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CONSERVATIVE MANAGEMENT OF DEEP CARIOUS LESIONS. A NARRATIVE REVIEW.

Suhael Ahmed
College of Medicine and Dentistry, Riyadh Elm University, Riyadh, Saudi Arabia

Albandari Atallah Albaiji
General Dentist, Riyadh, Saudi Arabia

Fahad Adel Almuayqil
Prince Sattam Bin Abdulaziz University, AlKharj, Saudi Arabia

Munirah Ahmed Almuawwad
General Dentist, Abha, Saudi Arabia

Tasneem Abdulkhaliq Humhum
General Dentist, Abha, Saudi Arabia

Aisha Moajel Alshammari
University of Hail, Saudi Arabia

Abstract

The management of dental caries has undergone major advancements in recent years. The most up-to-date practical methods involve preventing tooth decay, detecting it early, and diagnosing it based on risk indicators and assessments of risk factors. Moreover, in accordance with the principles of minimally invasive dentistry, the novel management strategies aim to conserve healthy tissue and sustain the vitality of the dental pulp. This article provides a comprehensive summary of the most recent advancements in minimally invasive techniques for managing and treating dental caries. This material will aid the reader in promptly identifying, diagnosing, and treating dental caries. PubMed (MEDLINE), Web of Science, and Scopus search engines were utilized to collect the most pertinent data on minimally invasive dental caries management. The search was limited to a duration of 10 years, from January 2013 to December 2023, and only research written in the English language was examined. A boolean search was conducted on the PubMed dataset to merge various keywords. The applicable filters include abstract, free full text, full text, clinical trial, randomized control trial, systematic review, meta-analysis, and review. Additional studies were acquired through manual searches conducted on Google Scholar and dental caries textbooks. A total of 694 papers and studies were acquired through the utilization of this procedure and after exclusion 19 studies were included in the review. Only the most pertinent published research was selected and utilized in the present evaluation. In conclusion,the early identification and diagnosis of tooth decay using risk indicators and assessments of risk factors is highly successful. Moreover, the utilization of minimally invasive restorative procedures is

advantageous for the treatment of dental caries and the maintenance of healthy tissue and should be employed wherever feasible. These novel insights, expertise, and resources ought to motivate professionals to adopt this approach. It is crucial to have a plan and system that revolve around patient-centered care. Our dental duties should prioritize patient-centered care.

Keywords- ART, minimally invasive, caries, papacarie, laser, air abrasion

Introduction

In recent years, there have been major changes in the management of dental caries. Current practical techniques mostly rely on the early detection and prevention of dental caries. Furthermore, they aim to formulate a diagnosis by evaluating risk indicators and conducting a risk factor evaluation. The novel management strategies strive to conserve healthy tissue, as advocated in the field of minimally invasive dentistry. The primary objectives include adopting a proactive approach, conducting personalized risk evaluations for patients, promptly identifying dental decay, and promoting the remineralization of non-cavitated lesions. Restorative methods pose a risk to tooth tissue and may potentially jeopardize the long-term health of the tooth when it undergoes repeated restoration processes (Quist et al., 2008). Hence, in cases where restorative intervention is required, it is advisable to opt for a method that is minimally invasive. This encompasses the act of fixing, renovating, or shining up flawed restorations instead of completely replacing them. However, when dental decay causes the pulp to be exposed, it can now be treated in a more conservative manner than before. This involves utilizing vital pulp therapy (VPT), such as a partial or complete pulpotomy, as an alternative to pulpectomy. Regrettably, a significant number of dentists persist in employing invasive methods to address dental caries and pulp disease (Schwendicke et al., 2015). Nevertheless, the adoption of noninvasive and minimally invasive methods in routine clinical practice is expected to require a significant amount of time.This article offers a comprehensive introduction to the concept of minimally invasive dental caries control. Additionally, the text explores the various techniques utilized to achieve minimally invasive dentistry, which are determined by the size of the decayed area. This material aims to aid the reader in identifying, diagnosing, and treating dental caries at an early stage, as well as when it progresses to the dentine, using minimally intrusive treatment methods.

Materials and method

The analysis focused on articles pertaining to the subject that were published in the PubMed, Scopus, and Web of Science databases, with particular attention given to the most recent 10 years. The publications were assessed for quality using the PRISMA guidelines, which involve the processes of identification, review, selection, and inclusion. The evaluation of the reviews was conducted using the AMSTAR-2, a measurement tool specifically designed for assessing systematic reviews. The search was conducted with Boolean logical operators including AND, OR, and NOT. The terms "caries", "minimally invasive", "ART", "papacarie", "laser", and "air abrasion" were used. The keywords were utilized both alone and in relation to one another. A total

of 694 papers and studies were acquired through the utilization of this procedure and after exclusion 19 studies were included in the review.

Discussion

The conventional method for caries excavation involves the use of drills and hand devices with sharp edges. However, temperature effects and pressure on the pulp often result in discomfort, despite the notable benefits of simplicity, speed, and efficiency (Innes et al., 2016; Santamaria et al., 2014). Furthermore, extraction can result in the removal of healthy tooth tissue adjacent to the affected carious area. While they can be beneficial, they also have significant drawbacks. Firstly, determining the appropriate amount of dentin to remove can be challenging since there is a risk of removing healthy tooth structure along with the decayed tissue. Furthermore, the application of local anesthetics is necessary to mitigate the pain and suffering induced by mechanical techniques. One often employed strategy for eliminating decayed tissue is the utilization of rotators. However, this procedure inflicts harm on the tooth by removing healthy tissue, rendering it one of the most irritating approaches for the patient (Innes et al., 2019; Rickets et al., 2006).

Atraumatic Restorative Treatment (ART)

The use of ART minimizes the superfluous utilization of rotational instruments and local anesthetics, resulting in a reduction of patient distress and apprehension. The procedure involves utilizing a precise manual tool to extract the deteriorated tooth structure and subsequently restoring it with ionomer. This technique aims to target the underlying causes of dental caries as part of its protocol. This method selectively removes only the diseased dentin, which is incapable of undergoing remineralization due to the extensive disarray of the collagen fibers. Meanwhile, it preserves the affected dentin, which can undergo remineralization, thereby conserving a larger quantity of tissue. A pointed spoon excavator with a diameter of either 1 or 1.5 mm, specifically designed for extracting soft caries, is used in ART. In addition, a dental chisel can expand the cavity. The ART treatment is devoid of the necessity for a local anesthetic, as it is both painless and widely tolerated (Katz et al., 2013; Bjorndal et al., 2010). ART is indicated in circumstances involving young and uncooperative children, individuals with special needs, and situations when conventional dental treatment is not feasible and needs to be delayed (Craig et al., 2008). The benefits of ART include cost-effectiveness, widespread accessibility, utilization of manual instruments for restoration instead of power tools, preservation of healthy tooth structure, minimal noise compared to motorized instruments, reduced sensitivity and pain, leading to decreased reliance on local anesthesia, and decreased patient anxiety (Hevinga et al., 2010).

Papacarie

The chemomechanical caries extraction technique is a non-invasive form of manual excavation that selectively removes only the affected dentin while preserving the demineralized portion for

healing and remineralization. This approach effectively reduces pulp irritation and minimizes patient discomfort. The development of this technology took place in 1975. This approach involves the use of natural or synthetic chemicals to dissolve and assist in the removal of degraded tissue (Padmanabhan et al., 2021). Papain enhances the breakdown of collagen fibrils present in rotting tissue, hence making the tissue softer and easier to remove with manual equipment. Upon utilization, the gel frequently undergoes a color alteration and becomes murky or generates bubbles, facilitating the identification of the reaction's conclusion or the absence of any remaining decomposing tissue. Non-incisive tools are subsequently used to extract the softened tissue. Enzyme-based materials provide anti-inflammatory characteristics, potentially resulting in improved treatment outcomes and less pain induction. Sodium hypochlorite, being a hypochlorite agent, requires less anesthesia because of its targeted action on pre-existing damaged collagen fibrils. Among the chemical-mechanical approaches, Papacarie stands out. The agent is a gel comprising papain and chloramine, which is utilized alongside hand instruments to achieve minimally invasive elimination of carious tissue. The efficacy of this approach has yielded satisfactory outcomes in terms of clinical monitoring, anxiety levels, patient comfort, pain management, patient satisfaction, and cost-effectiveness (Carvalho et al., 2020). Papacarie gel is effective for treating children with special needs, pediatric dentistry, and people with phobias. The deployment of this method is a significant option in public healthcare because of its combination of practicality, user-friendliness, affordability, and the absence of the need for local anesthesia.

Er: YAG Laser

The laser is a solid-state device that utilizes a yttrium-aluminum-garnet crystal doped with erbium metal molecules as its active medium. This technique is among the most recent advancements in the world of dentistry. The emitted radiation falls within the infrared light spectrum and has a specific wavelength of 2940 nanometers. Water absorption makes this wavelength ideal for accurately and precisely removing biological tissues that contain water. This targeted approach helps to minimize the risk of thermal injury. The laser emits pulsed shots with durations in the nanosecond range. When directed at tissue, this laser radiation causes the water in the targeted area to evaporate, leading to a microexplosion in the adjacent hard tissue (Marcelino et al., 2021). Protoporphyrin, a byproduct of bacterial breakdown, stimulated by the excitation wavelength, is responsible for the observed fluorescence signal. This process is called ablation. The procedure results in low heat generation in the underlying tissues and a negligible temperature increase in the pulp chamber. The thermal consequences generated by alternative laser types are unlikely to be connected to the tissue degradation induced by the Er:YAG laser. The vaporization of water in the cementum and other dental hard tissues is responsible for the microbursts. The Er:YAG laser effectively eradicates and sterilizes dentin caries due to the microorganisms responsible for the disease causing the breakdown of organic matter and the removal of inorganic matter, resulting in the production of water-rich substances. The high absorption capacity of the Er:YAG laser allows for the selective and conservative removal of carious tissue without impacting the healthy tooth

structure, which is further enhanced by the higher water content in carious tissue compared to healthy dental hard tissues (Valenti et al., 2021).

Air Abrasion

Air abrasion, a less forceful method for removing caries than traditional procedures, can be effectively used with adhesive restorative materials. Alumina, despite its current widespread use as an abrasive for cutting, is associated with contentious health and safety concerns and lacks remineralization characteristics. This treatment method harnesses the kinetic energy of abrasive granules propelled by a stream of compressed gas, often air (Eram et al., 2023). The process involves propelling aluminum oxide particles at a high speed, which helps remove rough areas on the tooth's hard structures and causes an increase in temperature. Dentists employ this procedure to treat minor cavities. The pressure range spans from 40 to 160 psi, while the particle size varies from 27 to 50 um. As the size of the particle increases, its abrasiveness also increases. Aluminum oxide exhibits chemical stability, is non-toxic, and has an affinity for water. The distinguishing feature of this technique is its ability to avoid generating pressure, vibration, or excessive heat on the tooth being treated (Shindova et al., 2021). Consequently, it diminishes dread and anxiety in the patient. Effective cleansing and removal of stains on the tooth surface enable the identification of caries lesions in pits and fissures. It also allows for the extremely careful preparation of restoration margins that have areas of infiltration. This approach is novel because it selectively removes carious tissue without causing irritation to the pulp or surrounding tissues.

Conclusion

Pain often occurs as a result of heat and pressure effects on the pulp during the treatment of dental caries using rotating instruments. Furthermore, drilling may also entail the extraction of sound tooth tissue neighboring the afflicted caries region. As a result of the limitations of the bur, other methods, such as chemomechanical caries removal using sharp tools (ART), lasers, and abrasive air, have been developed. These procedures effectively break down the caries tissue while preserving the majority of healthy dentin.

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