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Recent Methods in Caries Removal in Operative Dentistry

A Project Submitted to

The College of Dentistry, University of Al-Zahrawi, Department of Dentistry

Partial Fulfillment for the Bachelor Degree of conservative Dentistry

Prepared by:

Ahmed Fayez Saeed

Kawther Ahmed Abd

Zahraa Ghafoor Jabbar

Zahraa Ridha Salman

Supervised by:

Dr. Zaidoon Hasan Mohammed

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بسم الله الرحمن الرحيم

فَإِذَا عَزَمْتَ

فَتَوَكَّلْ عَلَى اللَّهِ

إِنَّ اللَّهَ يُحِبُّ الْمُتَوَكِّلِينَ

Supervisor Certification

I certify that this project "Recent Methods in Caries Removal in Operative Dentistry" was prepared by the fifth-year student:

Ahmed Fayez Saeed ,Kawther Ahmed Abd ,Zahraa Ghafoor Jabbar and Zahraa Ridha Salman

under my supervision at College of Dentistry, Al-Zahrawi University in Partial fulfillment of graduation requirements for the Bachelor degree in Dentistry.

Signature:

Name of the supervisor: Dr. Zaidoon Hasan Mohammed

Supervisor degree: B.D.S., M.Sc,

Date:

Dedication

The journey was not short, nor should it have been. The dream was not near, and the path was not paved with ease — but I did it. Praise be to Allah, who made the beginnings smooth and granted us the strength to reach the end.

To those who taught me how to climb the ladder of life with wisdom and patience...

To those who gave me life and hope...

To those whose presence in my life is a blessing from Allah — in kindness and gratitude: my dear father and beloved mother.

To the friends of the years, the companions in hardships, and the sources of my inspiration and success...

To those who extended a helping hand when I needed it most...

To the candles that light my way — my dearest friends.

To the one who graciously supervised this research, offering constant guidance and advice throughout the preparation period — we extend our deepest thanks and appreciation:

Dr. Zaidoon Hassan Mohammed.

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Firstly, all gratefulness, faithfulness to ALLAH for providing us with patience, perseverance and the ability to undertake and complete this study. This work is dedicated to Our family, and friends for their great support and for always believing in us. To our supervisor

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Thank you from all our heart.

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Introduction

Dental caries, According to world health organization (WHO), it is defined as "Localized post-eruptive pathologic process of external origin involving softening of the hard tissue and proceeding to the formation of a cavity(WHO, 2013).

Sturdevant defined it as "An infectious microbiological disease of the teeth that results in localized dissolution and destruction of calcified tissues". According to Shafers "Dental caries is a microbial disease of the calcified tissues of the teeth, characterized by demineralization of the inorganic portion and destruction of the organic substance of the tooth, which often leads to cavitations" (Sivapathasundharam, 2016; Pandey et al., 2021).

Dental caries, commonly known as tooth decay, is a prevalent oral health issue affecting individuals of all ages worldwide. The overall prevalence of dental caries in India is reported to be 54.16%, with age-specific rates of 52% among individuals aged 3-18 years and 62% among those above 18 years(Kittur et al., 2021).

Worldwide, dental caries affects nearly 100% of adults in most countries, and among children, approximately 240 crore (2400 million) permanent teeth and 62.1 Crore (621 million) primary teeth are reported to be affected. Traditionally, caries removal has been performed using mechanical methods, such as drilling, to excavate the decayed tooth structure. However, it is effective, but this approach may cause discomfort, anxiety, and fear in some patients, leading to dental phobia and avoidance of necessary treatments(Kim et al., 2023; Philip and Suneja, 2023).

There are two schools of thought - complete caries removal and a newer concept referred to as selective caries removal. Complete caries removal, also known as "traditional" or "conventional" caries removal, involves the complete removal of all infected and affected dentin and enamel during cavity preparation(Clarkson et a., 2021).

The goal is to eliminate all decayed tissue and create a clean cavity before placing the dental restoration. It typically uses hand instruments, dental drills, or rotary instruments to remove the decayed material(Lim et al.,2023).

Selective caries removal, also known as "minimally invasive" or "conservative" caries removal, takes a more conservative approach to caries management. Instead of removing all decayed tissue, dentists selectively remove only the soft, actively infected dentin, leaving the harder, more mineralized dentin unaffected. The focus is on preserving healthy tooth structure while still removing areas of active caries (Widbiller et al.,2022).

The choice between complete and selective caries removal depends on various factors, such as the extent of decay, the patient's oral health, their risk of developing recurrent caries, and the dentist's clinical judgment(Widbiller et al.,2022).

Aim of Study

"To study and compare recent methods in caries removal in operative dentistry, assessing their effectiveness, efficiency, patient comfort, and impact on tooth structure preservation."

Chapter One

Literature review

Chapter One: Literature Review

1.1.Need for alternative methods for Caries Removal

The need for alternative methods of caries removal arises due to several factors. Caries, commonly known as tooth decay or cavities, is a prevalent dental problem affecting people of all ages. Traditional methods of caries removal involve the use of rotary instruments (drills) to remove decayed tooth material. While effective, these methods have some drawbacks and limitations. To address these issues, researchers have been exploring alternative methods with potential benefits. Here are some reasons why alternative methods are sought after (Jacobsen et al., 2011).

1. Minimally invasive dentistry: Traditional drilling methods often remove more healthy tooth structure than necessary, leading to the loss of tooth substance. Alternative methods aim to preserve as much healthy tooth structure as possible, minimizing damage to the surrounding tissues(Jacobsen et al., 2011).

2. Pain and anxiety reduction: Dental drills can cause discomfort and anxiety in patients. Alternative methods that are less invasive and more comfortable can help improve the overall dental experience for patients(Jacobsen et al., 2011).

3. Fear and phobia management: Dental phobia is a common problem that prevents many people from seeking regular dental care. Alternative methods that are less intimidating may help overcome this barrier(Jacobsen et al., 2011).

4. Preservation of tooth vitality: Some alternative techniques focus on preserving the vitality of the tooth, allowing it to maintain its natural function and responsiveness.

5. Faster treatment: Novel approaches may offer faster and more efficient caries removal, reducing the time spent in the dental chair. (Jacobsen et al., 2011).

6. Avoidance of heat and vibration: Dental drills generate heat and vibration, which can cause discomfort during the procedure. Alternative methods that do not produce these effects can enhance patient comfort(Jacobsen et al., 2011).

1.1.1.Concepts of caries removal

According to a consensus assessment published by Schwendicke et al. numerous approaches of caries eradication have been explained in the literature and can be classified into three types:(Maltz et al., 2012).

- Non-selective caries removal: The softened dentine in the cavity is removed until hard dentin is reached throughout the cavity, and the tooth is permanently restored.

- Selective caries removal: Caries removal differs depending on the location of the cavity. When all caries has been eliminated, the cavity will have hard dentin around its outer perimeter and soft dentin in the middle of the cavity, which can be readily excavated with a spoon excavator without exposing the pulp. Following that, a permanent restoration is placed at the same appointment(Schwendicke et al., 2016).

- Stepwise caries removal: This procedure consists of two different sessions scheduled 6–12 months apart. The initial session involves selective caries removal and the temporary restoration of the cavity. In the subsequent visit, the caries is completely removed, and the tooth is restored with a permanent restoration. Although selective caries removal in a single visit presents more favorable outcome than step-wise selective caries removal approach, this has been remained as a controversy among the dental practitioners (Schwendicke et al., 2016).

This can be due to inability to compare the long-term outcome between two techniques. One explanation for the preference for one-step selective caries removal is the avoidance of iatrogenic dam-age to the tooth structure while re-entering the cavity in order to replace the tooth with a permanent restoration, which would have been unavoidable with stepwise caries removal. The primary goal of removing carious lesion is to preserve the pulp vitality in order to increase the tooth longevity in the mouth (Maltz et al., 2012).

1.2.Mechanical Methods

Mechanical methods are traditional approaches to caries removal, relying on instruments like burs and excavators to physically remove infected dentin. While effective, their efficacy can vary depending on several factors:

1. Operators skill and experience: Skilled operators can minimize healthy tissue removal and achieve precise cavity preparation.

2. Caries depth and severity: Deep or extensive caries may require more aggressive removal, increasing the risk of complications(Shindova, 2021).

3. Instrument selection and technique: Appropriate burs and excavators used with proper technique can improve efficacy and reduce invasiveness(Shindova, 2021).

1.2.1. Advantages

1. Thorough removal: Can effectively remove even hard, deeply infected dentin.
2. Precise control: Allows for precise cavity preparation and margin shaping.
3. Familiar and widely available: Most dentists have extensive experience with mechanical tools(Shindova, 2021).

1.2.2. Disadvantages

1. Potentially invasive: Can remove healthy tooth structure along with infected dentin.

2. Risk of pulp exposure: Increased risk with deeper caries, potentially requiring root canal treatment.

3. Sensitivity: May cause post-operative sensitivity due to dentin removal near the pulp (Peters et al., 2006).

1.2.3. Tungsten carbide bur

Utilizing burs on a high-speed handpiece to reach the carious area and a low-speed handpiece to eliminate carious dentine are the most common approaches for removing caries and preparing cavities. Steel bur excavation and traditional rotary practices result in over-preparation by removing greatest amount of sound tissue possible while potentially overextending the cavity and destroying healthy tissue. Additionally, it generates pressure and heat on the pulp, vibration, noise, causes pain stimulus, and requires the need for local anesthetic. This approach leaves aversion and pain anxiety in many individuals, particularly children

Studies have been conducted to compare the traditional approach with other techniques. Divya et al. investigated the time required to remove the caries and found that the traditional burs (151 sec) remove caries faster as compared to Polymer bur (344.80 sec), Papacarie (359.60 sec), and Carisolv (461.60 sec). The number of bacterial colonies after caries excavation differed considerably among the four agents utilized, with Polymer bur samples containing the highest and Stainless Steel Bur rep-resenting only 10% of the specimens. Whereas Somani et al. found no significant difference in the presence of microorganisms following caries eradication between traditional burs and smart burs

1.3. Polymer Burs

Polymer burs commonly consist of Bis-phenol A diglycidyl ether dimethacrylate (Bis-GMA), Triethylene glycol dimethacrylate (TEGDMA), and Urethane dimethacrylates (UDMA). Alternatively, some burs utilize a combination of Bis-GMA, Polymethyl methacrylate (PMMA), and Methyl methacrylates (MMA). These burs are designed to reduce heat generation during cutting, which helps minimize the risk of damaging the tooth or causing discomfort to the patient. The use of polymer burs also decreases the likelihood of producing micro fractures in the tooth structure, promoting better long term outcomes(Prabhakar and Kiran, 2009).

Due to their softer nature compared to metal burs, polymer burs are less abrasive and cause less wear on dental restorative materials like composites, reducing the

potential for restoration damage over time. Recently, incorporating nanoparticles into these polymer matrices has gained traction as a response to two key demands: enhancing the biocompatibility of the burs and improving their effectiveness in demineralizing tooth surfaces. Furthermore, the use of polymer burs in dental procedures has been found to reduce the noise level, making the patient's experience more comfortable and less stressful during treatment. Overall, polymer burs have proven to be a valuable addition to modern dental practices, offering enhanced cutting efficiency, reduced heat production, decreased wear on restorative materials, and a more patient-friendly experience. Their increasing popularity demonstrates the benefits they bring to both dental professionals and patients alike(Asal et al., 2020).

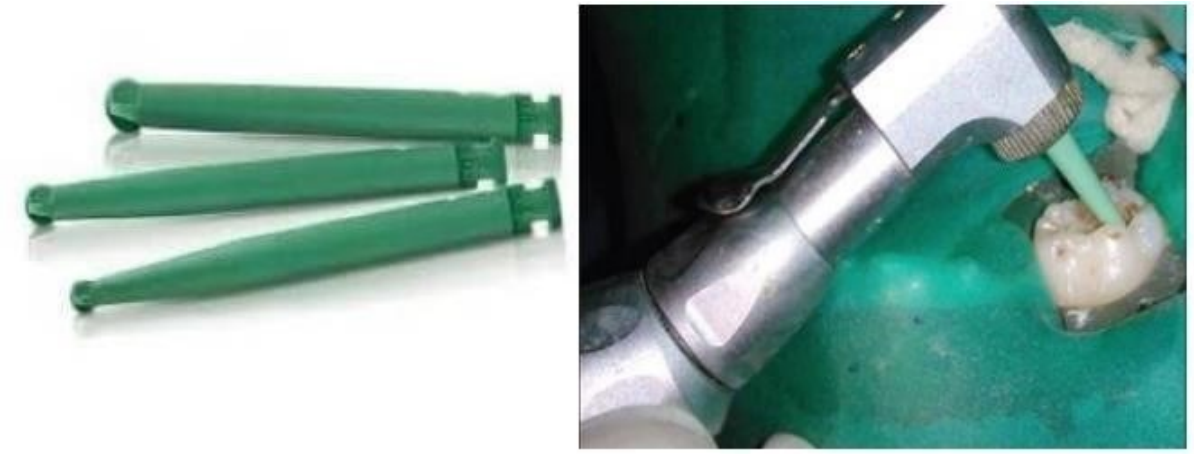

Figure 1:polymer bur

1.4. Air Abrasion

The procedure is conservative as it allows for the selective removal of decayed or damaged tooth structure, preserving more healthy tooth material compared to traditional drilling methods. The fine abrasive particles interact with the target area, causing minimal discomfort to the patient and often eliminating the need for local

anesthesia. The different air abrasive particles are Aluminum Oxide (Al2O3), Baking Soda (Sodium Bicarbonate - NaHCO3), Calcium Phosphate, Silicon Carbide and Glass Powder. Air abrasion offers several advantages, including reduced noise, less vibration, and a reduced risk of micro fractures compared to traditional dental drills(Mandinic et al., 2012).

Figure 2 : Air abrasion caries removal

Farooq et al. have explored fluoride-incorporated bioactive glass, discovering that reducing sodium content increases its hardness, which could be advantageous for creating bioactive glass air abrasives. Additionally, they demonstrated apatite formation in bioactive glass in Tris buffer solution, with potential implications for its abrasiveness compared to alumina in dentine air abrasion. Tan et al. invented a new customized fluoridated bioactive glass particles (Na0SR) and compared its efficacy against standard aluminum oxide particles. It was concluded that Na0SR

can be considered a viable abrasive alternative for alumina in air abrasion cutting because it performs similarly and has the added benefit of potentially facilitating remineralization and hydroxyfluorapatite production.

1.5. Laser

Laser technology has been in the scope of dentistry community since Stern & Sognnaes (1964) studied laser application on dental hard tissues. Lasers have become an attractive instrument for many dental procedures including soft tissues surgery, decontamination and for assuring anti inflammatory effects.

In restorative dentistry, laser has been used successfully for cavity preparation, caries prevention, caries decontamination and caries removal(Abdelaziz et al., 2022).

The use of lasers for cavity preparation and caries removal is based on the ablation mechanism, in which dental hard tissue can be removed by thermal and/or mechanical effect during laser irradiation.). This mechanism relies on the type of tissue to be irradiated, as well as the characteristics of laser equipments(Cardoso et al., 2020).

The laser drill has been proven to be efficacious in substituting the conventional traditional bur for cavity preparation. Initially only low-energy settings of the laser were used to help in achieving an analgesic effect on the tooth which is involved. This was followed by the higher-power setting of the laser which was done to aid in removing of the enamel and exposing the infected dentin. Consequently, the low power setting laser was used once for a second time for removing decayed dentin. There was difference in ablation rates for carious and sound tissue which led to selective elimination of carious lesions(Banerjee et al., 2000).

There is a rise in bond strengths of tooth-coloured materials because smear layer does not form when the tissue is irradiated with laser. In cases of carious lesions which are limited proximally having intact occlusal surface, lasers could be used to preparing a box only preparation on the proximal surface without destructing the sound occlusal surface (Banerjee et al., 2000).

In cases where the carious lesion extends deep within the tooth, lasers can be used to prepare the cavity, by restricting its initial depth of preparation and selective removal of the superficial layer of dentin without injuring the underlying pulp. The cases which require direct pulp capping treatment due to accidental pinpoint noncarious exposure, Er: YAG lasers can be used in a defocussed mode for partly necrotising the superficial tissue in order to create a defensive barrier surrounding the exposed pulp tissue(Banerjee et al., 2000).

1.6. Chemo-mechanical Caries Removal

Chemo mechanical caries removal (CMCR) is a minimally invasive technique of eliminating infected dentin using specific chemical agents and hand instruments. The method of caries removal is based on chemical dissolution. It is mainly indicated to overcome the use of burs and local anaesthesia, causing less discomfort to patients, preserving healthy dentin structure, thereby complying by the concept of minimal intervention dentistry (MID)(Sivapathasundharam, 2006).

The chemo-mechanical method is an effective alternative for caries removal because it brings together (Senthilkumar and Ramesh, 2020).

1. Atraumatic characteristics

2. Bactericide & bacteriostatic action

3. The active ingredient would soften the pre-Degraded collagen of the lesion without pain & undesirable effects to adjacent healthy tissues(Senthilkumar and Ramesh, 2020).

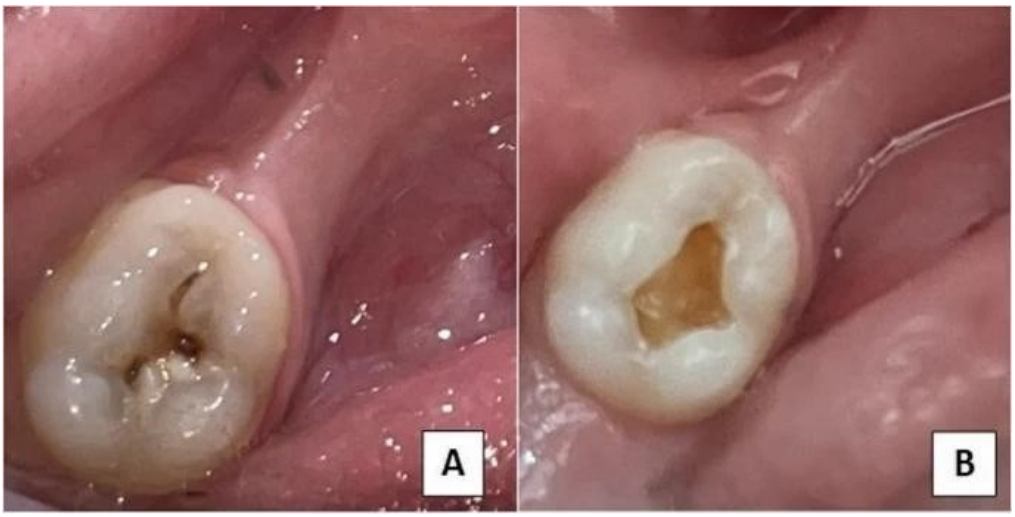

Figure 3: A Carious lower right E before Carie-CareTM application. B Lower right E after caries removal using Carie-CareTM

1.6.1. Caridex and Carisolv

In 1976, Goldman & Kronman, reported an alternative to tooth tissue removal – the possibility of removing carious material chemically using Nmonocloroglycine (NMG, GK-101). After subsequent modifications the caridex system, containing Nmonochloro D, L-2-amin-obutyrate (NMAB, GK101E), was introduced. This system was developed as a chemo-mechanical method for caries removal.

Carious dentine, softened further by NMAB (GK101E), should have been readily removed by lightly abrading its surface with the applicator tip. Many studies have indicated that in permanent teeth, the ability of carious dentine removal using NMAB was no greater than using a control of isotonic solution.

In deciduous teeth, however, addition of urea to the solution significantly improved carious dentine excavation compared with the some control solution without urea.

Carisolv™ reached the market promising to be more effective and easy to manipulate.

The key difference to other products already in the market was the use of three amino acids- lysine, leucine and glutamic acid(Sivapathasundharam, 2016).

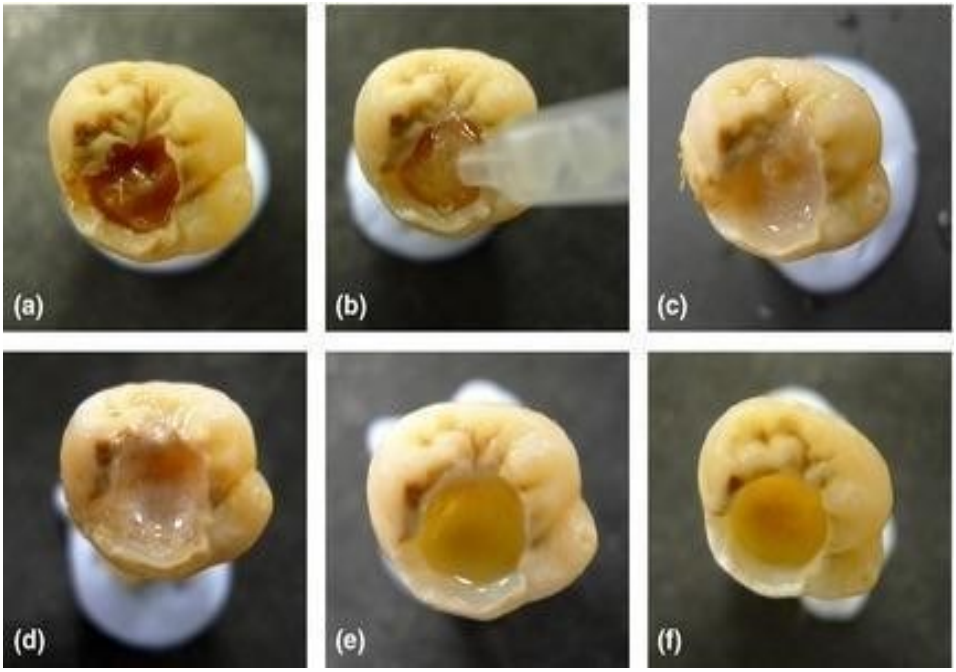

Figure 4 : Chemo mechanical caries removal procedures using Carisolv gel (Medi Team Dentalutveckling AB, Sweden). (a) Dentinal caries lesion. (b) The carious lesion was treated with Carisolv gel and left for 30 seconds prior to excavating the dentine. (c) Excavation of the caries using Carisolv non-cutting instruments (Medi Team Dentalutveckling AB, Sweden) until the gel becomes cloudy and then rinsed off with distilled water for 20 seconds. (d) The same process was repeated until successive application of the gel failed to become cloudy. €, (f) Post-excavation view of the lesion site.

1.6.2. New Cardisolv System (2013)

It was introduced by Rubicon Life Science and includes an advanced gel, a new excavation technique and a new patented caries detector. Special hand excavators with blunt cutting angles and the Komet bur Technology have been incorporated in this kit. The tissue preserving burs comprise of the ceramic bur CeraBur K1SM and the round polymer bur PolyBur P1. Duruk et al., 2022).

By means of a unique patented technology, the burs offer a considerably more minimally invasive treatment than traditional techniques. The CeraBur helps the dentist to distinguish between healthy and carious tissue in a tactile manner, which is reinforced when used with Carisolv Gel. The disposable PolyBur is softer than healthy dentin and is therefore self-limiting, and can thus be used in treatments close to the pulp. This new system provides an excellent bonding surface for bonded restorations(Peters et al., 2006).

1.6.3. PAPACARIE®

With the intension of presenting a chemo mechanical caries removal product that cost less than Carisolv® in 2003 Papacarie® a material was launched which consists of papain enzyme (extracted from the latex of leaves and fruits of the green adult Carica papaya tree, chloramine, toluidine blue, salts, preservatives, a thickener, stabilizers and deionized water. The main action depends on the presence of the papain enzyme which is a proteolytic enzyme that causes degradation of proteoglycans in the dentinal matrix(Parhizkar et al., 2017).

1.6.4. BIOSOLV

It is an experimental enzymatic chemo mechanical caries removal agent which is not commercially available (coded SFC-V and SFC-VIII). Based on the manufacturer's information, it consists of pepsin enzyme in a phosphoric acid/sodium biphosphate buffer. It is claimed that the phosphoric acid can dissolve the inorganic components of caries-infected dentine, while permitting the pepsin to selectively disrupt the denatured collagen fibres.

Meanwhile, this softened mass can then be easily removed by the specially designed plastics instruments (Star V1.3) without affecting sound tissue.

Figure 5: Carisolv system of caries removal

1.7. Sono Abrasion

Sono-abrasion is a minimally invasive procedure that uses high-frequency sound waves to remove decayed tooth tissue. It is a safe and effective alternative to traditional rotary instruments, which can cause heat, vibration, and noise. Sonoabrasion is also less likely to damage the surrounding healthy tooth structure. 31 The various tips used for enamel and dentine caries excavation are Enamel: Use finer grits (50 µm or less) of aluminum oxide (Al_2O_3) for initial caries or sensitive patients(Mandinic et al., 2022).

Dentine and deeper lesions: Use coarser grits (60-125µm) of Al_2O_3 for efficient removal. The procedure is performed using a handpiece that is fitted with a diamondcoated tip. The tip is vibrated at a high frequency, which creates sonic energy that is transferred to the tooth surface. This energy causes the decayed tissue to break down and be removed. Sono-abrasion is a relatively quick and painless procedure. It can be used to prepare cavities for fillings and crowns (Hassan et al., 2017).

Figure 6 : Instrument SF 849 009 SonicLine® (Komet) for pits and fissures, which allows opening and preparation of the carious distal occlusal fissure of tooth . A) tip on place B) final result

Figure 7: Instrument 42 311 Sonicflex® (Kavo) (diamond-coated ball and shaft) used here for an occlusal micro-preparation where there are cavities in the cuspal tips (21-year-old patient; severe erosion since childhood)

1.7.1. Limitations of Sono-abrasion

1. Limited Effectiveness on Hard Materials: Sonoabrasion is generally less effective at removing very hard materials such as old amalgam restorations. For instance, if a patient has a heavily calcified lesion or a very old filling, sono-abrasion might not be sufficient, and traditional methods may be necessary.

2. Generation of Heat: Similar to air abrasion, sonoabrasion can generate heat during the procedure. This can potentially cause discomfort or damage to the tooth if not managed properly. Effective cooling and water irrigation are required to mitigate this issue.

3. Potential for Sensitivity: The vibrations from the ultrasonic device can sometimes cause tooth sensitivity, particularly if the enamel or dentin is already

compromised. This can be uncomfortable for some patients, especially those with sensitive teeth.

4. Aerosol Production: Sono-abrasion can create aerosols, which poses a risk for the spread of infectious agents. Proper suction and infection control measures are necessary to minimize this risk.

5. Preparation Time and Precision: The process may take longer compared to traditional methods, especially for larger or more complex carious lesions. Additionally, while sono-abrasion provides good control, it may not always be as precise as hand instruments or rotary tools in certain situation.

1.8. Ultrasonic Method

Ultrasonic methods of caries removal involve the use of ultrasonic instruments to selectively remove decayed tooth structure. These instruments utilize highfrequency vibrations to break down and remove the infected dentin while preserving the healthy dentin. Ultrasonics are generally used in two types of frequencies.

1. Lower frequencies (25,000-30,000 Hz) tend to be more effective for removing softer caries and debris, while minimizing heat generation and damage to healthy dentin(Chery et al., 2022).

2. Higher frequencies (35,000-45,000 Hz) provide greater cutting efficiency for harder dentin but raise the risk of heat generation and potential damage to healthy tissue(Chery et al., 2022).

The ultrasonic device consists of a handpiece with a small, vibrating tip that can be directed precisely to the carious area. When activated, the tip vibrates at ultrasonic

frequencies, causing cavitation and microstreaming effects. These actions help to dislodge and remove the decayed dentin from the tooth.

1.The benefits of ultrasonic caries removal include its minimally invasive nature, which allows for the preservation of more healthy tooth structure.

2. It also reduces the risk of damaging the pulp and decreases patient discomfort during the procedure, often eliminating the need for local anesthesia.

Additionally, ultrasonic methods can be more effective in removing caries from difficult-to-reach areas, such as narrow pits and fissures. The fine and controlled vibrations of the ultrasonic tip allow for precise and targeted caries removal(Lima et al., 2009).

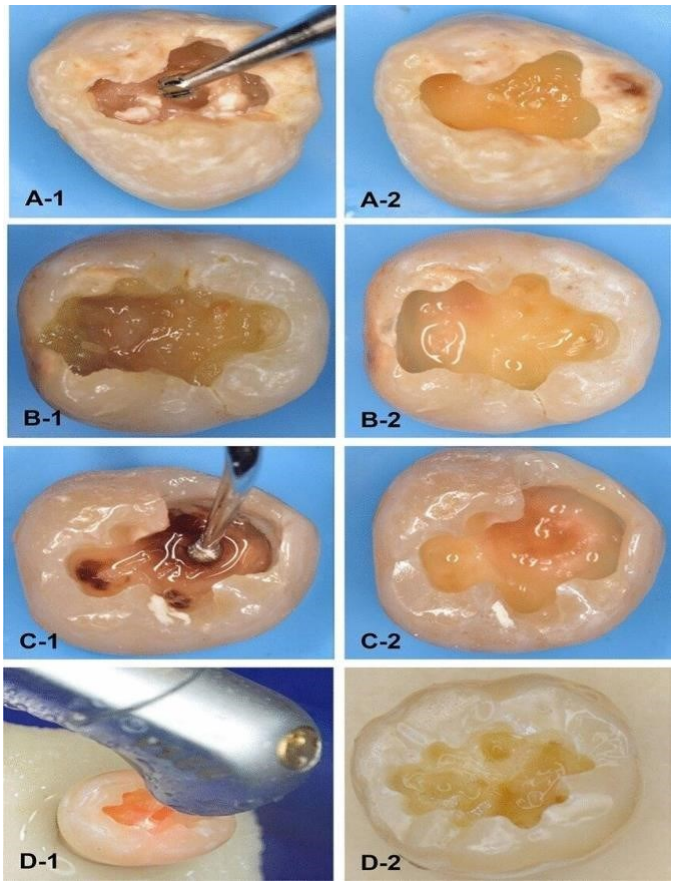

Figure 8 The caries excavation techniques for removing deep carious dentin lesions. (A-1) rotary excavation, (B-1) Brix 3000 application, (C-1) Ultrasonic Caries Removal Tip SB1, (D-1) Waterlase iPlus Er,Cr:YSGG Laser. (A-2,B-2,C2,D-2) The residual dentin after each technique, respectively.

1.9. Ozone Method

The ozone method of caries removal is a dental approach that utilizes ozone gas to treat decayed tooth tissue. Ozone, a molecule composed of three oxygen atoms, is applied to the affected area using a specialized device. Upon contact, ozone's oxidative properties break down bacterial cells and organic matter in the decayed tooth structure, aiding in disinfection and tissue removal. This technique aims to minimize damage to healthy tooth structure and has potential antimicrobial benefits(Almaz and Sönmez, 2015).

1.9.1. Contraindications of ozone therapy

1) Pregnancy.
2) Hyperthyroidism.
3) Glucose-6-phosphate-dehydrogenase deficiency.
4) Severe anemia.
5) Severe myastenia.
6) Active hemorrhage.
7) Acute alcohol intoxication(Almaz and Sönmez, 2015).

Figure 9: An ozone-generating system used in dental practice

Figure 10: Ozone can be used easily on children

1.10. Enzymes

Enzymes Studies have examined the possibility that carious dentine might be able to be removed by using certain enzymes. Goldberg and Keil In 1989, successfully removed soft carious dentine using bacterial achromobacter collagenase, which did

not affect the sound layers ofddentine beneath the lesion. Also, a more recent study has used the enzyme pronase, a non-specific proteolytic enzyme originating from Streptomyces griseus, to help remove carious dentine (Norbø H. et al,1996). This might have significant clinical implications but further laboratory research is required for validation of this technique (Banerjee, 2000).

1.11. What factors contribute to a favorable prognosis for the selective caries removal method?

A growing database of studies has also demonstrated that the selective caries excavation technique is prognostically effective. This procedure avoids injuring the dentine-pulp complex and removing a significant quantity of tooth tissue, preserving the pulp's vitality and improving the tooth's long-term prognosis.In the management of deep carious lesions, it's essential to thoroughly assess the final restoration to prevent potential failures in the tooth-restorative complex. Dentists should carefully inspect the restoration for surface irregularities and proper marginal integrity to avoid creating areas where plaque can accumulate. Leaving some carious tissue under a restoration after selective excavation could lead to legal issues. Patients need to be informed about the rationale behind this approach and the need for regular check-ups to ensure the tooth's pulp health over time Nevertheless, for long-term stability, cuspal coverage would be necessary to counteract the impact of repeated stress on the restoration for some cases(Takahashi et al., 1998).

Chapter Two

Discussion

2.1 Discussion

Dental caries, or tooth decay, is a common oral health problem caused by bacterial activity that demineralizes tooth enamel. While traditional caries removal involves mechanical drilling, several alternative methods have emerged, aiming to provide more conservative and efficient approaches. These alternative methods include

☆**Air abrasion**: Uses high-pressure streams of abrasive particles to gently remove decayed material, preserving more healthy tooth structure.

☆**Chemo mechanical removal**: Applies a chemical agent to soften carious tissue before mechanical removal with hand instruments.

☆**Ultrasonic method**: Employs high-frequency vibrations and water irrigation to eliminate decayed tissue with minimal damage to healthy structure.

☆**Ozone method**: Utilizes ozone gas to treat carious lesions, leveraging its oxidative properties to break down decayed tissue and disinfect the area.

☆**Laser technology**: Allows for precise tissue interaction, vaporizing decayed material while minimizing damage to healthy tooth structure. These alternative approaches offer potential benefits such as increased preservation of healthy tooth structure, reduced patient discomfort, and less need for anesthesia. However, their effectiveness varies depending on factors like the extent of decay, dentist expertise, and individual patient needs.

While these methods show promise for less invasive and more patient-friendly treatments, each has its own limitations. The choice of method should be based on careful consideration of the specific case and consultation with a qualified dentist.

Ongoing research and clinical studies are crucial to further establish the effectiveness and long-term outcomes of these alternative caries removal methods in various clinical scenarios.

Chapter Three

Conclusion

3.1 Conclusion

Modern caries removal techniques focus on minimally invasive dentistry, patient comfort, and preservation of tooth structure. While traditional rotary instruments remain widely used, these new methods offer promising alternatives, especially for pediatric, geriatric, and special needs patients. The ideal method depends on patient factors, caries extent, and clinical setting.

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