

## Recent Criterias of Tooth Preparation in Operative Dentistry

Ruchi Gupta<sup>1</sup>, Anil K Tomer<sup>2</sup>, Lungdin Leima Cecilia<sup>3</sup>

*1 Professor, Dept of Conservative Dentistry and Endodontics, Divya Jyoti College of Dental Sciences and Research, Modinagar, Ghaziabad*

*2 Professor and Head, Dept of Conservative Dentistry and Endodontics, Divya Jyoti College of Dental Sciences and Research, Modinagar, Ghaziabad*

*3 PG Student, Dept of Conservative Dentistry and Endodontics, Divya Jyoti College of Dental Sciences and Research, Modinagar, Ghaziabad*

*Corresponding Author: Dr Ruchi Gupta*

*Professor, Dept of Conservative Dentistry and Endodontics, Divya Jyoti College of Dental Sciences and Research, Modinagar, Ghaziabad*

---

### Abstract

*The modern concept for restorative dentistry is based on conservation and has concentrated on the importance of preservation of the sound tooth structure by taking the measures to preserve the integrity of teeth from being affected or by undergoing treatment protocols which involve the minimum intervention just necessary to restore the tooth as an active member in the masticatory apparatus and to ensure its future performance. Removal or to help remove caries-infected tissue as selectively as possible, while being minimally invasive through maximum preservation of caries-affected tissue with less time.*

---

Date of Submission: 01-03-2021

Date of Acceptance: 14-03-2021

---

Caries continues to affect a significant proportion of world population. Dental caries is an infectious disease caused by disequilibrium in the process of demineralization and remineralization of hard dental tissues. The earliest attempts to remove caries involved the use of hand drills which were later replaced by modern high speed drills. However the inherent fundamental drawbacks of the drilling approach like excessive tooth structure loss and discomfort to the patient still remains.

To overcome the disadvantages of rotary system, other procedures of caries removal have evolved. Moreover, with the advent of adhesive restorative materials & subsequent developments in cavity designs, the widely accepted principle of "Extension for Prevention" has been challenged and is now considered too destructive a method of caries removal.

Minimum Invasion Dentistry(MI) is defined as a philosophy of profession care, concerned with the occurrence, early detection and earliest possible cure of disease on a micro level, followed by minimally invasive treatment in order to repair irreversible damages caused by such disease. Preservation of the teeth with minimally invasive care is essential in today's dentistry. The current philosophy of Minimal Invasive Dentistry is to combine aesthetics, prevention, healing, adhesion and restoration to remove a carious lesion in the least invasive manner .Preservative dentistry is based on

- Accurate caries diagnosis
- Classification of the caries severity by using radiographs
- Assessment of individual caries risk (high ,moderate or low)
- Arresting active lesions
- Monitoring of cavitated arrested lesions
- Placement of restorations in cavitated lesions with minimal cavity designs
- Assessing disease management outcomes (that is, change in various decayed/missing/filled indices) at predetermined time intervals.

### CONCEPT OF MINIMAL INTERVENTION DENTISTRY

The concept of minimal intervention dentistry initiates from the traditional surgical approach to the elimination of caries lesions seen as radiolucencies in the inner half of the enamel, at the dentin-enamel junction (DEJ), and slightly into dentin, but with little or no evidence of cavitations. Preservation of natural tooth structure should be the guiding factor for the smallest, as well as the largest cavity. <sup>1</sup>

MID aims to empower patients through information, skills, and motivation of their own oral health so they require minimum from the dental profession.

### **The Minimal Intervention Approach**

It includes:

- 1) Caries Diagnosis
- 2) Early Restoration
- 3) Caries Control

### **Caries diagnosis**

It includes:

- A. CARIES RISK ASSESSMENT
- B. EARLY DETECTION OF CARIES

#### **.1 Caries risk assessment**

Caries-risk assessments aid in the success of the treatment. Since caries is preventable, the diagnosis of caries as a lesion in a tooth is not sufficient for a treatment plan. The caries-risk assessment tool (CAT) is used to assess the level of risk for caries (cavity) development in infants, children and adolescents based on a set of clinical, environmental and general health factors.

#### **Early detection of caries**

Detection of the carious lesion is an important aspect in the diagnosis of caries. Visual and tactile examination and dental radiographs are commonly used methods for caries detection. In recent years, newer caries detection methods and devices have been developed as traditional caries detection procedures do not detect caries until they have progressed through at least the thickness of enamel.

This include:

1. Laser fluorescence
2. Fiber-optic transillumination
3. Digital imaging fiber-optic transillumination
4. Ultraviolet illumination
5. Electronic caries detector
6. Dye penetration method
7. Quantitative light-induced fluorescence(QLF)
8. Ultrasound imaging
9. Endoscope / Videoscope

### **CARIES REMOVAL AND RESTORATION**

Rotary instruments used for the treatment of carious lesions have often resulted in a considerable removal of tooth structure. Caries removal and cavity preparation by using turbine and a hand piece result in an unpleasant perception of drilling to the patient. Newer techniques for removal of carious dentin have been developed to minimize this excessive tissue.

#### **Preventive Resin Restoration (PRR)**

PRR is indicated in teeth with minimal teeth and fissures decay. In this minimal cavity preparation is required to prevent unnecessary removal of healthy tooth structures for retention. If the decay is limited to enamel then no local analgesia is required. After etching, rinsing and drying the cavity is condensed with a normal composite or GIC.

#### **ART (Atraumatic Restorative Technique)**

ART approach involves the removal of only soft, demineralized tooth tissue with hand instruments, followed by filling the cleaned cavity & associated pits & fissures with adhesive restorative materials.

#### **NEW CAVITY CLASSIFICATION SYSTEM**

This new system defines the site, extent, and complex of a cavity and at the same time encourages a conservative approach to the preservation of natural tooth structure. This new system is designed to utilize the healing capacity of the lesion.

#### **THE THREE SITES OF CARIOUS\ LESIONS (ANATOMIC SITES)**

Cariou lesions occur at three sites on crown or root of a tooth: that is, in those areas subject to the accumulation of plaque.

- **Site 1** – pits, fissures and enamel defects on occlusal surfaces of posterior teeth
- **Site 2** – approximal enamel immediately below areas in contact with adjacent teeth.
- **Site 3** – the cervical one-third of the crown or, following a gingival recession, the exposed root.

**THE FOUR SIZES OF CARIOUS LESIONS (ACCORDING TO EXTENT & COMPLEXITY)**

- **Size 1** – minimal involvement of dentin just beyond healing through remineralization.
- **Size 2** – moderate involvement of dentin. Following cavity preparation, remaining enamel is sound, well supported by dentin and not likely to fail under normal occlusal load. The tooth is sufficiently strong to support the restoration.
- **Size 3** – the cavity is enlarged beyond moderate involvement. Remaining tooth structure is weakened to the extent that cusps or incisal edges are split or likely to fail if left exposed to occlusal load. The cavity needs to be further enlarged so that the restoration can be designed to provide support to the remaining tooth structure.
- **Size 4** – extensive caries and bulk loss of tooth structure has already occurred.

**Site 1, Sites 1, 2, 3 and 4 – PIT and Fissure Caries**

· Cavity located on the occlusal surface of a posterior tooth or any simple enamel defect on an otherwise smooth surface of any tooth.

· Black's class I – the smaller size 1 could not be carried out previously because suitable restorative materials were not

available, so Black's classification begins with Site 1, Site 2 (# 1.2).

**Site 2, Sites 1, 2, 3 and 4 – Approximal Lesion Commencing in Relation to Contact Areas**

· Cavity located on the proximal surface of any tooth (anterior or posterior) initiated immediately below the contact areas.

· Black's class II – lesions occurring between posterior teeth only. Because of materials limitations, there was no equivalent of Size 1, so the Black's classification begins with Site 2, Size 2(#2.2).

· Black's class III – cavity located between anterior teeth only. Because of materials limitations, there was no equivalent to Size 1, so the Black's classification begins with Site 2, Size 2 (#2.2).

· Black's class IV – an extension of a class III involving corner or Incisal edge of an anterior tooth. An alternate cause would be a traumatic fracture of the Incisal corner. Now classified Site 2, Size 4 (#2.4).

**Site 3, Sites 1, 2, 3 and 4 – Gingival One-third of the Clinical Crown or Exposed Root Surface Following Recession**

· Cavity located in the gingival one-third of the crown or exposed root. Black's class V– this classification does not differentiate lesions on the gingival one-third of the approximal surface (particularly root surface caries) from class II lesions. An erosion / abrasion lesion or a small carious cavity would be a Site 3, Size 1 (#3.1) or Site 3, Size 2 (#3.2) and interproximal lesions would usually be Site 3, Size 3,Size 4 (#3.4)

**Mechanical Method**

Conventional caries removal and cavity preparation entail the use of burs. In current practice, having gained access to the carious dentine using the high- speed air turbine hand-piece and the slow-speed hand-piece and bur or hand excavator can be used for carious dentine excavation. As the hand excavator will remove softened tissue with more sensitive tactile feedback than a bur, this method is more self limiting of the two.<sup>2</sup>

**CAVITY DESIGNS FOR MINIMALINTERVENTION**

**Tunnel Preparation**

It is considered in small, proximal carious lesions and where aesthetics demands are high. Access may be gained through the occlusal surface with No. 2 bur about 2.0 mm from the marginal ridge. After the removal of dentinal caries, the proximal enamel lesion is evaluated. If enamel is to be removed, a matrix band is placed to protect the adjacent tooth. If the marginal ridge has been undermined the tunnel preparation can be converted to a traditional Class II preparation at this time.

**Micro Chip Approximal Cavity Preparation**

It is considered when the fracture in the enamel wall extends down from the marginal ridge to the porous region. An extension of the occlusal access is made to include the fractured portion of the marginal ridge. The cavity is filled with glass ionomer cement and the excess is being removed from the occlusal surface. The glass ionomer and enamel are then etched, and the posterior composite is placed to restore the deficiency .

**“Minibox” Approximal Cavity Preparations**

In this preparation, the excavation of the dentin lesion is same as for the previous preparations.

The design differs only in the handling of the enamel. Initially, the integrity of enamel wall needs to be preserved by extending the margins where it can be considered stable and durable. A full box needs not to be developed. Later on, the enamel should be opened out to sound dentin until it can be considered stable. It is preferable to retain and reinforce this enamel even if it is unsupported by dentin by placing glass ionomer cement base.

**“Full Box” Approximal Cavity Preparation**

It is a very common procedure, where the enamel is in hopelessly poor condition and needs refining after eradicating the dentin lesion. The final refinement will depend on the type of restoration to be placed. For

example, the preparation design for an amalgam or composite. Amalgam restoration differs from the design for a porcelain or gold inlay.

### **CARIES CONTROL**

Restoration of carious lesions is the most effective method to control the progression of active, cavitated lesions. Caries control an operative procedure in which multiple teeth are treated quickly by removing the infected tooth structure, by medicating the pulp and by restoring the defects with a temporary material. Caries Control means “Initial treatment of caries and Maintenance”. Initial treatment includes evaluation and documentation of lesion followed by temporization and specific antimicrobial treatment. It also includes plaque and dietary control.<sup>3</sup>

### **RESTORATIVE MATERIALS USED IN MINIMUM INTERVENTION DENTISTRY**

The restorative materials used in MID are biomimetic in nature. In other words, the material should be biocompatible, biologically acceptable and not rejected by adjacent vital tissues.

### **Recent advances in caries removal techniques**

#### ***Air –Abrasion***

This method of cutting teeth seemed to dramatically reduce the problems of heat generation, vibration and other mechanical stimulation resulting in relatively pain- free procedures when compared with drill. There have been reports to indicate that there were no significant differences in pulpal response between air abrasion and high speed bur preparation using copious water spray.

Recent advances in air abrasion technology allow a metered flow of alumina particles, higher operating pressures and almost instantaneous initiation and termination of the abrasive stream. Further investigation into the use of alternative abrasive mixtures has indicated that softer particles, e.g. Polycarbonate resin or alumina-hydroxyapatite mixtures might be more selective in carious dentine removal as they are only capable of removing tissue of equivalent hardness, leaving healthier, sound tissue virtually unscratched. These factors, coupled with the use of protective rubber dam, barrier masks for the clinical team, more efficient suction units to expel the unwanted dust.<sup>4</sup>

#### ***Chemo-Mechanical Methods***

The chemo-mechanical method of caries removal was developed to overcome these shortcomings. It is not only more comfortable for the patient but also able to better preserve the healthy tissue. The chemo-mechanical method is an effective alternative for caries removal because it brings together (i) atraumatic characteristics, (ii) bactericide & bacteriostatic action (iii) the active ingredient would soften the pre degraded collagen of the lesion without pain & undesirable effects to adjacent healthy tissues.

The chemomechanically treated carious dentin becomes brittle, and is easily removed by curettage with hand instruments. Chemo-mechanical caries removal was introduced to dentistry as an alternative to conventional drilling methods (which was the most frequently used method for caries removal. Caridex, Carisolv, Papacarie and Carie-care are some of the chemo-mechanical organic caries removal agents. The review will address systems of chemo-mechanical caries removal and their advantages by comparing within the various chemo mechanical caries removal agents.<sup>4</sup>

### **CARIDEX**

It consists of two solutions:-

- a) Solution I: 1% NaOCl
- b) Solution II: Glycine, Aminobutyric acid, NaCl and NaOH

The two solutions are mixed immediately before use to give the working reagent [pH 12] which is stable for 1 hour.

Caridex consists of a reservoir for the solution, a heater and a pump which pass the liquid, warmed to body temperature through a tube to a hand piece and an applicator tip (in various shapes and sizes). The solution is applied to the carious lesion by means of this application which is used to loosen the carious dentin by a gentle scraping action, the debris together with the spent solution being removed by a spiration.

### **CARISOLV GEL**

Carisolv gel is commercially available in two different packages:-

- Carisolv gel – Multimix
- Carisolv gel – Single mix

Carisolv gel is marketed in 2 syringes. Equal parts of the two are mixed to form the active gel substance.

- a) **Syringe I:** 0.5% NaOCl
- b) **Syringe II:** Amino acids- Lysine, Leucine and glutamic acid, Carboxymethyl cellulose, Erythrocinand NaOH

The first marketed version of Carisolv gel was red, but in recent years the gel has been colorless, being prepared at the University of Goteborg, Sweden.

Increased amount of free chloramines needed to improve its efficacy, which in turn required a higher concentration of sodium hypochlorite. Effect of higher concentration of sodium hypochlorite is that the colour agent is removed, and the gel is uncoloured.

The gel is repeatedly applied to the carious dentin and softened caries dissolved by the Carisolv gel is gently removed with specially designed hand instruments, thus preserving the remineralizable layer of dentin, let alone underlying sound dentin.

#### **PAPACARIE**

In 2003, a research project in Brazil led to the development of a new formula to universalize the use of chemo-mechanical method for caries removal and promote its use in public health. The new formula was commercially known as Papacarie.

Papacarie basically comprises of papain, chloramines, toluidine blue, salts, thickening vehicle.

#### ***Papain***

Papain is a proteolytic enzyme. It has bactericidal, bacteriostatic and anti-inflammatory characteristics. Similar to the human pepsin, papain acts as a debriding, anti-inflammatory agent which does not damage the healthy tissue and accelerates the cicatricial process. Papain comes from the latex of the leaves and fruits of the green adult papaya. Papain acts only in infected tissues because infected tissues lack a plasmatic anti protease called a1- anti-trypsin.

#### ***Chloramine***

It is a compound comprised by chlorine and ammonia and has bactericidal and disinfectant properties. It is widely used as an irrigating solution of radicular canals in order to chemically soften the carious dentin. The degraded portion of the carious dentine collagen is chlorated by the chloramine and is easily removed with excavator.

#### ***Toluidine blue***

Initially, malachite green was used as coloring agent, however, after a few studies toluidine blue was found highly effective against *Streptococcus mutans*. It is a photosensitive pigment that fixes into the bacterial membrane.

#### **CARIE-CARE**

Carie care system was introduced in India by Uni-biotech Pharmaceuticals Pvt. Ltd., which consists of papaya extract(papain) 100mg, clove oil 2mg, colored gel(blue), chloramines, sodium chloride, and sodium methylparaben, with similar properties as that of papa carie.

#### ***GK-101***

The sole use of sodium hypochlorite was to be toxic and aggressive to adjacent healthy tissues. Therefore, a new solution was developed adding sodium hydroxide, sodium chloride and glycine to 5% Sodium Hypochlorite. This modified formula was known as GK -101 and it was comprised by N-monochloroglycine. It was more effective than the hypochlorite alone but was very slow in carious tissue removal.

#### **Biosolv**

It is an experimental enzymatic chemomechanical caries removal agent which is not commercially available. Based on the manufacturers information, it consists of pepsin enzyme in a phosphoric acid can dissolve the inorganic components of caries-infected dentine, while permitting the pepsin to selectively disrupt the collagen fibres. Meanwhile, this softened mass can then be easily removed by the specially designed plastics instruments without affecting sound tissue.

#### **Ozone therapy in minimal intervention**

Ozone is a natural allotrope of oxygen found in upper layer of atmosphere protecting living organisms on earth from U.V. Radiation. It is an unstable gas quickly giving up nascent oxygen which is a strong oxidant rendering multiple beneficial effects. Ozone can arrest white spot lesions and reverse early caries process thus leading to a promising future in minimal intervention dentistry.

#### **Applications:**

Modes of ozone generation in dentistry:

Ozone shows encouraging results in treating early tooth carious lesions thus promising a painless dentistry in future. Ozone can be used along with diagnodent to assess the caries risk in the earliest stages and thus delivered according to the severity of the lesion.

**Proximal Caries Lesions and root caries:**

Increasing exposure time of ozone from 10sec to 20sec, changed its antimicrobial effect from disinfection to sterilization . Application of ozone for 40 seconds significantly reduced S.mutans count, whereas 60sec exposure almost eliminated cariogenic species.

**Hyper – Sensitive Teeth:**

Enamel and Dentine loss occurring due to multiple factors like attrition, abrasion, erosion, trauma from occlusion may cause hyper sensitivity and diagnosis of etiology is vital. After elimination of cause 40 to 60 sec application of ozone is found to instantly reduce pain in these sensitive teeth.<sup>5</sup>

**Cracked Tooth Syndrome:**

After exploration of the crack, assess the prognosis and tooth is exposed to ozone for 60 – 120 sec and seal the tooth with an intermediate restoration like GIC8 . The tooth needs to be periodically assessed and restored.

**Cavity Preparation Using Ultra-Short Pulsed Lasers**

Ultra-short pulsed lasers (USPLs) have been shown to precisely cut hard materials including tooth enamel and dentin with less temperature rise than conventional lasers. One of the main advantages of using USPLs is the minimal temperature rise during cavity preparation, which may enable the operator to prepare the cavity without using a coolant. The higher ablation rate of USPLs is also helpful in overcoming the problem of time-consuming laser cavity preparation.

**Conclusion**

In general, the development of caries removal techniques in restorative dentistry is progressing towards a more biological and conservative direction. This has been made possible with better understanding of the aetiology, development and prevention of dental caries, the emergence of new caries removal techniques and advances in dental restorative materials. In particular, the development of reliable adhesive technology in the oral cavity, which led the way to a minimal cavity preparation concept, has given a great impetus to the current thinking in this area. The coming decades will continue to see shifts in the approach to caries removal techniques, cavity preparation and restoration techniques based on rational clinical and scientific principles.

**References**

- [1]. Tyas MJ, Anusavice KJ, Frencken JE & Mount G J. Minimal intervention dentistry-a review. *Int Dent J* 2000; **50**: 1–12.
- [2]. Simonsen RJ. From prevention to therapy: minimal intervention with sealants and resin restorative materials. *J Dent* 2011; **39**(2): 27–33.
- [3]. Frascaria M. Aesthetic rehabilitation in a young patient using a minimally invasive approach. A multidisciplinary case report. *Eur J Paediatr Dent* 2016; **17**: 234–238.
- [4]. Eichenberger M, Biner N, Amato M, Lussi A, Perrin P. Effect of magnification on the precision of tooth preparation in dentistry. *Oper Dent* 2018; **43**: 501–507.
- [5]. Yu H, Zhao Y, Li J. Minimal invasive microscopic tooth preparation in esthetic restoration: a specialist consensus. *Int J Oral Sci* 2019; **11**: 31.

Ruchi Gupta, et. al. "Recent Criterias of Tooth Preparation in Operative Dentistry." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 20(03), 2021, pp. 14-19.