EDITORIAL

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Biological and minimally invasive strategies in contemporary pediatric caries management.

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Introduction

Dental caries remains a frequent clinical problem in children and continues to represent an important challenge in pediatric dental practice. Although prevention, diagnosis and restorative materials have improved considerably, many children still present with active carious lesions that require careful and individualized management. In children, treatment decisions are influenced not only by the clinical aspect of the lesion, but also by age, cooperation, caries risk, diet, oral hygiene, parental involvement and the stage of dental development [1,2].

In recent years, the management of dental caries has moved toward more biological and minimally invasive strategies. Instead of focusing only on complete caries removal and cavity restoration, current approaches aim to control disease progression, preserve dental tissues, maintain pulp vitality, and reduce the negative impact of dental treatment on the child [3,4]. This is especially important in primary teeth, where the main goal is to keep the tooth functional and asymptomatic until its natural exfoliation, while avoiding unnecessary pulp exposure or overtreatment [5].

Contemporary pediatric caries management should therefore be based on prevention, early diagnosis, caries risk assessment and minimally invasive care when needed. Fluoride therapy, fissure sealants, dietary counseling, oral hygiene instruction, selective caries removal, atraumatic restorative treatment, silver diamine fluoride and the Hall technique are all usefull options in modern pediatric dentistry [1,3,6,7]. These methods should be selected according to each child's needs and should be seen as part of long-term strategy that focuses on long-term oral health.

Fluoride Therapy

Fluoride therapy remains one of the most effective and widely used measures for preventing and controlling dental caries in children. Its use may include fluoride toothpaste, professional fluoride applications, and individualized preventive protocols, especially for children with an increased caries risk [1,6].

In clinical practice, fluoride recommendations should be adapted to the child's age, caries risk, oral hygiene habits and ability to use fluoride products safely. Parental involvement is also essential, because daily routines at home, including toothbrushing, diet and regular dental visits, influence the long-term success of caries prevention[2,7].

Silver Diamine Fluoride

Silver diamine fluoride is now used quite often as a non-invasive treatment option for managing cavitated carious lesions in children. It is especially usefull when conventional treatment is difficult such as in very young children, anxious patients, children with limited cooperation or those with special healthcare needs [8,9].

One of its main advantages is that it can stop dentin caries without the need for local anesthesia, drilling or complex restorative procedures. For many children, this makes the treatment faster, less stressful and easier to accept. However, parents should be informed before treatment that the arrested carious tissue usually becomes dark or black after application, which may be an aesthetic concern [9,10]. When appearance is important, the use of potassium iodide after SDF may be considered to help reduce discoloration.

Selective Caries Removal

Selective caries removal is an important technique in minimally invasive pediatric dentistry, especially when treating deep carious lesions in primary teeth. In these cases, complete removal of all softened dentin may increase the risk of pulp exposure. For this reason, the focus is on cleaning the cavity margins well enough to allow a reliable seal, while the dentin near the pulp can be preserved when clinically appropriate [5,11]. Once sealed from the oral environment, the carious process can be arrested and pulp vitality preserved [11,12].

Atraumatic Restorative Treatment

Atraumatic restorative treatment (ART) reflects the principles of minimally invasive dentistry by combining hand-instrument caries removal with restoration using high-viscosity glass ionomer cement [13]. The technique typically does not require local anesthesia and tends to be better accepted by anxious or young patients. ART may also be a practical choice outside conventional dental clinics, particularly in community programs or situations where access to dental equipment is restricted [13].

The Hall Technique

The Hall technique can be used for carious primary molars when a conservative and less invasive treatment is preferred. In this approach, the carious lesion is not removed; instead, it is sealed under a preformed metal crown, usually without local anesthesia or tooth preparation. Once isolated from the oral environment, the carious lesion can become inactive, while the tooth remains functional until natural exfoliation. For many children, this makes treatment shorter, simpler and easier to tolerate. [14].

Deep Carious Lesions and Pulp Management

Deep carious lesions in primary teeth require careful clinical judgement, because treatment should protect the pulp whenever possible. The decision between selective caries removal, indirect pulp treatment or pulpotomy depends on the child's symptoms, clinical examination, radiographic findings and the vitality of the pulp. In many cases, preserving pulp vitality is preferable to aggressive caries removal, as it reduces the risk of pulp exposure, shortens treatment time and makes the procedure more comfortable for the child. [5,15].

Implementation Challenges and Education

Although minimally invasive approaches are supported by current evidence, they are not yet used consistently in everyday pediatric dental practice. Some clinicians and parents may still believe that effective treatment means complete caries removal followed by a conventional restoration. Other factors, such as, aesthetic concerns, limited access to specific materials, lack of training and the difficulty of changing established clinical routines may influence treatment decisions [8,10,12].

For these reasons, education plays an essential role. Undergraduate and postgraduate training should give more attention to caries risk assessment, prevention, biological treatment planning and communication with parents. It is important for future clinicians to understand not only how these techniques are performed, but also why they can be beneficial for children. A child-centered approach remains central in pediatric dentistry. Treatment decisions should consider not only the affected tooth, but also the child's cooperation, emotions, and previous dental experiences. By reducing pain, anxiety, and unnecessary invasive procedures, minimally invasive and biological approaches can help children develop a more positive attitude toward dental care.

Conclusions

Biological and minimally invasive approaches have become an important part of contemporary pediatric caries management. The focus is no longer limited to removing carious tissue and restoring the cavity, but also includes controlling the disease, preserving tooth structure, maintaining pulp vitality and improving the child's overall treatment experience.

Fluoride therapy, silver diamine fluoride, selective caries removal, atraumatic restorative treatment and the Hall technique can all be

valuable options when they are chosen according to the child's caries risk, lesion activity, cooperation level and parental expectations. In daily practice, successful management depends on early diagnosis, individualized treatment planning and regular follow-up.

These approaches are particularly relevant in pediatric dentistry because they respect both the biological needs of the tooth and the emotional needs of the child. By reducing the need for invasive procedures and improving the childs comfort during treatment, minimally invasive strategies can support better oral health outcomes and a more positive attitude toward dental care.

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Conflict of interest

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