

# Minimal Invasive Dentistry: Dawn of a New Era in Tooth Preservation

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# ABSTRACT

Minimal Intervention Dentistry is a modern dental practice designed around the principle aim of preservation of as much of the natural tooth structure as possible. The concept includes the use of all available information and techniques ranging from accurate diagnosis of caries, caries risk assessment and preservation to technical procedures in repairing restoration. The article discusses the advances in techniques and materials that have led to the changes and attempts to put them into perspective. The ultimate goal of minimal intervention is to extend the lifetime of the restored tooth with as little intervention as possible.

## INTRODUCTION

Minimal Invasive Dentistry (MID) is defined as the maximum preservation of healthy dental tissue. Within cariology, Minimal Invasive Dentistry includes everything from correct diagnosis of:

- 1. Primary and secondary caries lesion
- 2. The assessment of caries risk, caries prevention and evaluation of caries progression
- 3. Repair of the restoration as an alternative to replacement [1].

The concept of Minimal Intervention Dentistry has evolved as a consequence of the prevention of caries occurrence, inhibition of its progression and the development of newer adhesive restorative materials [2].

Minimal operative dentistry is based on a refined model of care and includes the following concepts:

- 1. Early caries diagnosis
- 2. Assessment of individual caries risk
- 3. Classification of caries depth and its progression using a radiograph
- 4. Reduction of cariogenic bacteria to decrease the risk of further demineralization and cavitation

The main goal of minimal intervention is to increase the life of the teeth, which was restored with less intervention. Now the concept is "prevention of extension" rather than "extension for prevention" [3].

# **PRINCIPLE OF MINIMAL INTERVENTION**

Minimal intervention operative dentistry is dependent on the following factors:

- 1. Demineralization Remineralization Cycle
- 2. Adhesion in Restorative Dentistry
- 3. Biomimetic Restorative Material

# MINIMALLY INVASIVE (MI) PREPARATION TECHNIQUES

Nowadays, the adhesive restorative materials in conjunction with increased knowledge on the pathology of caries and effective preventive methods allow for MI techniques. Atraumatic restorative and chemo-mechanical techniques have been developed as alternative methods for caries removal. The desire for preparation of small dimensions and microcavities has stimulated new approaches for cavity design and tooth cutting concepts, such as oscillating, kinetic, and hydrokinetic cavity preparation systems [4–8]

#### **MI Preparation Techniques**

- a) Mechanical Rotary High/Low-Speed Bur
- b) Non-rotary Atraumatic Restorative Treatment (ART)
- c) Air Abrasion
- d) Sono Abrasion
- e) Air Polishing
- f) Chemo-mechanical (Carisolv)
- g) Hydrokinetic Laser (CO<sub>2</sub>, Er: YAG, Nd: YAG)
- h) Ozone Technology (O<sub>3</sub>)

#### **Atraumatic Restorative Treatment (ART)**

Atraumatic restorative treatment (ART) is an alternative treatment for dental caries. Since MI requires no anaesthesia or electricity it was originally developed for use in underdeveloped countries, in rural areas. The increased interest in this technique was manifested in developed countries, because of its "atraumatic" approach in relation to the stress and pain experienced by patients [9].

The ART principles are:

- 1) Removal of carious tooth tissue using only hand instruments
- 2) Restoration of the cavity with a highviscosity glass-ionomer, along with concurrent sealing of the adjacent pits and fissures

Glass Ionomer Cement (GIC) that releases fluoride and reduces the onset of secondary caries is used as the ideal material. The often seen disadvantages of GIC namely low wear resistance and strength are minimized because the cavity preparations of ART technique usually result in relatively small restorations. In addition, new GIC with improved wear resistance and strength are being developed specifically for ART technique. The ART approach is very cost effective and friendly procedure. It makes restorative care more accessible to all population groups.

#### **Air Abrasion**

Air abrasion is a pseudo-mechanical, nonrotating technique, used to remove decayed tissues. The principle of air abrasion is to apply, under a high pressure, non-toxic particles, such as ions of aluminium oxide, to remove accurately the enamel, dentinal caries and old fillings. Air abrasion requires less time and energy consumption, it requires no anaesthesia and does not produce vibrations and heat [9]. The air abrasion system uses abrasive particles targeted mainly for the affected area of the cavity. Simple stains can be removed easily. Both stains and affected tissue can be removed easily using a strong jet of abrasive particles. Alternative abrasive particles have been proposed, showing that software particles, such polycarbonate resin or as alumina hydroxyapatite mixtures can be more selective in removing carious dentin because they are capable of removing only tissue of equivalent hardness. the healthier tissue remaining unaffected [10].

#### **Air Polishing**

Air polishing produces a high-pressure jet which contains sodium bicarbonate; it is projected on the surface of teeth, producing a cutting/grinding effect. Air polishing is not a very selective procedure when grinding tooth structure and it can affect the health of dentin and cementum. Used for removing stains and in the final preparation of the tooth to remove the remaining altered dentin.

Air polishing is accomplished by the propulsion of abrasive particles through a mixture of compressed air and water, with a handpiece, thus removing the stain and/or dental plaque. The abrasion rate is influenced by speed, pressure, time of abrasion, shape and hardness of the particles used [11].

## **Ultrasonics and Sono-Abrasion**

The high-frequency ultrasonic vibrations have been recommended since the 1950s to remove proximal carious lesions in both posterior and anterior teeth, with the aim of achieving a more conservative cavity preparation.<sup>11</sup> A diamondcoated tip oscillating at a frequency of about 6.5 kHz, up to a maximum frequency of 20-40 kHz is used to excise the dentin [12].

Sono-abrasion is a technique for the selective preparation of enamel and dentin, offering excellent efficacy, quality and safety. It utilizes high frequency, sonic, air scalers with modified abrasive tips which describe an elliptical motion with a transverse distance of 0.08–0.15 mm and a longitudinal movement ranging from 0.055 to 0.135 mm.

The advantages are minimizing or eliminating noise, vibration, heat and pressure. The disadvantages are relatively low abrasion and high hub excursion (0.4 mm) of the tips, and weakening of the enamel rods with the associating cracks adjacent to the prepared sites [12].

#### **Chemo-Mechanical Caries Removal**

Chemo-Mechanical Caries Removal (CMCR) involves the chemical softening of carious dentin followed by its removal by gentle excavation. The reagent involved is generated by mixing amino acid with sodium hypochlorite the resulting N-mono-chloro-aminoacid so selectively degrade demineralised formed collagen in carious dentin. About 10 - 15 minutes is required. It is well suited to the treatment of deciduous teeth, dental phobics, and medically compromised patients. Composite resin or GIC are the best materials for restoring the tooth

A new chemo-mechanical method of caries removal based on MID concept is a two paste system consisting of a gel of high viscosity, containing three amino acids, and a transparent fluid containing 0.5% sodium hypochlorite. This method enhances a better control when compared to removal with burs which lead to large amounts of dentin removal in blocks, and have a higher possibility of pulp exposure. Chemically, it softens the carious dentin while leaving the healthy dentin unaffected [12].

#### Lasers

Lasers are devices that produce beams of coherent and very high-intensity light. A large number of current and potential uses of lasers in dentistry have been identified that involve the treatment of soft tissues and modification of hard tooth structures [13].

Lasers that are currently being investigated for more selective hard tissue ablation include:

- Erbium: Yttrium-aluminum-garnet (YAG) and neodymium: YAG – Mid-infrared (IR) to IR emission
- CO<sub>2</sub> laser IR emission
- Excimer lasers
- Holmium lasers
- Dye-enhanced laser ablation exogenous dye, indocyanine green in conjunction with a diode laser

#### **Ozone Technology (O<sub>3</sub>)**

Ozone  $(O_3)$  is an energized form of oxygen. Ozone therapy has been extensively used in the medical professions for more than a century. Ozone is one of nature's most powerful oxidant, which accounts for its ability to kill bacteria, spores, and viruses. Ozone therapy is based on the premise that the primary carious lesions when exposed to ozone become sterile and remineralize after some time [13].

#### Rotary - High / Low-Speed Bur

Though rotary bur being used universally, there are problems that need to be overcome. The rotating bur easily cuts through carious dentin to eventually open up healthy tubules deeper in the tissue and in conjunction with water stimulation of odontoblastic processes that will result in pain associated with cavity preparation using this technique.

Fissurotomy bur is a new approach to ultraconservative dental treatment. The shape and size of the three unique burs; Original fissurotomy Micro STF and fissurotomy Micro NTF are designed specifically for the purpose of treating pit and fissure lesions. The comparison of a fissurotomy bur to a traditional cutting bur demonstrates the lessened invasiveness of this new design bur [13].

#### CONCLUSION

It is apparent that it is time for a change in operative dentistry. It is not possible to really imitate natural tooth structure on a long-term basis. 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 remineralization changes and in caries prevalence and progression, the management of dental caries has evolved from G.V Black's "extension for prevention" to "prevention for extension".

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