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MINIMALLY INVASIVE DENTISTRY

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Abstract:
Introduction: *Dental profession recognizes that artificial restoration is of less biological value than the original healthy tissue. This theory proposes the need for minimally invasive dentistry. It acts on the principle of tissue preservation, preventing the disease from occurring at early stages and intercepting its progress by removing only affected diseased tissue and normal healthy tissue as minimal as possible. Introduction of adhesive technologies has led to a giant leap in minimally adhesive dentistry.*
The aim of work: *The review aims to understand the concept of the minimal intervention of dental disease and other oral health related problems such as dental caries, diagnosis, risk assessment, prevention, and control.*
Methodology: *The review is comprehensive research of PUBMED from the year 1951 to 2013.*
Conclusion: *The practice of managing dental disease most efficiently has evolved in the recent era. The traditional practices taught in dental school have all developed and changed. Minimally invasive dentistry is an requires certain skill set of the clinician to be appreciated by patients as their attitude have also changed regarding modern dental care and desired outcome of dental treatment. Hence it must be understood that traditional techniques and process of preparing and filling cavity shapes does not cure dental caries and another dental disease rather the cure is control of origin of caries and prevention in long-term.*
Keywords: *Minimum intervention, minimally invasive dentistry (MID), caries, risk assessment, prevention, tooth preservation.*

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INTRODUCTION:

HISTORY:

The concept of minimally invasive treatment in dentistry was pioneered in the early 1970s with the application of silver fluoride followed by preventive resin restoration (PRR) in 1978, atraumatic restorative treatment (ART) in 1980s and chemo-mechanics method of caries removal in 1990s.[1-5]

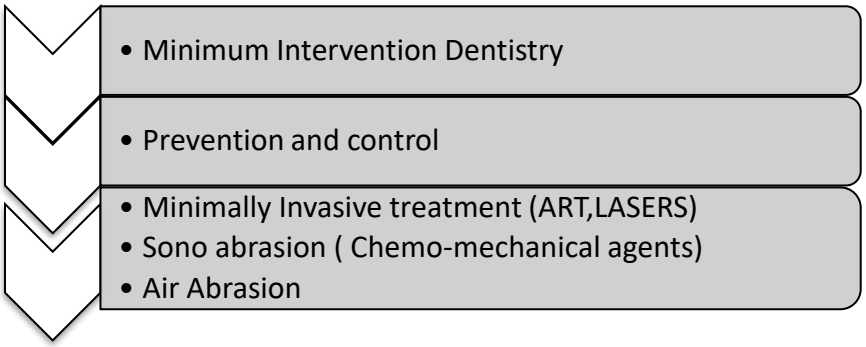
Martin et al. coined the term 'minimally invasive,' 'minimal intervention' or 'preservative dentistry' which was earlier termed as 'prophylactic odontomy' in 2000. MID can be defined as "a philosophy of professional care concerned with first occurrence, earliest possible cure of disease on micro (molecular) levels, followed by minimally invasive & patient-friendly treatment to repair irreversible damage caused by such disease" [6]

This new concept of MID evolved as a result of increased understanding of carious process prevention regarding the occurrence, inhibition of its progression and introduction of newer adhesive materials. Non-cavitated and demineralized enamel and dentin, which was earlier treated with surgical method along with 'extension for prevention' proposed by Black are no more followed. [7]

GOALS OF MINIMAL INTERVENTION DENTISTRY:

1. Caries prevention.
2. Cariogenic bacteria reduction.
3. Minimal surgical intervention of cavitated lesion.
4. Remineralization of early lesions.
5. Repair rather than replacement of defective restoration.

The ultraconservative treatment concept in MID is applied to preserve the tooth structure as much as possible and offer more patient-friendly treatment to fearful patients. The goal is 'prevention of extension' rather than 'extension for prevention.' The ultraconservative treatment includes.



DISEASE RISK ASSESSMENT, EARLY CARIES DIAGNOSIS, AND PREVENTION:

The goal of minimal intervention is stopped disease first and restore the lost. Caries risk assessment is defined as the 'probability of future caries disease development.' It includes both the new and progressive carious lesion. The assessment can be best done by visual appearance, tactile sensation, location, and gingival health. [8-10] Caries risk prediction is still a work-in-progress. One of the most common tools used worldwide by clinicians is 'Cariogram.' It demonstrates the chance to avoid new carious lesion development shortly and what various factors will affect this chance. [11]

The oldest method of diagnosis of a carious lesion is probing and radiographs. In recent times Fiber-Optic Trans-Illumination (FOTI) has become a reliable device for detecting approximal caries [12] compare to infrared laser fluorescence, and light-induced fluorescence devices which are not significantly reliable for assessing carious lesion in pits and fissures of occlusal surfaces. [13]

The goal of a caries prevention program is to reduce the cariogenic bacteria. The first step to prevention is consideration of overall resistance of patients to infection by cariogenic bacteria. Although other factors such as fluoride exposure, the function of the immune system and salivary glands may have a certain impact on risk, the patient has little control over these factors.[14] In contrast, the patient is capable of controlling factors such as diet, oral hygiene, use of antimicrobial agents and dental care — preventive treatment limits tooth demineralization caused by cariogenic bacteria, hence preventing cavitated lesions.

These mainly include:

- Limiting pathogen growth and metabolism
- Increasing the resistance of tooth surface to demineralization

The enamel and dentin demineralization is not a dynamic, irreversible process. But in series of demineralization and remineralization cycles, the tooth loses and gains calcium and phosphate ions alternately, depending on the microenvironment. Fluoride uptake enhances the calcium and phosphate ions and forms fluoroapatite which demineralizes at pH less than 4.5, making it more resistant to demineralization. In a noncavitated lesion, the approach to remineralization includes:

- Decreasing the frequency of intake of refined carbohydrates
- Ensuring optimum plaque control
- Ensuring optimum salivary flow
- Conducting patient education.

Chlorhexidine and topical fluorides can be applied to encourage remineralization. Chlorhexidine acts by reducing the number of cariogenic bacteria while topical fluorides increase the availability of fluoride ion for remineralization and the formation of fluoroapatite. [6]

MINIMALLY INVASIVE PREPARATION TECHNIQUES:

A wide variety of clinical application is shown by different preparation technologies, but each technique has significant potential and is used in the now recent era of dentistry. [15] Following techniques are used :

1. Mechanical

- Atraumatic restorative treatment – ART[16]

This approach was pioneered in Tanzania in the 1980s as part of the primary oral health program. The technique of caries removal using hand instruments only with combined use of modern restorative material with adhesive characteristics. Recently GIC with fluoride release that reduces the onset of secondary caries is used.

- Rotary – High/low-speed bur

- Sonic oscillation –SONICSYS micro [15]
  Sono-Abrasion is the use of high-frequency sonic air scalers with modified abrasive tips which describe elliptical motion with the transverse distance between 0.08 and 0.15mm and longitudinal movement between 0.055 to 0.135mm. 40 µm grit diamond is coated on one side and uses water irrigant at a flow of 20-30ml/min as a coolant.

2. Chemomechanical (Carisolv) [17]
   The chemomechanical methods involve softening of dentin by chemical agent application which further can be excavated gently using spoon excavator. N-Monochloraminoacids are formed when amino acids are mixed with NaOCl which selectively degrade demineralized collagen in carious dentine. The approximate time for this 10-15min later restored with composite resin or GIC. The technique is advantageous for dental phobics, medically compromised patients and children.

3. Kinetic (Air abrasion)[18]
   This technique involves the use of alumina particles in a high-velocity stream of air to remove tooth structure as conservative as possible and is mostly restored with bonded resin materials.

Figure (1) showing minimal pit and fissure caries (2) Conservative cavity preparation using air abrasion (3) Prepared Cavity.[19]

4. Hydrokinetic (Laser- CO2, Er: YAG, Nd: YAG, etc.) [20]
   LASERS are new technology produce beams of coherent and very intensity light. LASERS have been used in various treatment soft and hard tissue in dentistry. Factors LASERS efficiency depends on various factors such as wavelength, pulse energy, optical properties of incident tissue. Most commonly used hard tissue ablation includes

- Erbium: Yttrium-aluminum-garnet (YAG) and neodymium: YAG – Mid-infrared (IR) to IR emission
- CO2 laser – IR emission
- Excimer lasers (ArF [Argon: Freon] and XeCl [Xenon: Chlorine]) UV emission
- Holmium lasers
- Dye-enhanced laser ablation – exogenous dye, indocyanine green in conjunction with a diode laser.

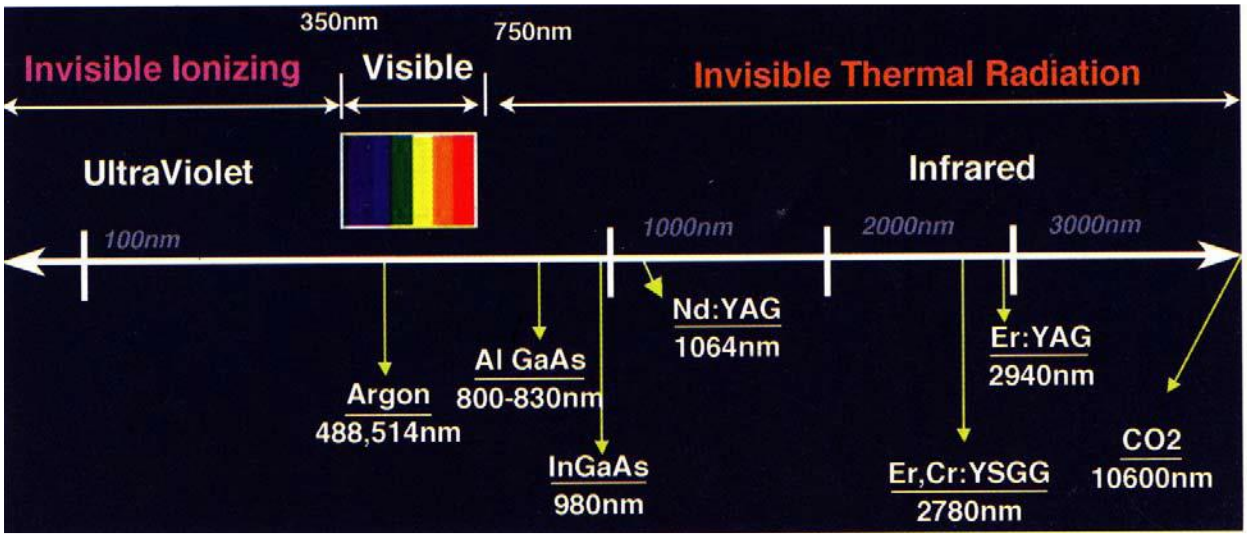


Figure showing portion of electromagnetic spectrum showing dental laser wavelengths being used for treatment.[21]

5. Ozone Technology (O3) [22]
   Ozone therapy uses energized form of oxygen and is new treatment modality being introduced as an alternative to local anesthesia and management of dental caries. Ozone is one of the most powerful oxidants, able to kill bacteria, spores, and viruses. Primary lesion, when exposed to ozone, becomes sterile and remineralize after some time. Thus, it is a radical approach to remove acidophilic microorganisms in dental caries.

Cavity Designs for Minimal Intervention [23]:
Basic cavity design principles are as follow:

- Removal of infected tooth structure, incapable of regeneration.
- Gaining access to the body of the lesion without being destructive
- Avoiding exposure to sound unaffected dentine
- Reducing restoration perimeter
- Retaining and reinforcing sound, but undermined enamel
- Keeping restoration margin away from the gingiva
- Reducing occlusal stress on final restoration

The Designs for cavity preparation are as follow:

1. Tunnel preparation
2. Microchip cavity preparation
3. Minibox cavity preparation
4. Full box cavity preparation

(A) (B) (C)

Figure (A) showing Microchip and Minibox cavity design (B) Tunnel Preparation (C)Full box cavity. [23]

Treatment Plan of MID [24]:

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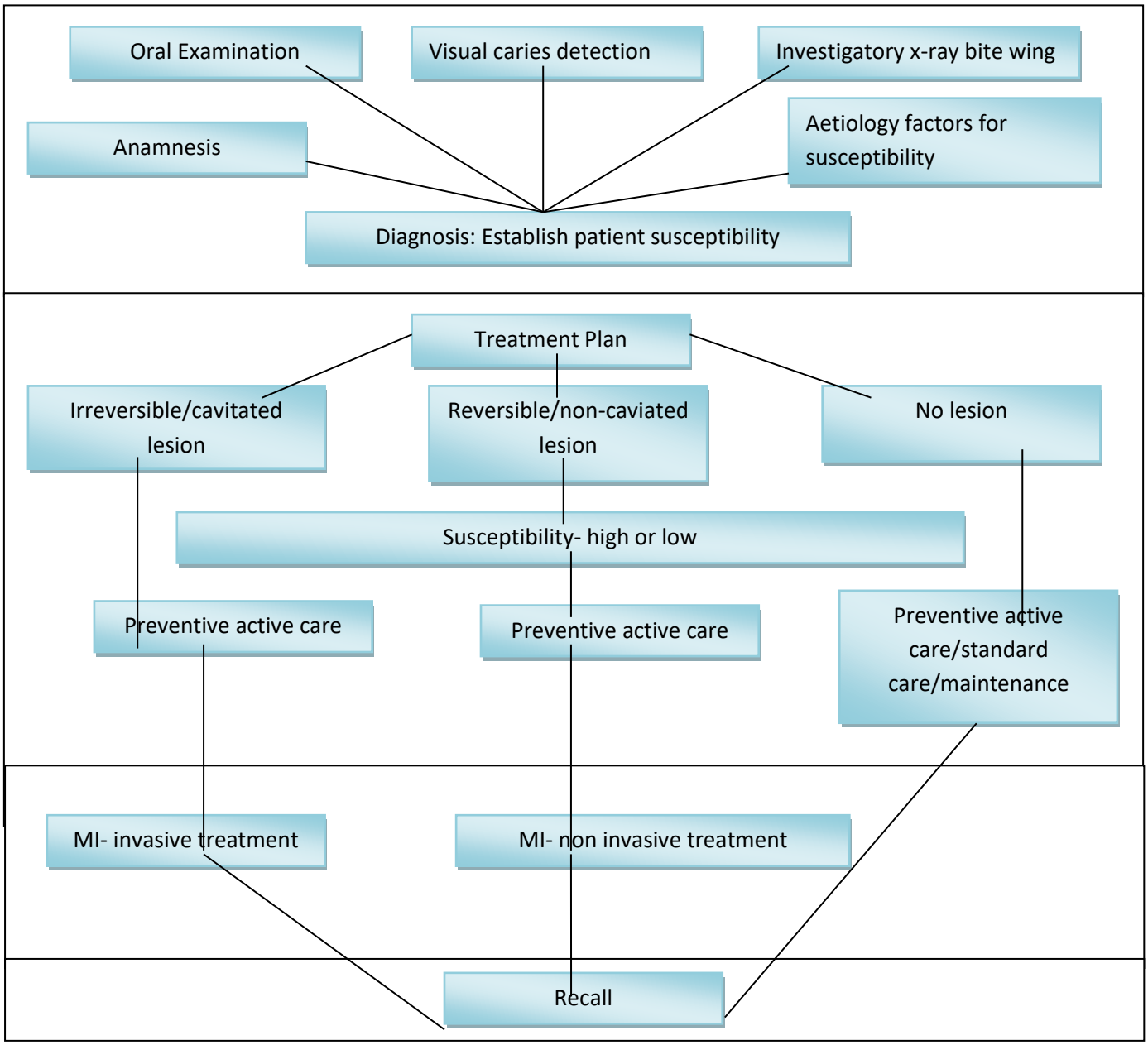

CONCLUSION:

The philosophy of minimum intervention of oral healthcare is not only dependant on materials/techniques used but on effective patient-centered disease prevention and tooth preservation as well. Thus an astute dentist must apply the concept of MID for conservative management of dental caries and offer patients a friendlier and health-oriented treatment option.

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