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Minimal Invasive Techniques in Pedodontics- A Review

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Abstract:
Aim: To understand the techniques involved in minimal invasive dentistry
Modern dentistry has evolved into a minimally invasive approach. Natural human enamel and dentin are still the best dental materials in existence and thus minimally invasive procedures that conserve a great part of the original, healthy tooth structure have to be paid attention to. The application of minimally invasive dentistry in pedodontics can be justified on the grounds that no restorative material can adequately replace natural tooth structure for the long-term and hence its preservation is of paramount importance. The key to success of practicing minimal invasive techniques lies in the clear understanding of balance between pathological and protective factors.

INTRODUCTION:

Dental caries is a disease that has many contributing factors, including biological, genetic, socioeconomic, cultural, and environmental issues. It is the most common disease occurring in primary dentition among children. The painstaking preservation of a healthy set of natural teeth for each patient must be the objective of every dentist. Conservative dentistry is a treatment procedure wherein a minimum of healthy tooth structure is removed along with a decayed portion and is then restored. Thus this is inherently a desirable dental objective. Minimally invasive dentistry is a technique that has developed a new approach for addressing dental decay and the preservation of tooth. It is a philosophy that is developed to reduce restorative procedure time, pain and stress, and decrease patient anxiety. This concept is based on the assessment of a patient's caries risk and the application of the current therapies to prevent, control and treat the disease. It is often referred to as treating dental caries with a biologic, therapeutic, or medical model. [1][2]

History and Evolution of Minimal Invasive Techniques:

The earliest techniques for minimal invasive dentistry were developed by G.V. Black. During his time surgical model continued to drive dentistry which meant that the clinical symptoms of any decay were to be addressed by tooth extraction or restoration. Restorations of that time were carried out using an alloy that corroded rapidly and experienced problems such as expansion. Several events that occurred later made way for the improvement of dental amalgams and the introduction of bonded restorations. In 1955, Buonocore described a technique for etching enamel surfaces to make them retentive for a restoration and Bowen in 1962 invented adhesive materials, which lead to the invention of minimally invasive preparation.[3][4]

Principles of MID

A. Early diagnosis of the carious lesion
B. Classification of the caries depth and its progression
C. Assessment of individual risk
D. Optimal caries preventive measures
E. Remineralization of early lesions
F. Minimal surgical intervention of carious lesions
G. Repair the defective restoration

A. Early diagnosis of the carious lesion:

In children dental caries can start as a result of exposure to risk factors such as increased sugar consumption and eating frequency or the breakdown of protective saliva properties. Evaluation of saliva is done by testing quality and quantity of saliva, pH of saliva, buffering capacity of saliva and various tests for oral bacteria levels.[5]
In case of a primary lesion, which has not reached the stage of an established lesion with cavitation, one can visually detect changes of color, translucency and structure of the enamel. An initial inspection on wet surfaces can spot cavities and brown or white stains. Periodontal status and restorations is also checked. At this stage, caries activity is determined by checking the build-up of plaque biofilm and the gingival pathology at suspect sites.
Newer diagnostic aids include electrical conductance measurement, quantitative light induced fluorescence, dye enhanced laser fluorescence, diagnodent, fiber optic trans illumination, digital radiology, digital subtraction radiography, optical coherence tomography, tuned aperture computed tomography and electrical impedance tomography. [6]

B.Classification of the caries depth and its progression:

A new classification of the carious lesion was proposed by Mount and Hume in 1997. This classification is based on the site and size of the lesion and is linked to its stage of progression.[7]

Location	1=Minimal	2=Moderate	3=Advanced	4=Extensive
Site 1: Pits and fissures	1.1	1.2	1.3	1.4
Site 2: Proximal surfaces	2.1	2.2	2.3	2.4
Site 3: Cervical surfaces	3.1	3.2	3.3	3.4

C. Assessment of Individual Risk

Caries risk is defined as the probability of future caries disease development. There are some factors, which are related for the assessment of individual risk. Direct factors are the amount of plaque, type of bacteria, type of diet, frequency of carbohydrate intake, saliva secretion, saliva buffer capacity, and exposure to fluorides. Indirect factors are socioeconomic circumstances and general health of the child. Identification of caries risk at early stage can be done by recording patient history, clinical examination, nutritional analysis, salivary analysis and by using accurate caries diagnostic methodologies.[8][9]

D. Optimal Caries Preventive Measures

- ***Diet counseling and sugar substitutes***
  Frequency of intake of sugars is an important factor in managing carious lesion development. Use of sugar substitutes i.e. xylitol and sorbitol, are sugar free products. According to sources, immediately after meals, the use of sugar-free chewing gums reduces carious lesion progression.[10][11]
- ***Pits and fissure sealants***
  Complex morphology of pits and fissures make them an ideal site for retention of bacteria and subsequent caries development. Sealing of patent pits and fissures aim to protect them from bacterial colonization and exposure to fermentable substrate and can be cleaned easily.[12]
- ***Antimicrobial agents and chemotherapeutic approaches***
  Mouthrinses deliver chemotherapeutic agents, and it is widely accepted in school fluoride rinsing programs both by self-administration and under supervision. Chlorhexidine, essential oils, triclosan, cetylpyridinium chloride, sanquinarin, sodium dodecyl sulfate, and various metal ions such as tin, zinc, copper are the active ingredients present in mouthrinses, which has an ability to reduce mutans streptococci. Povidone iodine is known as a powerful germicidal agent effective against a wide range of bacteria, viruses, fungi, protozoa, and spores and 10% solution can be used for topical oral applications and a moderate suppression of mutans streptococci in plaque and saliva. [13]

E. Remineralisation of early lesions:

- ***Glass ionomer cements (GIC)***
  Application of GIC, as a dressing over the white spot lesion, provides necessary mechanical protection of weakened enamel and with continuous release of fluoride encourages the remineralization process. Resin-modified GIC can also be used in which resin is infiltered in the lesion and prevents further demineralization, while the fluoride ions that are released from GIC boost remineralization mechanisms.[14]
- ***Fluoride***
  Incorporation of fluoride into the crystalline structure of the carbonated hydroxyapatite, during the remineralization/ demineralization cycle not only decreases crystal solubility, but also increases the precipitation rate of enamel mineral in the presence of calcium and phosphate due to the lower solubility of fluorapatite. [15][16]
- ***Enamelon***
  It's an unstabilized calcium and phosphate salt with sodium fluoride. Delivery of fluoride along with soluble calcium and phosphate occurs with the liquid calcium formula. Enamelon toothpaste is beneficial in the reduction of white spot lesions. [17]
- ***Novamin***
  Novamin is a bioactive glass compound which comprises of minerals that naturally occur in the body and reacts when it comes into contact with water, saliva or other body fluids and releases calcium, phosphorus, sodium and silicon ions that results in the formation of new hydroxylcarbonate apatite crystals. This layer is mechanically strong and more resistant to acid.[18]
- ***Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP)***
  CPP is a derivative of the milk protein casein which is unique in its ability to bind calcium and phosphate ions and stabilize ACP in metastable solution and thereby preventing precipitation. Anti-cariogenic mechanism for CPP-ACP is by the localization of ACP on the tooth surface, which buffers the free calcium and phosphate ion activities, thereby helping to maintain a state of supersaturation with respect to the tooth enamel and, thus, preventing demineralization and enhancing remineralization. CPP-ACP is a useful cario-static agent for the control of dental caries. It can be used as an adjunct preventive therapy to reduce caries in high-risk patients and to repair enamel in cases involving white-spot lesions. [19]

F. Minimal Surgical Intervention of Carious Lesions

Conservation of tooth structure using minimally invasive cavity preparations is possible because adhesive materials do not require the incorporation of mechanical retention features. Biomimetic potential including the release of fluoride, calcium and phosphate ions can be of value in enhancing remineralization potential of the carious lesion. Several materials that can be used are GIC, composites etc.

- ***Atraumatic restorative treatment (ART)***
  ART involves removal of carious tooth tissues using hand instruments only and restoration of the cavity with a restorative material that sticks to the tooth. It includes the absence of noise and vibration and the reduced need to administer local anesthesia.[20]
- ***Chemo-mechanical method of caries removal***
  Chemomechanical caries removal is a modified hand excavation procedure utilizing a gel containing sodium hypochlorite which acts as a lubricant to aid in the mechanical removal of caries and exerts a chemical effect on the infected carious dentine. Sodium hypochlorite is a non-specific proteolytic agent, which removes organic components at room temperature. [20]
- ***Air abrasion***
  It is a pseudo-mechanical, non-rotary technique of caries removal which was originally developed in 1945 by Dr. Robert Black. Method of tissue removal

involves the transfer of kinetic energy from the incident particles, traveling in high velocity to the softened dentine surface. It is an alternative means of cavity preparation by providing an entirely conservative preparation for preservation of a maximal sound tooth structure.[20]

- ***Lasers***

  Lasers have been reported to have the ability to remove hard tissue and selectively remove caries leaving healthy enamel and dentine with an ability to destroy mutans streptococci. It has various advantages i.e. selectively removes caries, seals dentinal tubules to reduce sensitivity, well tolerated by pediatric patients, no need for LA, does not leave a smear layer-better bonding and conservation of tooth structure can be done.[21][22]

CONCLUSION

It is important that the dental profession embraces modern science and move into the new era of Minimal Invasive Dentistry, which is based on a large body of scientific evidence. The key to success of practicing this technique lies in the clear understanding of balance between pathological and protective factors. Although further research is needed, Minimal Invasive Dentistry has the potential for dentists to apply a more conservative approach to caries treatment and simultaneously offer patients a more friendly and health orientated treatment option.

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