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Review Article

MEDICAL MANAGEMENT OF DENTAL CARIES: A CHANGE IN THERAPEUTIC APPROACH

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ABSTRACT
Dental caries is an infectious, communicable disease, which causes destruction of teeth by acid-forming bacteria found in dental plaque. Caries progression or reversal is determined by the balance between protective and pathological factors in the mouth. There have been revolutions in every field and dentistry is no exception to it, these changes have led to a change in concept from the conventional surgical approach of removing dental decay and cutting of tooth structure to the medical model which deals with interception of disease at different stages and possible reversal of the disease process. The key to medical paradigm is determination of caries risk in an individual and effective early detection of initial carious lesions. There are various equipments available in market which uses different principles for diagnosing caries susceptibility in an individual. In the years of thorough research different agents have been investigated for their role in caries prevention and reversal. There is a separate treatment plan for managing patients falling in different risk category. This article outlines the need for the medical management of dental caries and how it can be a viable option in dental decay management.
Keywords: dental caries, white spot lesion, caries risk, fluoride, remineralization

INTRODUCTION

In the recent years the conventional drill & fill surgical attitude to managing caries has been taken over by medical approach. Medicine includes not only filling the decayed teeth but also looks at general oral health status and ascertains the reasons for the decay. Hence the aim is to change the oral environment from being prone to decay to an environment averting caries.

The most widely used classification to classify caries i.e. G.V. Black's classification is based on surgical approach of management. However the new classification systems have been designed in recent years which help to understand better the medical model of Caries Management**.** ICDAS & FDI are other assessment criteria introduced which help identify the patient's caries risk along with the present caries status.

Jenson & colleagues introduced ICDAS (The International Caries Detection & Assessment System). [1]

Table 1

Carious Lesion Codes	
0	Sound tooth surface, no or slight change after prolonged air drying
1	First visual change in enamel seen after prolonged air drying
2	Distinct visual changes in enamel
3	Localize enamel breakdown, no dentine involvement
4	Underlying dark shadow from dentin (not cavitated into dentin)
5	Distinct cavity with visible dentin
6	Extensive cavity with visible dentin

CARIES BALANCE PARADIGM

The Caries Balance/Imbalance model was created to represent the multifactorial nature of dental caries disease and to emphasize the balance between pathological and protective factors in the caries process. If pathological factors outweigh protective factors, the caries disease process progresses. This is a dynamic and delicate balance, tipping either way several times a day.[2,3] Based on this concept, the reversal stage should be identified and the proper therapy should be instituted to prevent the frank loss of tooth structure. **Caries risk determination** and diagnosing **initial carious lesions** are keys to managing dental caries disease by this approach.

Caries Risk determination

Caries risk assessment (CRA) is a critical component of dental caries management and should be considered a standard of care and included as part of the dental examination. It is essential in decision making to guide the clinician in the diagnosis, prognosis and treatment recommendations for the patient.

Using a risk assessment provides for better cost-effectiveness and greater success in treatment compared with the more traditional approach of applying identical treatments to all patients, independent of their risk**.**[4]

There are several forms available to determine caries risk in an individual however ADA form has been found to be the most accepted one. (Table 2)

Initial carious lesions

The initial carious lesions are the so-called "white spot" lesions, which implies that there is a subsurface area with most of the mineral loss beneath a relatively intact enamel surface.[6]

Clinically, early caries lesion in enamel is initially detected as a white opaque spot and is characterized by being softer than the adjacent sound enamel and is increasingly whiter when dried with air. A cross-section of the white opaque spot reveals the characteristics of carious enamel and this means that dental caries is essentially an enamel defect with a relatively intact surface layer and some subsurface damage due to acid formed from plaque on tooth surface.[7] This type of examination has certain limitations, as research has demonstrated a high ability of clinicians to correctly identify sound tooth surface sites but a low ability to correctly identify carious lesion sites, especially sites demonstrating early stages of caries activity.[8]

This could lead to a higher rate of surgical treatment than what is really necessary. In addition, the technique of using a sharp dental explorer pushed into the pits and fissures of the tooth surface to check for "stickiness" is controversial, as the potential to cause an opening (cavitation) in the enamel surface is high, thus allowing for the penetration of pathologic bacteria. It has been suggested that a more appropriate use of the dental explorer is to use it to remove plaque from the examination area and to determine surface

roughness of non-cavitated lesions by gently moving the explorer across the tooth surface.

Patients can be screened according to the classification proposed by Mithra Hegde et al which is useful for clinical assessment of susceptibility of the tooth to caries and progression of carious lesion.[9] (TABLE 3)

Even radiographs have not proven to be of much use in initial carious lesions as traditional radiographic images tend to underestimate the actual lesion depth and cannot accurately identify early enamel carious lesions**.** [10] Also, radiograph does not differentiate between an active and inactive lesion which will unnecessarily lead to surgical approach being followed in its management.

Therefore, it becomes imperative to adopt novel technologies of caries diagnosis which have high sensitivity in terms of initial caries detection. The newer technologies in early enamel lesion detection includes auto-fluorescence (such as QLF) of teeth, electrical resistance (such as ECM), imaging techniques, transillumination, DIAGNOdent and DIFOTI devices, fibre-optics-based confocal imaging system, OCT (optical coherence tomography) imaging, polarization-sensitive optical coherence tomography (PSOCT) system, frequency domain photothermal radiometry (FD-PTR or PTR) and modulated luminescence. [11] (Table 4)

However there are certain limitations to these methods diagnosing caries using different wavelengths of light, there are other elements of organic and inorganic origin that can emit additional fluorescence and thus lead to error in the detection of caries: fluorosis, hypomineralization, bacterial plaque, calculus, proximal surface caries and other stains.[15]

PRE-REQUISITES TO RESTORATIVE TREATMENT

To begin the restorative process, the patient, with the guidance of the dentist, must meet some basic parameters. The following parameters should be continuously monitored during treatment, after insertion of the final restoration(s), and in recall visits in order to keep a healthy environment for restored and non restored teeth.[16]

1. Adequate oral hygiene: The daily removal of plaque maintains a healthy periodontal environment, removes leftover nutrients for cariogenic bacteria, and therefore reduces their number, which in turn affects the amount of acid produced.

2. Dietary Control of carbohydrates: The frequent ingestion of carbohydrates, especially those in the form of sucrose, provides the nutrients for cariogenic bacteria and enhances their metabolic potential toward producing acids. Basically, the greater the frequency of sugar in the diet, the greater the amount of acids attacking the dental surfaces and the margins of the restorations.[17]

MANAGEMENT OF HIGH RISK PATIENT

1) Restore all carious lesions that have penetrated the dentin. In cases with multiple restorations, placement of well-adapted temporary restorations is recommended until the levels of infection have been reduced.[16]

2) Simultaneously apply pit and fissure sealants to teeth with deep morphologic features (usually molars). Cariogenic microorganisms trapped below a sealant will decrease in number and remain metabolically inactive for the duration of their entombment.[16]

3) Chlorhexidine is an antimicrobial agent that is highly effective against *S. mutans* infections and should be applied, maintaining the concept of an intensive short term treatment to a therapeutic end point. However, there are two main drawbacks to the rinse: a bitter taste and a potential to reversibly stain teeth and composite restorations. For this reason, chlorhexidine in the form of a varnish can be used to paint the dentition or even specific areas of the teeth. This antimicrobial will suppress *S. mutans* for 12 to 26 weeks.[18]

4) Chewing gum that contains xylitol. This gum not only demonstrates noncariogenic properties, but also actually appears to be a very helpful adjunct to the remineralization therapy. Xylitol is a five-carbon sugar that is not fermentable by *S. mutans.* The gum causes increased salivary flow, and saliva is a wonderful remineralizing solution. This gum should be chewed three times a day for at least 20 minutes.[19,20]

5) Fluoride rinses. Patients should be instructed to use over-the-counter fluoride rinses in addition to fluoridated toothpaste at least twice a day at times separated from tooth brushing. The presence of the fluoride ion with the saturated solution of calcium and phosphate from the saliva stimulated by the Xylitol gum will remineralize early carious lesions.[20]

6) A first recall visit should be scheduled 3 months after the end of antimicrobial therapy. Bacteriologic testing should be performed, and the integrity of temporary restorations as well as pit and fissure sealants should be checked. If infection levels are low, final restorations can be performed (if possible, fluoride-leaching material should be used). If infection levels are still high, preventive re-treatment should be performed until there is a therapeutic effect.[21,22]

MANAGEMENT OF MODERATE RISK PATIENT

1) Most patients in this category will be benefited by modification of diet i.e decreasing the frequency of sugar intake.

2) Brushing with fluoridated toothpaste at least twice a day is recommended.[23,24]

3) Antimicrobial treatment is also helpful in these patients to bring down the cariogenic microorganism count to a number where they are not pathogenic. Chlorhexidine varnish applications should be done until levels fall to SM < 2.5×10^5 .[16]

4) Professional fluoride application with fluoride varnish or APF gel should be done and routine dental checkups every 6 months.[18]

MANAGEMENT OF LOW RISK PATIENT

Even in the low caries risk group less frequency of sugar intake should be followed.

- Brushing with fluoridated toothpaste at least twice a day
- The individuals in this group can be put on yearly routine follow up. [24]

Table 2

CARIES RISK ASSESSMENT FORM			
Patient Name:			
Birth Date:		Age:	Date:
Contributing Conditions	**Low Risk**	**Moderate Risk**	**High Risk**
1. **Fluoride Exposure**	Yes	No	
2. **Sugary Food or Drinks**	Primarily at meal times		Frequent or prolonged between meal exposures
3. **Caries Experience or Mother, Caregiver, siblings** (6-14 years)	No carious lesions in last 24 months	Carious lesions in last 7-23 months	Carious lesions in last 6 months
4.**Dental Home** (established patient food record)	Yes	No	
General Health Conditions			
1. **Special Health Care Needs**	No	Yes (>14 years)	Yes (6-14 years)
2. **Chemo/Radiation Therapy**	No		Yes
3.**Eating Disorders**	No	Yes	
4.**Medications that Reduce Salivary Flow**	No	Yes	
5.**Drug/alcohol Abuse**	No	Yes	
Clinical Conditions			
1. **Cavitated or Non –Cavitated** (incipient) **Carious Lesions or Restorations** (visually or radiographically evident)	New carious lesions or restorations in last 36 months	1 or 2 new carious lesions or restorations in last 36 months	3 or more carious lesions or restorations in last 36 months
2. **Teeth missing due to caries in past 36 months**	No		Yes
3.**Visible Plaque**	No	Yes	
4.**Unusual tooth morphology that compromises oral hygiene**	No	Yes	
5.**Interproximal Restorations** -1 or more	No	Yes	
6. Exposed Root surfaces Present	No	Yes	
7.**Restorations with overhangs** and/or **open margins**; **Open contacts** with food impaction	No	Yes	
8. **Dental/Orthodontic Appliances** (fixed or removable)	No	Yes	
9.**Severe Dry Mouth** (Xerostomia)	No		Yes

Table 3: Clinical Classification of detection of initial carious Lesions

Surface Affected / Lesions	**Pit & Fissure I**	**Smooth Surface Proximal II**	**Smooth Surface Buccal Cervical III**	**Smooth Surface Buccal Occlusal IV**	**Smooth Surface Incisal V**
White Spot Lesions Measuring (Diameter)					
< 2mm (A)					
< 4 mm (B)					
>4 mm (C)					
DISCOLORATION (D)					

Table 4: Commercially available advanced diagnostic aids for initial Caries

Device name	Manufacturer	Features
Diagnodent [12]	Kavo Dental Corporation Lake Zurich,USA	1. Uses pulsed 655nm laser light. 2. The device has to be calibrated. 3.Gives a quantified measure of caries.
Midwest Caries I.D [13]	Dentsply professional,York, Pennsylvania	1. Uses LED light 2. A specific optic signature defines caries 3.Color indicator for caries
Soprolife [12]	Acteon,Marsilles,France	1.Uses 450nm light for fluorescence 2.Operates in Two modes-diagnosis and treatment 3.Caries is marked by red color.
Canary system [13]	Quantum Dental technologies,canada	1.Uses low power pulsed laser light. 2.Reflected heat and light from tooth depicts caries.
Spectra [14]	Air techniques Melville, New York	1. Uses LED light of wavelength 405nm. 2.Red color indicates caries 3.Gives both graphic and numerical value for caries.
InspektorBiluminator [15]	Inspektor Research Systems,Amsterdam, Netherlands	1.Uses 410 nm blue light. 2.Stains porphyrin which are the by-product of bacterial metabolic activity. 3.Can detect white spot lesion, approximal caries, occlusal caries, margin leakage and secondary caries.

Table 5: Agents used for medical treatment of dental caries

Agent	**Recommended use**
1) Fluoride	Fluoride varnish, APF gel (1.23%) : twice yearly application for high risk patient; once yearly application for moderate risk patients[25]
i) Professional	Tooth paste containing 1000 ppm for low and moderate risk patients; 1500ppm for high risk patients [25]
ii) For home use	Fluoride mouthwash: .05% daily or .2% weekly for high risk patients
2) Chlorhexidine	Chlorhexidine varnish 1% quarterly application for high risk patients[26,27]
3) Combination of chlorhexidine and Fluoride	.12% chlorhexidine and .05% sodium fluoride daily rinses : very effective in high risk patients[27]
4) Xylitol	Optimum dose for caries reduction: 10g (Five 2g tablets) [19,20] After meal chewing for 20 minutes[20]

CONCLUSION

Dental caries is a chronic infectious disease with multiple etiological factors so following a unidirectional surgical approach has failed to decrease the prevalence of the disease. Incorporating the precepts of a medical model for infection control into the routine practice of clinical dentistry is simple, practical, and tremendously beneficial to patients.

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