# MINIMAL INTERVENTION DENTISTRY AND REDUCTION OF AEROSOL GENERATION OF COVID-19: EVIDENCE-BASED RECOMMENDATIONS

**REVIEW ARTICLE**

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## ABSTRACT

Transmission of the COVID-19 pandemic was spread by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The oral cavity appears to be a site for SARS-CoV-2 infection and its direct role in viral transmission between dental staff and patients. The aim of this study was evidence-based management for dental caries by Minimal Intervention Dentistry (MID) principles to reduce the generation of aerosols. The MID approaches were divided into 4 levels: non-invasive treatments, micro-invasive treatment, invasive treatment and mixed treatment. The management of caries disease and carious lesions focuses on the control and /or inactivation of the process, such as fluoride-based intervention, pit and fissure sealants, resin infiltration technique, atraumatic restorative treatment and hall technique. Minimal intervention practice protocols for managing carious lesions remove or reduce aerosol generation and are still effective post-COVID-19 care.

Keywords: COVID-19, Dental caries, Dental atraumatic restorative treatment, Fluoride.

## 1. INTRODUCTION

The emergence and rapid spread of coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), a potentially fatal

illness, is rapidly leading to public health crises across the world (Sales-Peres *et al*., 2020). Although SARS-CoV-2 transmission occur by the oral cavity, such as speaking, breathing, coughing, sneezing and even singing of infection (Huang *et al*., 2021).

The global impact of COVID-19 on oral health appears to be multidirectional and immunological, acting through multiple routes, reflecting the pathological nature of the coronavirus' respiratory tract invasion through mucous membranes (Dziedzic; Wojtyczka, 2021). Oral cavity is a critical local, due to the sites of early infection, they could play an important role in transmitting the virus via saliva, such as pneumonia and inflammatory bowel diseases.

Public health measures, such as practice of social distancing and wearing masks, are intended to combating the contraction of COVID-19. On the other hand, if there is a nasal infection that spreads to the oral cavity, the possibility of an oral infection via droplet/aerosol inoculation or fomite ingestion in the dental clinic increases the risks (Huang *et al*., 2021).

Considering oral diseases, cavitated caries lesions is still a higher problem. Traditionally, management of dental caries involved using instruments that have potential to generate bioaerosols containing saliva, blood, and tooth debris. Thus, a care position is to keep aerosol generation as low as possible (Eden *et al*., 2020).

The uncertainty surrounding the oral cavity represents an underappreciated location for SARS-CoV-2 infection and its direct role in viral transmission between dental staff and patients. The evidence-based management for dental caries by Minimal Intervention Dentistry (MID) principles to reduces the generation of aerosols is the aimed of this study.

## 2. DENTAL CARIES AND MINIMAL INTERVENTION DENTISTRY

Dental caries is a well-established multifactorial biofilm-mediated by a frequent intake of fermentable dietary carbohydrates. Clinically, the disequilibrium will influence the demineralization and remineralization processes that might lead to a mineral loss within dental hard tissues (Fejerskov; Nyvad; Kidd, 2015).

The current trend in treating dental caries is using nondestructive risk-based caries management strategies (Fontana *et al*., 2010). Assessment of the characteristics of a carious lesion, once detected, includes severity (depth and surface integrity), extent (enamel or dentin) and activity (active or inactive). Therefore, caries diagnosis is the art or act of identifying a disease from its signs and symptoms, allowing the identification of the past or present occurrence of the caries disease (Longbottom, 2009).

Minimal Intervention Dentistry (MID) is a philosophy of care that focus on tooth tissue maintenance, by means of prevention and interception of the disease still in its early stages (Eden *et al*., 2020). MID principles are based on disseminating information to developing skills and be motivated to be responsible for their own oral health take care of their own oral health (Mickenautsch, 2009).

The dental caries management strategy based on the individual patient risk assessment since each one has their own unique set of pathologic and protective factors. This involves an evaluation of the etiologic and protective factors and the establishment of the risk for future disease, followed by the development of a patient-centered evidence-based caries management plan (Maheswari *et al*., 2015) The balance between protective factors, such as saliva and its components (fluoride, phosphate and calcium) and pathological factors as bacteria, frequency of ingestion of fermentable carbohydrates and reduced salivary function is the most important aspect between demineralization and remineralization (Leal; Nyvad, 2016).

The most common intervention for dental caries continues to be conventional restorative treatment (Ricketts, Pitts, 2009), using rotary instruments and resins (Araujo *et al*., 2020).

In addition to the approach of caries disease at the patient level, MID philosophy take care of managing carious lesions, slowing the downward restorative spiral and reducing discomfort during the conventional dental treatment (Frencken, 2017). Therefore, MID initiative can and should be applied to any patient, regardless of age, and in both dentitions. For the pediatric patient, however, the recommended treatment strategies, in addition to preserving dental tissues, are considered more friendly

treatment options, triggering lower levels of anxiety in the patient with the same effectiveness as conventional treatments (Leal, 2014).

The management of caries disease and carious lesions focuses on the control and /or inactivation of the process, with maximum preservation of dental tissue that helps the tooth to remain functional for as long as possible (Schwendicke, *et al*. 2016). Approaches such as non-invasive, microinvasive, invasive and mixed (Figure 1) fit in with MID principles.

Recently, the use of non-restorative approaches to manage cavitated dentin carious lesions has been advocated. Various non-invasive approaches for treating early childhood caries have been proposed, such as brushing with fluoridated toothpaste and the use of fluoride varnish (Gao *et al*., 2016), silver diamine fluoride solution (Clemens; Gold; Chaffin, 2018) xylitol, chlorhexidine and casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) (Li *et al*., 2014). Sealants and resin infiltration of fissure caries lesions are microinvasive treatments (Lausch *et al*., 2017). Invasive treatment is a selective removal of decayed tissue, such as atraumatic restorative treatment.

Atraumatic Restorative Treatment (ART) has been commonly used in pediatric dentistry because it is associated with lower levels of anxiety, pain and discomfort, as well as greater acceptance by children, compared to the conventional treatment (Araujo *et al*., 2020). Moreover, Hall Technique (HT) is also a non-aerosol generating procedure that has become routinely used in many countries (AAPD, 2018–2019).

A recent clinical study conducted by Araújo *et al*. (2020) investigated HT and ART restorations placed in a school setting after 36 months. The data suggest that both ART and the HT were acceptable to the subjects and their parents. However, the crown appearance concerned almost a quarter of parents in the HT group. Children experienced less discomfort in the ART group, but HT had almost three times higher survival rates for restoring primary molar occluso-proximal cavities compared to ART. It was concluded that both treatments can be performed in a non-clinical setting and have the advantage of being non-aerosol generating procedures (Araújo *et al*., 2020)

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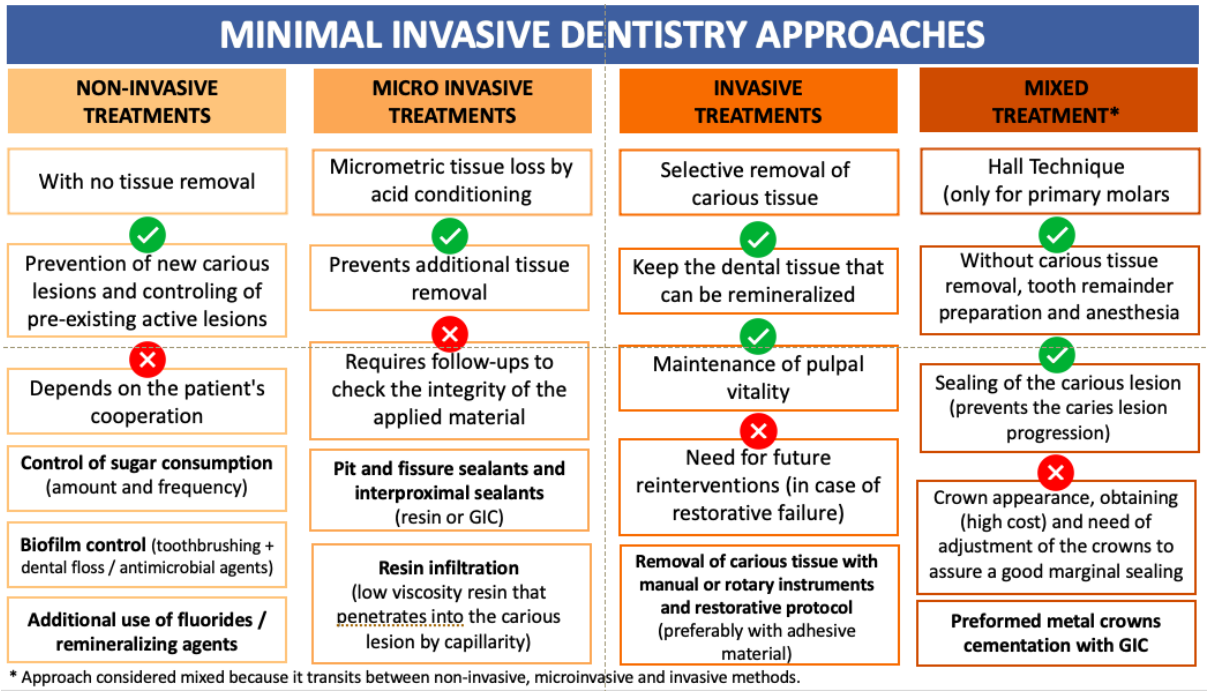
Figure 1. Levels of intervention for the treatment of dental caries according to minimal intervention dentistry with a description of the main positive (✓) and negative (✗) aspects of each approach




Source: Authors, 2024.

## 3. MID APPROACHES

## 3.1 FLUORIDE-BASED INTERVENTIONS

Non-restorative treatments have the intention to avoid the loss of sound tooth tissue. An important systematic review with network meta-analysis conducted by Urquhart *et al*. (2019) outlines the evidence on nonrestorative treatments for two clinical outcomes: 1. arrest/reversal of non cavitated and cavitated carious lesions on primary and permanent teeth and 2. adverse events. The results indicated that 5% NaF varnish was the most effective approach for arresting/reversing noncavitated facial/lingual carious lesions (low certainty) and that 38% Silver Diamine Fluoride (SDF) solution applied biannually was the most effective for arresting advanced cavitated carious lesions on any coronal surface (moderate to high certainty) (Urquhart *et al*., 2019) SDF treatment is noninvasive and easily operated. It can be a promising strategy to manage

dental caries in young children or those who have special needs (Table 1) (Gao *et al*., 2016).

Table 1. Technical specifications for Silver diamine fluoride

| | |
|---|---|
| **Component parts** | Solution containing ionic silver, fluoride, and ammonia in different concentrations (12%, 30% e 38%) |
| **Clinical indications** | 1. As an agent to inhibit dental caries<br>2. In the prevention of dental caries in children<br>3. In the prevention of secondary caries<br>4. In the prevention of cavities in pits and fissures<br>5. As a dentin desensitizer |
| **Instructions for use** | I - Shock treatment: 4 weekly applications, lasting 1 to 4 minutes depending on age.<br>II - Maintenance treatment: 1 application every 6 or 12 months.<br>Technique or procedure:<br>1. Dental clean or prophylaxis;<br>2. Protect soft tissues with petroleum jelly or rubber dam isolation;<br>3. Dry and apply the product for about 2 to 3 minutes;<br>4. Wash |

Source: Authors, 2024.

## 3.2 PIT AND FISSURE SEALANTS

In the past, pit and fissure sealants were indicated on healthy surfaces considered at risk for the development of caries lesions, however, according to MID principles, the main indication of this strategy is for incipient lesions control. When applied to the occlusal surface, the sealant prevents the biofilm from coming into contact with the pits and fissures, thus preventing the penetration of bacterial acids associated with the development of the lesion (Splieth *et al*., 2010) (Table 2).

As for the restorative material, the sealants can be resinous or ionomeric. Even if the "fluoride-releasing resin sealants" are better than "Glass Ionomer Cement (GIC)", with regards to retention of the material, their effectiveness in preventing fissure caries in permanent molars seems to not differ significantly over 24 months (Colombo; Beretta, 2018) it may be possible since remains of the GIC could be microscopically found at the bottom of the pits and fissures even though the material is no longer seen clinically (Frencken; Wolke, 2010) (Table 2).

Table 2. Technical specifications for therapeutic pit and fissure sealants

| | |
|---|---|
| **Composition** | Glass ionomer or resin-based materials |
| **Clinical indications** | To prevent the progression of an existing caries lesion as initial enamel lesions and dentin lesions with limited depth up to half of the dentin and extension (cavity opening) of a maximum of 3.0 mm[26] |
| **Instructions for use** | Follow the manufacturer's guidelines |

Source: Authors, 2024.

## 3.3 RESIN INFILTRATION TECHNIQUE

Sealing caries lesions on proximal surfaces has also been seen as a promising treatment[27], however, the drawback is the need for two clinical sessions, the first being to place the elastic separator to enable access for treatment of the lesion. In this context, resinous infiltration has the advantage of being applied in a single session by means of a different technique as to the mechanism of action. According to a recent ultramorphological analysis resin infiltrant filled the spaces between the crystallites and resulted in an enamel hybrid layer (Perdigão, 2020) (Table 3).

Table 3. Technical specifications for resin infiltration

| | |
|---|---|
| **Component parts** | Icon© (DMG, America, Ridgefield Park, USA)<br>Smooth Surface or proximal kit with needed accessories for application<br>Icon-Etch (15% hydrochloric acid)<br>Icon-Dry (99% ethanol)<br>Icon-Infiltrant (Low-viscosity resin) |
| **Clinical indications** | 1. Arrests caries at an early stage (noncavitated lesions)<br>2. Proximal lesions radiographically enclosed to the outer enamel half<br>3. Esthetic results on smooth surfaces (White spots in post-orthodontic patients)<br>4. Preserves healthy tooth structure |
| **Instructions for use** | 1. Local anesthesia and rubber dam isolation<br>2. Dental cleaning with prophylaxis paste<br>3. Application of the Icon-ecth (2 minutes)<br>4. Rinse with water for 30 seconds<br>5. Application of the Icon-dry (30 seconds)<br>6. Inspection of the need of reapplication the icon etch (appearance of white spot lesion discoloration)<br>7. Application of the Icon infiltrant (3 minutes)<br>8. Removal of excess resin with cotton roll<br>9. Light cure (40 seconds)<br>10. Infiltrant resin reapplication (1 minute), removal of excess and light cure<br>11. Surface polishing |

Source: Authors, 2024.

## 3.4 ATRAUMATIC RESTORATIVE TREATMENT (ART)

ART is a managing dental caries method based on 2 columns: sealants for preventing carious lesions in pits and fissures and restorations for cavitated dentine carious lesions. Treatment according to ART is always combined with a caries preventive program (biofilm control and diet guidance) (Leal *et al*., 2018) (Table 4).

At the beginning of the ART approach development, the indication of ART restorations was restricted to teeth with dentine cavities in communities without access to conventional dental treatment (Frencken *et al*., 1998), however, the ART method is currently a standard practice in modern dental clinics in many countries, especially indicative for uncooperative patients, the elderly, and special needs patients (Honkala *et al*., 2003) (Table 4).

The principles of the MID concept since only the “infected” carious tissue is removed, local anesthesia is seldom required and dental anxiety in children is reduced (De Menezes *et al*., 2011) considered a patient friendly approach (Frencken; Leal; Navarro, 2012). Both cavity opening and carious tissue removal are performed exclusively by hand instruments (Leal *et al*., 2018). It is important to note that operator and type of restoration are significant factors influencing the success rate of ART restorations (Jiang *et al*., 2021), highlighting the importance of technical training and use of good quality restorative material (Table 4).

Table 4. Technical specifications for Atraumatic restorative treatment

| **Component parts** | Hand instruments and high viscosity glass-ionomer cement |
|---|---|
| **Clinical indications** | 1. Single-surface cavities in primary and permanent teeth<br>2. Multiple-surface cavities in primary teeth |
| **Instructions for use** | 1. Toothbrushing or removal of the biofilm with a cotton ball and water<br>2. Relative isolation (cotton roller)<br>3. Access to the lesion (ART opener instrument)<br>4. Enlargement of the lesion to removal of enamel without support (ART enlargement instrument)<br>5. Selective removal of decayed tissue with excavator instruments<br>6. Handling and application of the restorative material according to the manufacturer's instructions<br>7. Finger pressure to adapt the restorative material<br>8. Removal of excesses with sculpting/ remover instrumental<br>9. Surface protection of the restoration (petroleum jelly or top coat) |

Source: Authors, 2024.

## 3.5 HALL TECHNIQUE (HT)

Although ART was developed to address the high dental treatment need, its survival rate in occluso-proximal lesions is low. An alternative, for occluso-proximal lesions is the Hall Technique (HT) (Hesse *et al*., 2016).

The HT is a less invasive caries management technique for treating asymptomatic carious primary molars (Midani *et al*., 2019). HT seems to be a durable and economical management option for primary molars with carious lesions, which in addition offers the benefit of full coronal coverage, reducing the risk of future carious lesion development (Santamaría; Innes, 2018) (Table 5).

The technique combines the biological management of caries lesions (depriving bacteria of nutrition by sealing the cavity) with the preservation of dentinal structure showing a similar success rate for stainless steel crowns placed with the traditional technique (with local anesthesia, removal of carious tissue and cavity preparation) or the Hall technique (Ludwig *et al*., 2014) Furthermore, compared to conventional restorations, HT presents less discomfort associated with the procedure and is less prone to the development of problems such as pain and abscess (Innes *et al*., 2015) (Table 5).

One of the concerns with the HT has been the increase in the occluso-vertical dimension (OVD) after the crown cementation. (Altoukhi; El-Housseiny, 2020) The literature shows that children does not seem to be bothered by the transient occlusal alteration, which resolves within a few weeks, with no detriment with no temporomandibular joint pain (Van der zee; Van Amerongen, 2010) (Table 5).

In spite of the final appearance of a metal crown can present a problem for some parents, children do not seem to mind the appearance and commonly report very positively on their crowns, referring to them as their ‘special’, ‘shiny’, ‘space’ ‘princess’, ‘Iron Man’, ‘pirate’ or ‘star’ tooth (Foster Page *et al*., 2014) (Table 5).

Table 5. Technical specifications for Hall technique

| | |
|---|---|
| **Component parts** | Preformed stainless steel crowns and glass ionomer luting cement |
| **Clinical indications** | 1. Proximal lesions<br>2. Cavitated or non-cavitated occlusal lesions, non-cavitated if the child is unable to accept a fissure sealant |

| | |
|---|---|
| | 3. Occlusal lesions, cavitated if the child is unable to accept selective caries removal |
| **Instructions for use** | 1. Protect airway with gauze<br>2. Proof of different crowns over the tooth until the correct size is found (covering the cusps and giving a feeling of 'spring back')<br>3. Dry the crown, and fill with glass-ionomer luting cement, ensuring the crown is well filled<br>4. Fully seating the crown. The child can use their bite force to seat the crown with cotton wool. The gingiva appears to be blanching as the crown is sitting slightly subgingivally. |

Source: Authors, 2024.

## 4. DISCUSSION

This review provides scientific information on dental caries treatment procedures through Minimal Intervention Dentistry (MID) as an alternative to reducing aerosols in dental care, in pandemic situations.

Coronavirus disease 2019 (COVID-2019), caused by SARS-CoV-2, was declared a pandemic by the World Health Organization in 2020, and with its rapid spread, it brought new challenges to healthcare professionals and managers around the world1. In this sense, the dental office has become an environment with a high risk of cross-contamination due to the large dissemination of aerosol particles generated by dental care, associated at the time with inconclusive biosafety protocols, leading to concerns, fear, and insecurity for dental surgeons and patients (Bertevello *et al*., 2022).

Therefore, the pandemic brought the need to highlight alternative behaviors to the routine of dental offices, therefore the results of a study carried out by Eden, *et al* (2020) corroborate our findings, as tooth decay is still an oral condition of greater prevalence, causing pain and limitations to patients. Thus, over the years, the evolution of dentistry has brought new equipment, techniques, and scientific evidence on the determining and modifying factors of tooth decay. Therefore, minimally invasive dentistry as an alternative for the treatment of tooth decay has been improved by several scholars, as it promotes limiting the progression of tooth decay without the need for aerosol-generating equipment.

Regarding the management of injuries in the philosophy of minimum intervention Gao *et al*., (2016) and Tannure *et al*., (2022) report that non-invasive treatments involve

educational and preventive measures to control the disease such as reducing sucrose consumption, guidance on tooth brushing, use of fluoridated toothpaste and fluoridated varnishes. Clemens; Gold; Chaffin (2018) add that silver diamine fluoride is an easy-to-apply agent for stopping the progression of carious lesions in children at high risk for the disease, it is painless and does not require instruments and is easy to accept for parents and children.

Our results also demonstrate that restorations performed with glass ionomer cement, using the ART technique, are indicated in cases where it is necessary to reduce aerosols, as this technique consists of the selective removal of decayed tissue using dentin curettes and subsequent application of glass ionomer.

The longevity of these restorations has already been reported in the literature over the years, as evidenced by Honkala *et al*, (2003) where class I restorations in primary molars after two years of follow-up showed a high success rate.

However, it is worth highlighting that several factors must be observed when choosing the restorative technique. A randomized clinical trial in a school environment, in which Araujo *et al*., (2020) confirmed that restorations with glass ionomer cement using the ART technique were well accepted by children and their guardians, in caries lesions in primary teeth involving the proximal ones Steel crowns showed greater longevity when compared to ART restorations. Therefore, professionals need to always be up to date regarding the indications for restorative materials as well as the best technique for each patient.

Our findings reinforce scientific knowledge regarding the management of carious lesions in primary and permanent teeth, as an effective alternative for the control and treatment of dental caries, given its high prevalence associated with the context of situations in which it is necessary to prevent the spread of droplets of saliva, as was the case with the COVID-19 pandemic. All reported techniques can be used by dental surgeons regardless of specialty or place of practice.

The limitations presented to the study are mainly related to the study design, which predominantly involves qualitative analysis and the risk of selection and evaluation biases of the work. To minimize this fact, focus restriction was adopted, establishing

clear criteria for searching the literature, focusing on a specific set of studies, and establishing relevant selection criteria. The strengths are based on the possibility of guiding healthcare practice through the protocol discussed and presented.

## 5. CONCLUSIONS

Minimal intervention practice protocols for managing carious lesions, such as the atraumatic restorative technique, silver diamine fluoride and the Hall Technique, remove or reduce the generation of aerosols and can allow a successful risk reduction approach and are still effective care pos-COVID19.

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