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Flattening the 'caries' curve – role of a Pediatric dentist - A literature review.

[1]Swathi Renuka M, BDS, Post-graduate Student, Department of Pediatric and Preventive Dentistry Manipal College of Dental Sciences, Mangalore – 575001 Manipal Academy of Higher Education (MAHE), Manipal, Karnataka, India

[2]Ashwin P Rao, MDS**,** Associate Professor, Department of Pediatric and Preventive Dentistry, Manipal College of Dental Sciences Mangalore – 575001, Manipal Academy of Higher Education (MAHE), Manipal, Karnataka, India

[3]Karuna Y M, MDS, Associate Professor, Department of Pediatric and Preventive Dentistry, Manipal College of Dental Sciences, Mangalore – 575001, Manipal Academy of Higher Education (MAHE), Manipal, Karnataka, India.

[4]Anupama Nayak, MDS, Assistant Professor, Department of Pediatric and Preventive Dentistry, Manipal College of Dental Sciences, Mangalore – 575001, Manipal Academy of Higher Education (MAHE), Manipal, Karnataka, INDIA

Corresponding Author: Ashwin P Rao, MDS, Associate Professor, Department of Pediatric and Preventive Dentistry, Manipal College of Dental Sciences Mangalore – 575001, Manipal Academy of Higher Education (MAHE), Manipal, Karnataka, India

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Abstract

Caries was traditionally seen as an infectious disease and thus attempt to completely remove all cariogenic bacteria has been caried out to treat this disease. This meant that both the affected and infected dentin were removed. Recent perspective on the understanding of dental caries has shifted the aim of carious tissue removal.

The main goal of minimally invasive dentistry is removal of the diseased tissue with minimal tissue loss and prevention of disease occurrence. This is of great importance in treating children with dental caries, as it enables the clinician to provide a pleasant and less invasive treatment experience to the child patient. This review explains in detail the various new concepts and caries management strategies with its relevance to Pediatric dentistry.

Keywords: Caries excavation, Primary teeth, Young permanent teeth, Selective caries removal.

Introduction

Dental caries has been long perceived as a microbial infectious disease of the teeth. Attempts to completely remove all cariogenic bacteria has been caried out to treat this disease. This meant that both the affected and infected dentin were removed. [(1)] However, this theory no longer holds good to treat carious lesions. Restorative materials like non-adhesive amalgam, cements, or

indirect metal restorations were the predominant treatment of choice for carious lesions. [2]

Dental caries is a biofilm-based, lifestyle-mediated disorder. Recent perspectives on the understanding of the disease have forced a shift in the goal of removal of carious tissue towards maximizing restoration longevity, without unnecessary removal of remineralizable or sound dentin. [3]

The main goal of minimally invasive dentistry is removal of the diseased tissue with minimal tissue loss and prevention of disease occurrence. Consequently, there has been a change in the dental diagnostic systems and the approach towards management of dental caries. [4]

This is of great importance in treating children with dental caries, as it enables the clinician to provide a pleasant and less invasive treatment experience to the child patient.

Complete carious tissue removal – changing concepts

Historically, all bacteria were removed from tooth tissue by removing carious tissue. The emergence of fermentable carbohydrates as the main source of nutrients has disrupted the balance of the oral environment. [5]

A decrease in pH is triggered by the fermentation of carbohydrates, initiated by few cariogenic species. Competitive domination of the bio film by cariogenic species is observed, as commensal bacteria do not survive in such acidic environment. Eventually, rapid reduction of the pH takes place to a level at which the demineralization of enamel and dentin occurs. If uninterrupted, the process will continue creating a cariogenic niche. This leads to dysbiosis resulting in a net loss of minerals from the hard tooth structure. [6]

The conventional goal of removing carious tissue is no longer applicable, which means that not all bacteria need to be removed from the mouth to control tooth decay and prevent caries. Research has shown that when a complete seal is provided, even demineralized dentin had the capacity to remineralize. This finding has paved way for the development of an innovative treatment approach which could provide a successful outcome in the treatment of carious lesions. [1]

Clinical assessment of carious tissue removal – a constant challenge?

A constant challenge exists in clinical assessment of how much carious tissue should be removed. Clinical identification of the extent of carious lesions has been a difficult task for the Pediatric dentists as histologically described "zones" does not correlate well with the clinical appearance of carious dentin.

The idea that drove carious tissue removal for decades was that, histologically no bacteria would be present at a certain dentin quality in a carious lesion.

Hence, either a “complete” or an “incomplete” carious tissue removal was carried out. However, distinguishing infected dentin from non-infected dentin was clinically impossible. Further, the possibility of "complete" removal of carious tissue was hardly a reality when the conventional concept is considered. [7]

Therefore, utilizing the characteristics of residual dentin like assessing the hardness of the dentin with the help of probes or an excavator during the removal process, can better describe the goal of carious dentin removal. [8]

A number of terms can be used to describe hardness.

1. Hard dentin: “A pushing force needs to be used with a hard instrument to engage the dentin and only a sharp cutting edge or a bur will lift it. A scratchy sound or ‘cri dentin Aire’ can be heard when a straight probe is taken across the dentin.”

2. Firm dentin: "Firm dentin is physically resistant to hand excavation and some pressure needs to be exerted through an instrument to lift it."

3. Leathery dentin: "Although the dentin does not deform when an instrument is pressed onto it, leathery dentin can still be easily lifted without much force being required."

4. Soft dentin: "Soft dentin will deform when a hard instrument is pressed onto it and can be easily scooped up (e.g., with a sharp hand excavator) with little force being required."

Although hardness is relatively reliable and easy to judge, repeated re-calibration might be required, and thus it is difficult to standardize hardness of remaining dentin. Various other standards such as moisture, color have nothing to do with the degree of tooth decay nor have they been validated clinically. Hence, hardness of the residual dentin can be employed as the standard assessment criterion to excavate carious lesions. [9]

Caries removal strategies

Many caries removal strategies can be explained based on factors such as the perception of the disease, the goal of removing carious tissue and using hardness as a standard for carious tissue removal.

The International Caries Consensus Collaboration (ICCC) has given newer regulated terminologies for ease of use. "Selective removal of carious tissue" as proposed by the ICCC has the following goals,

- Removal of carious tissue with satisfactory depth to provide a long-standing restoration.
- To make sure that exposure of pulp does not take place during the caries removal process. [1]

These methods are a clear indication in cases with no signs of pulpal inflammation or irreversible pulpal pathology. [1,8]

Non-selective Removal to Hard Dentin

This method of caries removal is no longer recommended. It was earlier known as "complete removal". [1] In this method, all softened dentin is removed from all the aspects of the cavitated lesion. Carious tissue removal was ceased upon approximating hard dentin. This method is no longer endorsed especially for deep carious lesions, because of the associated adverse effects such as pulpal exposure and also it does not show any benefits over other newer proposed methods. This is of a serious concern in deciduous teeth with pulp horns located higher compared to the permanent teeth. [10] (Fig 1.)

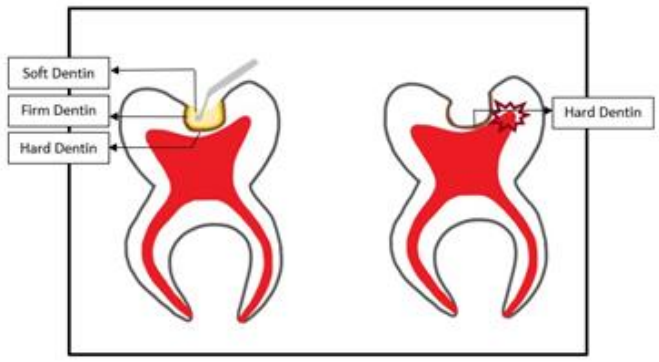


Fig 1: Non – Selective caries removal to hard dentin in deciduous teeth showing highly placed pulp horns which poses a high risk of pulpal exposure. (Self-Illustrated)

Selective Removal to Firm Dentin

In selective removal, various standards for carious tissue removal are used in the periphery of the cavity and in the pulpal aspect. [1] Caries is removed until only sound enamel and hard dentin are left at the periphery of a cavity. Firm dentin can be left in the pulpal aspects of the cavity. (Fig 2.) This is in consensus with the principle of achieving tight and effective sealing with a focus on maximizing restoration longevity. [8] This is recommended for carious lesions which do not involve the inner third of the dentin radio graphically or approximating the pulp clinically. This method can be used effectively for shallow or medium deep lesions. [1]

This technique is especially beneficial in cases wherein the child is anxious as it reduces more aggressive and pain inducing treatment options.

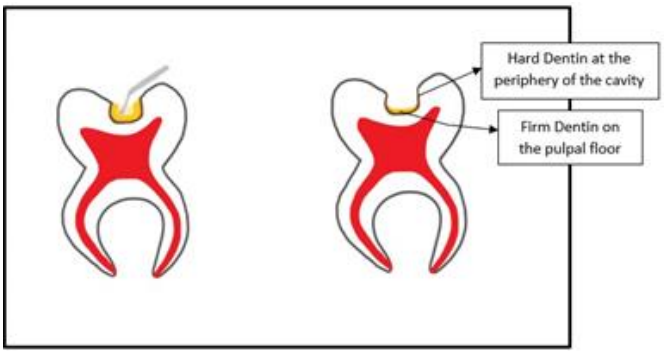


Fig 2: Selective caries removal to firm dentin. (Self-Illustrated)

Selective Removal to Soft Dentin

This technique should be performed, where maintenance of pulp vitality is essential, such as in deep lesions. Peripherally, the caries is removed to hard dentin/ sound enamel. The goal in this method is to avoid exposure of the pulp. [1] Therefore, dentin infected with caries in the floor of the cavity is left undisturbed, which is soft and leathery. (Fig 3.) The risk of pulpal exposure is thus reduced. Providing a proper cavity seal ensures decrease in the activity of biofilm, by removing nutrient supply to the bacteria, thereby arresting the progression of caries. [11] This technique majorly favours undisturbed development of the immature teeth.

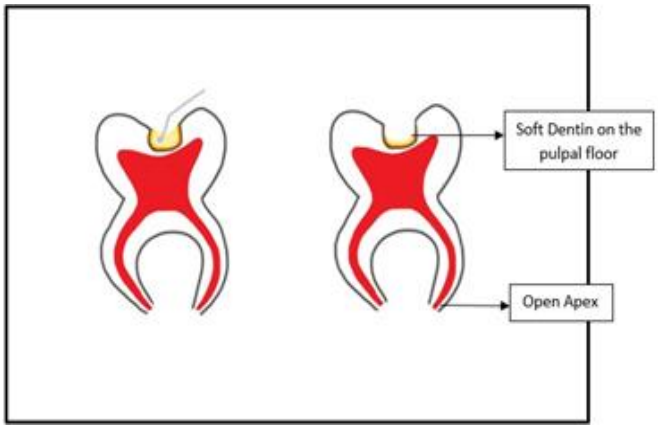


Fig 3: Selective caries removal to soft dentin in deep carious lesion in an immature tooth. (Self-Illustrated)

Stepwise Removal

This involves carious tissue removal in two steps. [12] The first step is to selectively remove caries to soft dentin and then perform a temporary restoration. In the next 6-12 months, the bacteria are inactivated, and the secondary dentin continues to develop and remineralize. Thereafter, the restoration is replaced, and the firm dentin from the Center of cavity is removed. The gradual removal is based on the idea of avoiding exposure of the dental pulp in the first step. The temporary restoration should be durable for at least 12 months and should consist of properties that provide a hermetic seal. The main complication of gradual removal is temporary premature failure, which can endanger the vitality of the dental pulp. [13] Stepwise removal has been demonstrated to have lower risks than non-selective removal technique, although it might pose greater risks of exposure of the pulp than other methods. In deep lesions that affect the inner quarter of the dentin, it is recommended to remove them in a step wise manner. (Fig 4.) This aims at preserving the young permanent teeth and maintain its vitality.

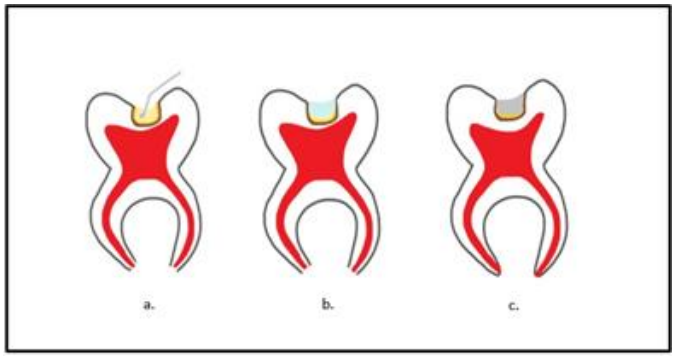


Fig 4: Step wise caries removal. (Self-Illustrated) a. Caries removed until hard dentin at the periphery and soft dentin at the pulpal aspect, b. Temporary Restoration in place, c. temporary restoration replaced with permanent restoration after removal of caries to firm dentin.

Sealing-In Lesions

Sealing-in lesions are based on the logic that carbohydrates are not available to bacteria and therefore the lesion is arrested. Moreover, sealing installs a diffusion barrier against acids and thus protects the sealed tooth structure. Fissure sealing can be successful over non-cavitated occlusal lesions, if well maintained. However, load bearing lesions would require sealing using durable restorative options, such as the stainless-steel crowns. [14]

Hall's technique is a suggested treatment option for the purpose of sealing off lesions. This technique applies only to primary molars which involves placement of a crown without any tooth preparation and without any carious tissue removal. (Fig 5.)

The hall technique provides an effective control of the lesion activity through a long-lasting and durable restoration. [1]

The major advantage is that Hall Technique, when compared with conventional restorative treatment has been found to be highly efficacious in children who refuse to accept dental treatment. [15]

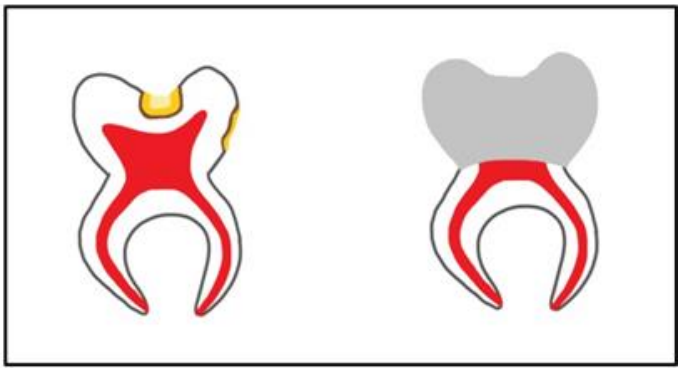


Fig 5: Multi-surface carious lesion sealed in using Stainless steel crown without excavation. (Self-Illustrated)

Non-Restorative Cavity Control

The main idea behind non-restorative cavity control is to re-establish a cleanable surface. This technique is done as a three-step process. This is begun with employing an oral hygiene routine and monitory dietary habits.

The cavity is then opened up by chiseling or drilling away the overhanging enamel or dentin, thereby achieving cleanability using this lesion exposure method. [16]

Supportive therapy using 38% silver diamine fluoride (SDF) or 5 % sodium fluoride (NaF) varnish application is provided. [17] To this point, this technique has been limited to deciduous teeth and root surface lesions. Non-restorative dental caries control methods are ideal for children who may not receive other treatments under certain circumstances.

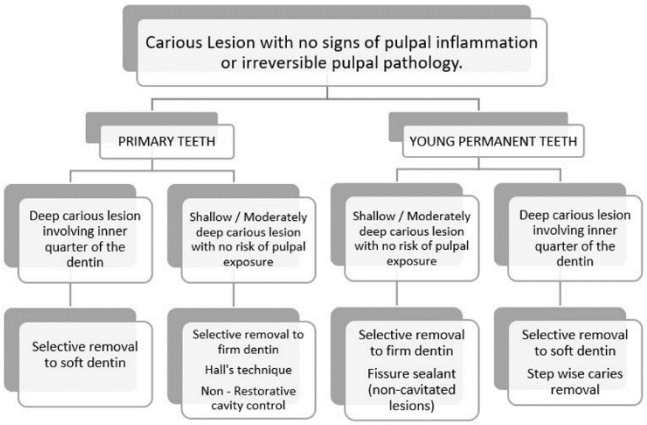
These treatments require optimal monitoring. Evidence of changes in eating/brushing habits, cautious selection of cases, and repeated, consistent, well-documented follow-up ensures that the lesion state is maintained over time. [18]

Relevance to Pediatric dentists

This paradigm shift, from the conventional concept of complete removal of caries to newer concepts that emphasize on less invasive procedures, plays a major role in the field of Pediatric dentistry. It enables enhanced compliance from the child and at the same time avoids the requisite for more invasive procedures like pulp therapy. It is a known fact that pulp therapy is a far more invasive technique of treating a tooth that involves local anaesthetic administration. The newer concept would also help alleviate the problems of enforcing behaviour management techniques that a pulp therapy would necessitate.

Summary

The following is a summarized flowchart on clinical decision making in the management of a carious lesion. (Fig 6)



Conclusion

In view of minimizing the tissue loss and providing the child with a positive dental experience with an aim to maintain the vitality of the tooth, the traditional goal of completely removing carious tissue should not be pursued at any cost before providing the restoration. The shift towards newer concepts can be well implemented with careful case selection. In short, the state of the pulp and the depth of the lesion determine the selected strategy, but they also vary with dentition. Long-term efforts to remove carious tissue until hard dentin are not consistent with current evidence and are thus not recommended. Thus, as Pediatric dentists we can play a key role in flattening the caries curve by effective implementation of the newer emerging strategies.

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