is rejected. Currently in fracture resistance, the conservative method is the preparation that offers the best results.

The methods of TAC and CAC preparations were compared in the different studies reviewed. We have seen that the opinions and results are divided despite the predominance of favourable opinions for the conservative method.
Several authors have shown that the CAC preparation has the advantage of preserving the peri-cervical dentin, thus increasing fracture resistance. However, this advantage may become a disadvantage during root canal treatment; difficulties in instrumentation and irrigation may lead to less effective disinfection of the root canal.

On the other hand, new technologies continue to improve and make CAC preparations a promising method.

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