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**Yulissa Martinez Valdes**  
Master of Sciences Student,  
Universidad Autonoma de Nuevo  
Leon, Facultad de Odontologia,  
Monterrey, Nuevo Leon, 64460  
ZIP, Mexico

**Sergio Eduardo Nakagoshi Cepeda**  
Professor, Universidad Autonoma  
de Nuevo Leon, Facultad de  
Odontologia, Monterrey, Nuevo  
Leon, 64460 ZIP, Mexico

**Adriana Leticia Garcia Moyeda**  
Professor, Universidad Autonoma  
de Nuevo Leon, Facultad de  
Odontologia, Monterrey, Nuevo  
Leon, 64460 ZIP, Mexico

**Karla Isabel Juarez Ibarra**  
Professor, Universidad Autonoma  
de Nuevo Leon, Facultad de  
Odontologia, Monterrey, Nuevo  
Leon, 64460 ZIP, Mexico

**Luis Martin Vargas Zuñiga**  
Professor, Universidad Autónoma  
de Guerrero, Facultad de  
Odontología, Acapulco de Juárez  
de Guerrero, México

**Jose Francisco Giles Lopez**  
Professor, Universidad Autónoma  
de Guerrero, Facultad de  
Odontología, Acapulco de Juárez  
de Guerrero, México

**Juan Manuel Luna Gomez**  
Professor, Universidad Autónoma  
de Guerrero, Facultad de  
Odontología, Acapulco de Juárez  
de Guerrero, México

**Juan Manuel Solís Soto**  
Professor, Universidad Autonoma  
de Nuevo Leon, Facultad de  
Odontologia, Monterrey, Nuevo  
Leon, 64460 ZIP, Mexico

**Corresponding Author:**  
**Juan Manuel Solís Soto**  
Professor, Universidad Autonoma  
de Nuevo Leon, Facultad de  
Odontologia, Monterrey, Nuevo  
Leon, 64460 ZIP, Mexico

## Minimally invasive treatments for pediatric dentistry

**Yulissa Martinez Valdes, Sergio Eduardo Nakagoshi Cepeda, Adriana Leticia Garcia Moyeda, Karla Isabel Juarez Ibarra, Luis Martin Vargas Zuñiga, Jose Francisco Giles Lopez, Juan Manuel Luna Gomez and Juan Manuel Solis Soto**

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### Abstract

**Introduction:** Minimally invasive (MI) treatment of dental caries is an approach that considers the management of carious lesions with conservative techniques to preserve maximum tooth structure.

**Objective:** To analyze the literature on some MI treatment alternatives for the management of caries lesions that are currently used, sealants, atraumatic restorative treatment, infiltration and Hall technique.

**Methodology:** An extensive literature search was carried out in the PubMed, SCOPUS and Google Scholar databases, analyzing the keywords: minimally invasive treatments, sealants, atraumatic restorative treatment, resin infiltration and Hall technique.

**Results:** Pit and fissure sealants show high rates of durability, both in permanent and primary teeth, they help to reduce and stop caries. Atraumatic restorative treatment (ART) helps stop active caries and cavitated caries, stops the spread of infection, decay, relieves pain and anxiety. Infiltrative resin helps in the reduction of white stain, although it has been found to be more effective in fluorosis and hypo mineralization can be used in both permanent and primary teeth, it reduces and seals the white stains to stop their progression. The Hall technique controls carious lesions in primary molars, shows a low failure rate and offers good acceptance in uncooperative patients, although it may be more uncomfortable for patients.

**Conclusions:** Pit and fissure sealants and infiltrative resin are good treatments of choice for patients with mild carious lesions either active or inactive, atraumatic restorative treatment and the Hall technique are treatments that can be used when moderate carious lesions and in situations where a traditional dental clinic is lacking.

**Keywords:** Minimally invasive, sealants, atraumatic restorative treatment, resin infiltration and Hall technique

### 1. Introduction

Minimally invasive treatment (MIT) of dental caries is an approach that considers the management of carious lesions with conservative techniques to preserve maximum tooth structure [1].

The advent of adhesive and bioactive dental materials that micromechanically bond to the tooth and provide support has made extensive removal of tooth structure unnecessary for restoration retention [2].

A better understanding of caries pathology combined with new dental materials and evidence gathered from clinical studies have paved the way for non-invasive and minimally invasive treatment approaches, which emphasize maximum preservation of healthy tooth structure and avoid the need for conventional restorations that often submerge the tooth in a treatment cycle [3]. Pit and fissure sealants are plastic materials used to seal deep pits and fissures on the occlusal surfaces of teeth. The application of a pit and fissure sealant, a non-invasive preventive approach, can prevent dental caries by forming a protective barrier that reduces food entrapment and bacterial growth [4].

Atraumatic restorative treatment (ART) consists of the removal of carious tissue with hand instruments, followed by restoration of the cavity with an adhesive material, mainly glass ionomer cement [5].

Resin infiltration into the microporous enamel areas of initial non-cavitated carious lesions is obstructed by light-cured resins of low viscosity, thereby inhibiting caries progression [6].

The Hall technique is a non-invasive treatment for primary molars in non-cooperative patients. The carious lesion is sealed under preformed stainless-steel crowns [7].

The current recommendations in pediatric dentistry restorations are the preservation of dental tissue and minimally invasive treatments, which are the treatments of choice at present. In this work we analyzed the literature on the most common MI alternatives for the management of caries lesions, such as sealants, ART, infiltration and Hall's technique.

## 2. Materials and methods

Articles on the subject published through the PubMed, SCOPUS and Google Scholar databases were analyzed, with emphasis on the last 5 years. The quality of the articles was evaluated using guidelines, i.e., identification, review, choice and inclusion. The quality of the reviews was assessed using the measurement tool for evaluating systematic reviews [8]. The search was performed using Boolean logical operators AND, OR and NOT, with the keywords: minimally invasive treatment, sealants, atraumatic restorative treatment, resin infiltration and Hall technique. The keywords were used individually, as well as each of them related to each other.

## 3. Results & Discussion

### 3.1 Pit and fissure sealants

#### 3.1.1 Efficacy

Pit and fissure sealant is an effective means of preventing pit and fissure caries in primary and permanent teeth [9].

Resin-based sealants (light-curing, self-curing and fluoride-releasing sealants) that are placed in conjunction with acid etching show high long-term retention rates [10].

The main recommendations are that pit and fissure sealing of primary and permanent teeth is safe and effective in both preventing and arresting caries [11].

#### 3.1.2 Usage Considerations

Sealants are the primary recommended method of caries prevention. The clinical efficacy of sealants is directly related to their retention potential [12].

In addition, they were effective in reducing *S. mutans* counts, so it can be concluded that they can be used effectively on tooth surfaces as a preventive material to help decrease the incidence of dental caries in children [13, 14].

#### 3.1.3 Limitations

An important limitation is the correct adhesion to the tooth surface, the application of sealant with bonding agent showed a higher retention rate than without the use of bonding agent [15].

Sealant placement in non-cavitated caries lesions is good, but individual risk assessment and comprehensive clinical judgment should be considered [16].

The preventive effects of the sealant are only maintained as long as it remains fully intact and adhered in place, therefore, it should be kept in mind that they should be followed up to verify that the sealants are maintained in good condition [17].

Pit and fissure sealants show high rates of durability, both in permanent teeth and in primary teeth, they help to reduce and stop caries, and it should be considered that they should be followed up to verify that they remain in good condition and

continue to fulfill their preventive function.

## 3.2 Atraumatic restorative treatment

### 3.2.1 Efficacy

The ART approach can be used to control cavitated caries lesions in children. The operator and restoration type are significant factors influencing the success rate of restorations [18]. It is efficient, affordable and practical for the treatment of single-surface cavities in primary posterior teeth [19]. It stops the spread of infection, decay, relieves pain and anxiety without resorting to aggressive treatments such as pulp treatment or extraction [7].

### 3.2.2 Usage considerations

It is used to treat patients in dental clinics to control caries progression or manage certain health characteristics of the patient [20]. This treatment can be performed in a non-clinical setting and has the advantage of being a non-aerosol generating procedure [21].

ART helps to stop active caries in primary and permanent teeth [22]. It is a clinical treatment that can be used to treat caries in young children and helps to significantly reduce the levels of *Streptococcus mutans* in saliva [23].

### 3.2.3 Limitations

The survival rate of ART for occlusal-proximal lesions is low compared to an occlusal lesion [24].

The most common side effect of SDF is staining of the teeth and oral mucosa due to inadequate isolation. This staining is the result of silver oxidation and affects only the damaged part of the tooth; healthy enamel is not affected [25].

ART helps to stop active caries and cavitated caries, stops the spread of infection, decay, relieves pain and anxiety, can be performed in a non-clinical setting, survival in occlusal-proximal lesions is low, but in single surface cavities it is efficient, the limitation of this treatment is the staining of the silver in both tooth and mucosa if there is not adequate isolation.

## 3.3 Infiltrative resin

### 3.3.1 Efficacy

Resin infiltration and fluoride varnish are clinically viable and effective methods for the treatment of white spot caries [26]. It has been shown to be effective in the resolution of white spot lesions [27]. Resin application improves the white spot lesion and is more effective than varnish and fluoride [28].

### 3.3.2 Use Considerations

Resin infiltration treatment has been found to be more effective in teeth with fluorosis [29]. It has been found that improve the esthetics of hypo-mineralized incisors [30]. It significantly changes surface roughness, microhardness and shear bond strength in both solid enamel and white stains [31] and can be used in both permanent teeth and primary dentition to reduce white spots and preserve tooth tissue [32].

### 3.3.3 Limitations

Infiltrative resin treatment is sometimes not able to completely camouflage white stains, but it is able to reduce them [33]. Although some concerns have been raised about radiopacity, color stability and its use in deep dentin lesions [34].

Infiltrative resin helps to reduce white stain, although it has been found to be more effective in fluorosis and hypo mineralization, it can be used in both permanent and primary

teeth, it reduces and seals white stains to stop their progression.

### 3.4 Hall Technique

#### 3.4.1 Efficacy

The Hall technique appears to be a good method for controlling dental caries in primary molar teeth <sup>[35]</sup>. It shows high acceptability and longevity and a low failure rate for the management of carious primary molars compared to conventional treatment options commonly applied in primary care settings <sup>[36]</sup>. It offers an effective treatment option for the management of dental caries in primary molar teeth, especially in-patient misconduct or difficult handling and where treatment under general anesthesia can sometimes be a problem <sup>[37]</sup>.

The Hall technique is not only a predictable restorative option but has significantly outperformed the conventional method of treating decayed primary molars <sup>[38]</sup>.

#### 3.4.2 Considerations for Use

It is a successful technique for the management of dentin caries in primary molars, particularly for proximal or multi-surface lesions <sup>[39]</sup>.

This treatment is applicable when dental facilities are not available, as it is a minimally invasive approach and no sprays are used, reducing the risk of cross-infection of dental treatment by sprays and droplets <sup>[5]</sup>.

It is effective in halting the progression of dentin caries in primary teeth compared to no treatment and conventional restorations <sup>[40]</sup>.

#### 3.4.3 Limitations

Parents dislike the appearance of Hall technique crowns <sup>[5]</sup>. It was found to be more uncomfortable for patients because of the placement of separator ligatures, but still during chair time when placing them they suffered less anxiety <sup>[41]</sup>.

Hall technique controls carious lesions in primary molars, shows a low failure rate and offers good acceptance in uncooperative patients, this technique reduces the risk of cross-infection by aerosols since they are not used and helps to stop the progression of carious lesions, although it may be more uncomfortable for patients.

### 4. Conclusions

Minimally invasive treatments reviewed in this article offer improved dental care against loss of tooth structure. Each patient should be evaluated to decide which is the best treatment option, and thus implement preventive measures to control both present lesions and the appearance of new lesions. Pit and fissure sealants and infiltrative resin are good treatments of choice for patients with mild carious lesions either active or inactive, atraumatic restorative treatment and the Hall technique are treatments that can be used when there are moderate carious lesions and in situations where there is a lack of a traditional dental clinic.

### 5. Conflict of Interest

Not available

### 6. Financial Support

Not available

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