



MINIMAL INTERVENTION DENTISTRY FOR CHILDREN WITH LATEST ADVANCEMENTS

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ABSTRACT

This Dawson and Makinson were the first to use the term minimal interventional dentistry (also referred to now as minimally invasive dentistry [MID]). This model stresses early caries detection and risk assessment, re-mineralization of demineralized enamel and dentin, caries prevention, minimally invasive operative procedures, and means to repair rather than replace restorations. The main goal of minimal intervention is to increase the life of the teeth, which was restored with less intervention.

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INTRODUCTION

Minimal intervention is a concept introduced by Mount and Hume in 1997 (Murdoch-Kinch, 2003). Minimum intervention dentistry (MI) can be defined as a philosophy of professional care concerned with the first occurrence, early detection and earliest possible cure of disease on micro levels, followed by minimally invasive, patient friendly treatment to repair irreversible damage caused by such disease.

Principles of Minimal Intervention

Principles of Minimal Intervention Adopted by the FDI General Assembly, 1st October 2002, Vienna, (FDI Statement, that must be applied to fulfill the description of minimal intervention dentistry are (Jo, 2012).

- Control the disease through reduction of cryogenic flora
- Re-mineralize early lesions
- Perform minimal intervention surgical procedures, as required
- Repair, rather than replace, defective restorations

Early caries detection and caries risk assessment detection devices: The oldest device used for detecting carious lesions, apart from the probe, is the X-ray machine. Radiography is reliable for detecting carious lesions in proximal tooth surfaces but considered unreliable in occlusal surfaces, particularly for diagnosing carious lesions in enamel and in the outer one-third to one half of the dentine.

Xeroradiography - Xeroradiography is twice as sensitive as conventional D-speed films and a phenomenon of "Edge Enhancement" is possible with this technique.

Subtraction Radiography: Subtraction radiography is a technique by which structured noise is reduced in order to increase the detectability of changes in the radiographic pattern. It is useful in detecting the progress of re-mineralization and de-mineralization patterns of dentinal caries.

Fiber-Optic Trans-Illumination (FOTI) -FOTI appears to be a very reliable device for detecting carious lesions in proximal surfaces, particularly in anterior teeth and for detection of lesions on occlusal, proximal, and smooth surfaces, on enamel as well as dentin (Mohanraj, 2017).

Digital Imaging Fiber-Optic Trans-Illumination (DIFOTI) -DIFOTI technique essentially picks up surface scattering of the visualizing light and readily indicates the presence of very

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early carious lesions, cracks, or imperfections in the tooth surface (Mohanraj, 2017).

Quantitative Light / Laser – Induced Fluorescence -QLF enhances early detection of carious lesions, particularly progression or regression of white spots of smooth surface lesions.

DIAGNOdent - DIAGNOdent uses infrared laser fluorescence of 655 nm for the detection of occlusal and smooth surface caries (Mohanraj, 2017).

Caries Risk Assessment: Caries risk is defined as ‘the probability of future caries disease development’. Most importantly, for assessing lesion activity accurately in one session, using a combination of indicators (visual appearance, location, tactile sensation and gingival health) might still provide the best way to determine lesion activity (Harris, 2004). A strong body of evidence exists that at all ages the ‘past and present caries is still the most accurate and powerful, single predictor of risk of future carious lesion development. A patient’s caries risk may also change rapidly to extreme risk if, e.g., medications have been prescribed that affect salivary glands and lead to hypo-salivation. A significant reduction in caries increment was shown when caries preventive measures were targeted at children with active non-cavitated lesions (Hausen, 2007). Caries risk status used to determine a personalized recall interval allows for enhanced recall periods, resulting in more effective use of oral healthcare professionals’ time. The personalized recall interval, directed towards optimal oral health, can be adjusted to the person’s compliance with preventive and maintenance advice.

Remineralization of demineralized enamel and dentine

Streptococcus mutans and *Streptococcus sobrinus* are two important bacteria in the initiation of enamel demineralization, with *Lactobacillus casei* assuming greater importance after initial progression of the carious lesion. This is Loesche’s so-called ‘specific plaque hypothesis’ (Kidd, 2004). Dental caries occurrence is due to organic acids produced by mutans streptococci and *Lactobacilli* as by-products of the metabolism of sugars, namely lactic, formic and acetic acids. Repeated consumption of readily fermentable carbohydrates, especially sucrose, leads to the proportional over growth of cariogenic bacteria such as *S. mutans*. These changes in the biofilm increase the potential for enamel mineral loss, the subsequent production of organic acids, and an amphibiotic change in the oral micro-flora leading to increased risk of carious lesion development (Kidd, 2004).

Mechanisms of action of fluoride in enamel: The presence of fluoride during the re-mineralization / de-mineralization cycle leads to its incorporation into the crystalline structure of the carbonated hydroxyapatite, which 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 (Marinho, 2008).

Casein phosphor-peptide-amorphous calcium phosphate complexes: Casein phosphor-peptides (CPP) have the ability to stabilize high concentrations of calcium and phosphate in metastable solution. The complexes are bound in plaque and buffer the calcium and phosphate ion activities in the plaque fluid and at the tooth surface, establishing an environment

supersaturated with calcium and phosphate, inhibiting demineralization and driving re-mineralization (Peters, 2010).

Optima/l caries preventive measures

Diet counselling and sugar substitutes - Diet control, in terms of intake of sugars and other fermentable carbohydrates, is still an important factor in managing carious lesion development. Xylitol and sorbitol are the sugar alcohols most frequently added to ‘sugar-free’ products (Ly, 2006). Although the consumption of xylitol-based candies and lozenges favours a reduction in carious lesion increment, in general, this effect is not seen on proximal tooth surfaces.

Fluoridated agents: Fluoride can be provided via water, milk or salt, or be administered topically by professionals and through self-application devices (toothpaste, gel, varnish and mouthwash).

Chlorhexidine-containing agents - Chlorhexidine is available in mouth rinses, gel and varnish. Chlorhexidine varnish can be considered a short term option for caries control in individuals at high caries risk who have high bacteria counts.

Silver di-ammine fluoride - Silver di-ammine fluoride (SDF) is a combination of silver nitrate and sodium fluoride ($\text{Ag}(\text{NH}_3)_2\text{F}$) that, when applied to carious tissues, inhibits carious lesion progression by its interaction with bacteria.

Casein phosphor-peptide-amorphous calcium phosphate agents - CPP-ACP has a short-term re-mineralization effect and a promising caries control effect for long-term clinical use (Yengopal, 2009).

Ozone -In dentistry, ozone is claimed to have a sterilizing effect, killing cariogenic bacteria and subsequently leading to the arrest of carious lesions.

Infiltration method - Resin infiltration combined with fluoride varnish application was superior in arresting superficial carious lesions in proximal surfaces of primary molars, compared to only fluoride varnish application, after 3 years (Yengopal, 2010).

Pits and fissure sealants - The morphology of pits and fissures has been reported to be one of the main caries risk factors, with molars being more frequently affected than premolars. Sealing aims to modify patent pits and fissures into smooth surfaces that are protected from bacterial colonization and exposure to fermentable substrate and can be cleaned easily.

Minimally Invasive Operative Interventions

Within MID for dental caries, the principle guideline for managing a cavitated tooth is to remove decomposed (previously named ‘infected’) dentine, to leave de-mineralized (previously named ‘affected’) dentine behind and to restore the cleaned cavity with a restorative that has optimum biological and physical properties.

Appropriate Excavation Methods: The rotating round metal burs have the tendency to over prepare cavities and laser and oscillation techniques under-prepare cavities. Self-limiting burs made of polymer and ceramic material have been

introduced but found to under-prepare cavities. The most appropriate decomposed dentine removal methods had used either a chemo-mechanically applied gel (Carisolv, Sweden) or a metal hand excavator.

Disinfecting excavated cavities - Common disinfection agents are 2% chlorhexidine solution and, more recently, ozone gas (Eden, 2006).

Repair Rather Than Replacement of Restorations

Minimal Intervention Dentistry aimed to limit unnecessary removal of healthy tooth structure and repair of defective restorations is one of its strategies. The repaired restorations may even outlast those that were replaced probably relates to the fact that most of the restoration's original form is kept intact, limiting the introduction of new elements that can affect the success of the restoration. When other restoration stress factors are considered, such as stress on the tooth, post-operative sensitivity, and re exposure of the dentinal tubules with possible pulpal reactions to thermal or mechanical stimulus, damage to the adjacent tooth and the possibility of more complex restorations, it makes perfect sense to pursue the repair of defective restorations as a predictable and conservative approach to preserving tooth structure (Gordan, 2012).

Minimal Intervention tooth Preparation

Various minimally invasive tooth preparation techniques involve (Krishna Dixit, 2012)

- Mechanical rotary including burs,
- Mechanical non rotary including air abrasion, air polishing, art, ultrasonics and sono-abrasion
- Chemo mechanical including Carisolv, Caridex and enzymes
- Photo ablation including lasers.

BURS

Fissurotomy Kit (SS White): Fissurotomy Micro STF (shallow taper fissure) and fissurotomy Micro NTF (narrow taper fissure) are designed specifically for the purpose of treating pit and fissure lesions. The head length of the fissurotomy original and fissurotomy micro NTF burs 2.5 mm, allowing the dentist to limit the bur tip to the tooth structure just below the DEJ and not further into dentin. Length of fissurotomy micro STF is 1.5 mm which make it suitable for use in the primary teeth, adult premolars and enameloplasty. The tapered shape of the bur allows cutting tip to encounter very few dentinal tubules at any given point of contact and this minimizes heat buildup and vibrations.

Micro Diamond Prep System (Brasseler USA): It is a set of eight burs which are designed for minimally invasive dentistry.⁷³ The No. 889m of the kit is used in narrow pit and fissures and it allows initial preparation with minimal tooth destruction. No. 838 M 007 can be used to create ideal trough incisal edge preparation while maintaining the integrity of labial and lingual walls. No. 830 RM, 830 M, 935 AM remove enamel defects such as white spots and undesirable color prior to restoring with composite resin.

Polymer Caries Removal Burs (Smart Burs):- They are used for removal of carious lesion with conservation of sound

tooth structure. Instead of metal body and cutting blades, these burs have a metal shaft and polymer blades. Disease dentin has a Knoop hardness number of 0-30. Healthy dentin has a Knoop hardness number of 70-90 and enamel has 360-430 KHN. Polymer blades have a Knoop hardness of 50; therefore only diseased dentin will be removed, leaving a healthy tooth structure that will effectively resist the action of a polymer cutting instrument.

Atraumatic Restorative Therapy

The Atraumatic restorative treatment is a procedure based on removing carious tooth tissues using hand instruments alone and restoring the cavity with an adhesive restorative material. It is also known as "Alternative Restorative treatment". ART is launched by the World Health Organization on 7th April, 1994 (world health day) (Neena, 2015).

Air abrasion (micro-abrasion and kinetic cavity preparation)

Air abrasion for restoration preparation removes tooth structure using a stream of aluminium oxide particles generated from compressed air or bottled carbon dioxide or nitrogen gas. The abrasive particles strike the tooth with high velocity and remove small amounts of tooth structure. An air abrasive unit called AIRDENT was introduced in 1951 (Imran Farooq, 2011). Clinical uses of air abrasion are in Class I, II, III, IV, V cavity preparations, Sealants and preventive restorations, Repair of composite and porcelain especially margin of veneers, Removal of composite and amalgam.

CHEMICO-MECHANICAL REMOVAL OF CARIES

An alternative to the conventional mechanical removal of caries is chemo mechanical method. The need for local anesthesia is reduced or eliminated as there is little pain during the procedure. It is an effective alternative for caries removal because it brings together atraumatic characteristics and bactericide / bacteriostatic action. The chemicals used can be in the form of liquid (caridex) or gel (carisolv).

Caridex - Caridex was developed by CM Habib from a formula made of N- mono -chloro glycine and amino butyric acid and was called as GK 101 E. The solution was claimed to cause disruption of collagen in the carious dentine, thus facilitating its removal. The mechanism of softening involved chlorination of remaining partially degraded dentinal collagen and the conversion of hydroxyl-proline to pyrrole-2-carboxylic acid, which initiated disruption of the altered collagen fibers in the caries.

Carisolv - Carisolv key difference to other products was the use of three amino acids – Lysine, Leucine, and Glutamic acid – instead of the amino-butyric acid. The amino acids bind chlorine and form chloramines at high Ph. The chemical reactions result in breakdown of degraded collagen characteristically found in the demineralized portion of carious lesion. The gel softens only the carious dentin, while healthy tissue is unaffected.

Papain Gel - Papain comes from the latex of the leaves and fruits of the green adult papaya. Papain promotes Chemical debridement, Granulation and epithelialization, which hastens the phases of cicatrization and Stimulation of the tensile

strength of the scars. Papain Gel has bacteriostatic properties which inhibits growth of gram positive and gram negative organisms.

OZONE: Ozone therapy causes re-mineralization of incipient pit and fissure caries as well as incipient root caries. Ozone readily penetrates through decayed tissue, eliminating the ecological niche of cariogenic micro-organism's as well as priming the carious tissue for re-mineralization¹⁷. The re-mineralization process will then take place with the aid of a topically applied re-mineralizing solution and the recommended patient's maintenance kit. Ozone has the effect, through its powerful oxidizing properties, of not only removing the protein protection the biomolecules that allow the niche to survive and expand. The lesion will become populated with normal mouth commensals which do not produce acid, after ozone therapy.

Conclusion

With the development of new dental restorative materials and advances in adhesive dentistry, a better understanding of the caries process and the tooth's potential for re-mineralization and changes in caries prevalence and progression, the management of dental caries has evolved from G.V. Black's "extension for prevention" to "minimally invasive." The future promises further evolution toward a more primary preventive approach, facilitated by emerging technologies for diagnosis, prevention and treatment. However, there are technical, cultural and economic obstacles that must be overcome for this to be fully realized in clinical practice.

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