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Recent Advances In Minimal Invasive Dentistry

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Abstract
Comprehensively, Minimal invasive dentistry combines the functional and aesthetic aspects to design minimally invasive treatments and do not compromise the aesthetic, psychological, or physiology aspects of patients. MICD mainly emphasized on patients benefits. Conventional treatment always focuses on the objective factors of minimally invasive dentistry, while MICD brought the attention to the subjective factors of patient psychology. The concept of MIPP involves clinical procedure that focuses on the use of minimally invasive treatments to achieve a high standard of aesthetic dental function. The comprehensive concept of MIPP was especially appropriate for dental attrition with reduced occlusive height, which could be reconstructed with minimal reduction of the tooth tissue. Long-term restoration outcomes reported that the principle of MIPP was suitable for aesthetic rehabilitation as well. The core principle was maximum preservation of tooth tissue, which is also one of the earliest consensus for the preparation of dental treatments in aesthetic area.
Keywords*: Minimal invasive dentistry, preservation, esthetics, function.*

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Minimum Invasive Dentistry is defined as a philosophy of professional 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 causes by such disease.

I. Principles:

Disease control by reduction in cariogenic bacteria.
Remineralization of early lesions.
Avoid removal any more tooth structure than is absolutely required to restore teeth to their normal conditions.
Use of dental materials that conserve the maximum of tooth structure.

Use of only the strongest and longest lasting dental materials to reduce, the need for future repairs and replacements.
Repair, rather than replacing defective restorations.
Use of dental procedures that keep the number of necessary appointments to the minimum.

II. Golden Triangle Of Minimal Invasive Dentistry:

A thorough understanding and appreciation of the interplay between three critical factors is required to achieve success clinically when using a minimally invasive operative caries management strategy.

Minimally invasive dentistry (MID) can be classified by its approach and techniques. MID primarily focuses on preserving tooth structure by minimizing intervention, often through early diagnosis, prevention, and targeted treatments. It's characterized by using techniques that minimize the removal of healthy tooth tissue and maximizing the use of remineralization and preventative measures.

1. By Approach:
Preventive:

This involves strategies to prevent dental caries (cavities) and other oral diseases from developing in the first place, such as fluoride treatments, sealants, and proper oral hygiene education.

Remineralization:

This focuses on helping teeth repair themselves naturally by promoting remineralization of early enamel lesions, often with fluoride varnish or other treatments.

Conservative Treatment:

This involves minimally invasive procedures for removing decayed tooth structure, restoring cavities, and repairing restorations.

2. By Techniques:

- **Atraumatic Restorative Treatment (ART):** This technique uses hand instruments and non-rotary tools to remove decay and restore teeth with glass ionomer cement.
- **Chemo-Mechanical Caries Removal (CMCR):** This technique uses chemicals to soften decay, followed by gentle removal with hand instruments.
- **Laser Dentistry:** Lasers can be used to prepare cavities, remove decay, and sterilize tooth surfaces.
- **Air Abrasion:** This technique uses a stream of abrasive particles (like aluminum oxide) propelled by compressed air to remove decay.
- **Ultrasonics:** High-frequency vibrations are used to remove decay and prepare cavities.
- **Ozone Therapy:** Ozone gas is used to disinfect and kill bacteria in cavities.

3. By Cavity Designs:

- **Tunnel Preparations:** These are minimally invasive cavity designs for proximal (between teeth) lesions, often used with adhesive materials.
- **Microchip and Minibox Preparations:** These are small cavity designs that minimize the removal of tooth structure.
- **Full Box Cavity Preparations:** These are larger cavity designs that may be necessary for larger lesions.

III. The Minimal Intervention Approach Includes:

Early detection of caries
Caries removal and restoration.

IV. Classification Of Caries Depth And Progression

In 1997, Mount GJ and Hume WR developed a modern classification for carious lesions in contrast to Dr. GV black's old classification

New classification of caries depth and progression:

SITE\SIZE	S1: PIT AND FISSURE	S2: PROXIMAL SURFACE	S3: CERVICAL SURFACE
MINIMAL	1.1	2.1	3.1
MODERATE	1.2	2.2	3.2
LARGE	1.3	2.3	3.3
EXTENSIVE	1.4	2.4	3.4

Tools and Techniques in Minimal Invasive Dentistry

Advanced Diagnostic Aids

- Laser Fluorescence
- Fiber- optic transillumination
- Digital imaging fiber-optic transillumination
- Ultraviolet illumination
- Electronic caries detector
- Dye penetration method
- Quantitative light-induced fluorescence
- Ultrasound imaging
- Endoscope/Videoscope

Non-Invasive Preventive Measures

- Topical fluoride applications
- Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP)
- Silver diamine fluoride (SDF)
- Pit and fissure sealants

Minimally Invasive Caries Removal Techniques

- Air abrasion
- Chemo-mechanical removal (e.g., Carisolv)
- Atraumatic Restorative Treatment (ART)
- Laser-assisted removal

Remineralizing Agents

1. Casein Phosphopeptide-Amorphous Calcium Phosphate (CPP-ACP)

CPP-ACP is derived from milk protein casein and stabilizes calcium and phosphate ions, maintaining a state of supersaturation in the oral environment. This promotes the deposition of these ions into the enamel subsurface, enhancing remineralization. Studies have shown that CPP-ACP effectively remineralizes white spot lesions and reduces enamel demineralization.

2. CPP-ACP with Fluoride (CPP-ACPF)

The combination of CPP-ACP with fluoride enhances the remineralization process by forming fluorapatite, which is more resistant to acid attacks. This synergistic effect has been demonstrated to be more effective than fluoride alone in remineralizing early enamel lesions.

3. Tricalcium Phosphate (TCP)

TCP is a calcium phosphate compound that, when combined with fluoride, releases calcium, phosphate, and fluoride ions upon contact with saliva. This targeted delivery enhances remineralization while minimizing the risk of premature interactions between fluoride and calcium.

4.Nanohydroxyapatite(nHAp)

nHAp mimics the natural mineral component of enamel and can integrate into the enamel structure, repairing microdefects and enhancing surface smoothness. Its nano-sized particles facilitate deeper penetration into enamel lesions, promoting effective remineralization.

5. Titanium Tetrafluoride (TiF_4)

TiF_4 forms a protective layer on the enamel surface, increasing its resistance to acid attacks. It has been shown to enhance enamel hardness and reduce demineralization, making it a valuable agent in preventive dentistry.

Materials Used in Minimal Invasive Dentistry

- **Glass Ionomer Cements (GICs)**: Bond chemically to tooth, release fluoride, ideal for ART.
- **Resin-Modified GICs**: Improved aesthetics and strength with fluoride release.
- **Composite Resins**: Esthetic and conservative, require adhesive bonding.
- **Bioactive Restorative Materials**: Promote remineralization and tooth repair.

Benefits of Minimally Invasive Dentistry

- Maximizes preservation of natural tooth structure
- Reduces pain and the need for anesthesia
- Improves long-term prognosis of teeth
- Increases patient acceptance and satisfaction
- Supports cost-effective dental care
- Ideal for managing dental anxiety in children and adults

Challenges and Limitations

- Requires accurate caries diagnosis and training
- Limited in cases with extensive decay or structural damage
- Dependence on patient compliance for preventive care
- Access to technology may be a barrier in low-resource settings

Sandwich Technique

The Sandwich Technique is a restorative approach in dentistry that combines Glass Ionomer Cement (GIC) and Composite Resin to harness the benefits of both materials. This method is particularly beneficial when cavity preparations extend beyond the enamel into the dentin or cementoenamel junction (CEJ).

Summary Table:

Material/Technique	Strength & Durability	Aesthetics	Bonding to Tooth	Fluoride Release	Technique Sensitivity
Silver Amalgam	High	Poor	Mechanical only	No	Low
Composite Resin	Moderate to High	Excellent	Adhesive	No	High
Glass Ionomer	Moderate	Fair	Chemical	Yes	Moderate
Sandwich Technique	Combined Benefits	Good	Chemical & Adhesive	Yes	High

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