Textbook of
OPERATIVE DENTISTRY

FOURTH EDITION

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Foreword

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Prisha and Vedant

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FOREWORD

Operative dentistry is the principle part of practical dentistry and most of the operative dental procedures are routinely offered by the general practitioners in their everyday practice. As such, the operative procedures are the primary dental care procedures which give the basic principles to either restorative or conservative dentistry. Thus, a textbook for operative dentistry is of utmost important for all the dental students and dentists.

This fourth edition of the *Textbook of Operative Dentistry* covers broad topics such as basic science of cariology, restorative concepts for the operative and esthetic dentistry, material science and biomechanics, most current minimal invasive dentistry and nanotechnology. I believe this textbook has followed and updated the most contemporary technologies and concepts.

A textbook should present basic principles and rationales of the treatment procedures with the answers for What, Why, When and Where. This textbook presents these requirements very well with a good text style and nice presentations of figures and tables. Also, I am sure that this textbook is providing a profound knowledge and information which is a distillation of the knowledge and experience of the authors. Therefore, it will be a favorite book for all readers including students and a book that will help dentists re-live their intellectual interest throughout their career as clinicians.

I hereby congratulate all the authors and editors—Professors Nisha Garg and Amit Garg who dedicatedly wrote this textbook for the publication of fourth edition. I also congratulate all the readers who may get the valuable knowledge and concept from the fourth edition of *Textbook of Operative Dentistry*.

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PREFACE TO THE FOURTH EDITION

Writing a book is harder than we thought and more rewarding than we could have ever imagined. First of all, we would thank God who gave us power to believe in our passion and pursue our dreams. We could never have done this without having faith in you, Almighty.

Our journey started in 2006 and since then, appreciation from our readers has kept us always motivated to bring this book in its best form.

This book is simple, comprehensive, incorporating the most recent techniques and materials in restorative dentistry yet not losing the sight of basics. To continually improve the book further, we incorporated clinical photographs and comments from experts of this field.

We are especially thankful to Dr Roma Turetskyi, Dr Mohan Bhuvaneswaran, Dr Jojo Kottoor, Dr Deepak Mehta, Dr Nikhil Bahuguna, Dr Varinder Goyal, and Dr Priya Titus for their ready to help attitude and providing us their excellent clinical cases photographs as per our requirements, despite their busy schedules. We owe our sincere thanks to Dr Stephan Lampl, CEO and Founder, Edelweiss Dentistry, Austria for providing clinical case photographs for the book. Case photographs provided by them illustrate step-by-step procedure of restorative techniques for better understanding of the subject.

We would like to thank Dr Tom Dienya for editing Interim Restorations, Dr Anil Chandra for editing Direct Filling Gold, Dr Poonam Bogra for Smile Designing in Operative Dentistry, Dr Sanjay Miglani for Pulp Protection, Dr Pranav Nayyar for Evidence-based Dentistry, Dr Shabnam for Nanotechnology in Dentistry, and Dr Neetu Jindal for editing Noncarious Lesions of Teeth.

We are extremely thankful to Dr Neetu Jindal for her constant critical evaluation to bring this book in best possible form. We are thankful to Dr Sweety Gupta, senior resident of KGMC Lucknow for providing us photographs of direct filling gold restorations. Completion of this project would not have been possible without support of our colleagues Dr Sandeep, Dr Varinder, Dr Ruhani, Dr Jasdeep, Dr Achla, and Dr Arjun for their ready to help attitude and positive criticism which has helped in improvement of the book.

We would like to compliment the wonderful team of our postgraduate students who whole heartedly helped in completing this project. We are especially thankful to Dr Garima, Dr Komal, Dr Deeksha, Dr Sahiba, and Dr Amreen for their valuable time for checking the manuscript repeatedly and critically evaluating and pointing out the mistakes in earlier drafts. Special thanks to Dr Navneet for tirelessly clicking the photographs for the book. Thanks to Dr Bharat, Dr Sukhman, Dr Ankur, Dr Vivek, Dr Akanksha, Dr Suvani, Dr Meghna, Dr Sachin and Dr Akshun for helping in this project in their best capacity possible.

We are grateful to our teachers, Dr RS Kang and Dr JS Mann for always guiding us to do our best.

We offer our humble gratitude and sincere thanks to Mr Vikram Bhojia (Secretory, Bhojia Trust), for providing healthy and encouraging environment for our work.

We would like thank Hu-Friedy, Dentsply, GC India and Ivoclar Vivadent for letting us use HD photographs of their products.

We are extremely grateful to our parents for their love, prayers and sacrifices for educating and preparing us for our future.

We are indebted to our kids, Prisha and Vedant for their understanding, patience and emotional support when we were busy in our book.

Thanks to everyone working on this project who helped us so much. Special thanks to Shri Jitendar P Vij (Group Chairman) of M/s Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, India, for showing his confidence in our work, his never-ending motivation to bring best out of us. We are thankful to Mr Ankit Vij (Managing Director), Mr MS Mani (Group President), Dr Madhu Choudhary (Publishing Head–Education), Ms Pooja Bhandari (Production Head), Ms Sunita Katla (Executive Assistant to Group Chairman and Publishing Manager), Dr Astha Sawhney (Development Editor), Mr Rajesh Sharma (Production Coordinator), Ms Seema Dogra (Cover Visualizer), Ms Uma Adhikari (Typesetter), Mr Laxmidhar Padhiary (Proofreader), and Mr Gopal Singh Kirola (Graphic Designer), our amazing coordinators for all their support to work in this project and make it a success.

Nisha Garg
Amit Garg

PREFACE TO THE FIRST EDITION

Operative dentistry is one of the oldest branches of dental sciences forming the central part of dentistry as practiced in primary care. The clinical practice of operative dentistry is ever-evolving as a result of improved understanding of etiology, prevention and management of common dental diseases. The advances and developments within the last two decades have drastically changed the scope of this subject.

Since effective practice of operative dentistry requires not only excellent manual skills but also both understanding of disease process and properties of dental materials available for use. The main objective of the book is to provide students with the knowledge required while they are developing necessary clinical skills and attitude in their undergraduate and postgraduate training in operative dentistry. We have tried to cover wide topics such as cariology, different techniques and materials available for restorations, recent concepts in management of carious lesions, infection control, minimally intervention dentistry and nanotechnology.

So we can say that after going through this book, the reader should be able to:

- Understand basics of cariology, its prevention and conservative management
- Tell indications and contraindications of different dental materials
- Apply modern pulp protective regimens
- Know the importance of treating the underlying causes of patient's problems, not just the restoration of the damage that has occurred
- Select suitable restorative materials for restoration of teeth
- Know recent advances and techniques like minimally intervention dentistry (MID), nanotechnology, lasers, diagnosis of caries and advances in dental materials.

Nisha Garg
Amit Garg

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Chapter 1

Introduction to Operative Dentistry

CHAPTER OUTLINE

INTRODUCTION

Operative dentistry is foundation of the dentistry from which other branches have evolved. It plays an important role in enhancing dental health and now branched into dental specialties. Operative dentistry deals with diagnosis, prevention, interception, and restoration of the defects of natural teeth. Goal of the operative dentistry is to maintain the health and integrity of teeth and their supporting structures.

DEFINITIONS

Sturdevant—"Operative dentistry is defined as art and science of diagnosis, treatment planning and prognosis of defects of the teeth that do not require full coverage restorations for correction. Such treatment should result in the restoration of proper form, function and aesthetics while maintaining the physiologic integrity of the teeth in harmonious relationship with the adjacent hard and soft tissues, all of which should enhance the general health and welfare of the patient".

Gilmore—"Operative dentistry is that subject which includes diagnosis, prevention, and treatment of defects of the natural teeth, both vital and nonvital, so as to preserve the natural dentition and restore it to the best state of health, function and aesthetics.

Mosby's dental dictionary—"Operative dentistry deals with the functional and aesthetic restoration of the hard tissues of individual teeth".

HISTORY

The profession of dentistry was born during the early middle ages. Barbers were doing well in dentistry by removing teeth with dental problems. ***Baltimore College of Dental Surgery (1840)*** in Maryland was world's first dental college. Till 1900 AD, the term "Operative dentistry" included all the dental services rendered to the patients, because all the dental treatments were considered to be an operation which was performed in the dental operating room or operatory. As dentistry evolved, dental surgeons began filling teeth with core metals. In 1871, GV Black gave the philosophy of "**extension for prevention**", for cavity preparation design. ***Dr GV Black (Greene Vardiman) is known as the "Father of operative dentistry"***. He provided scientific basis to dentistry because his writings developed the foundation of the profession and made the field of operative dentistry organized and scientific. The scientific foundation for operative dentistry was further expanded by Black's son, Arthur Black.

In early part of 1900s, progress in dental science and technology was slow. Many advances were made during 1970s in materials and equipment. By this time, it was also proved that dental plaque was the causative agent for caries. In the 1990s, oral health science started moving toward an evidence-based approach for treatment of decayed teeth **(Table 1.1)**. The recent concept of treatment of dental caries comes under minimally invasive dentistry. In December 1999, the World Congress of Minimally Invasive Dentistry (MID) was formed. Initially, MI dentistry

Table 1.1: Evolution of operative dentistry.

Era	*Year*	*Major inventions/events*
Prehistoric era	5000 BC	A Sumerian text describes "tooth worms" as the cause of dental decay.
	500–300 BC	Hippocrates and Aristotle wrote about dentistry, including the eruption pattern of teeth, treating decayed teeth.
	166–201 AD	The Etruscans practiced dental prosthetics using gold crowns and fixed bridgework.
	700	A medical text in China mentioned the use of "silver paste," a type of amalgam.
Pre 1700	1530	Artzney Buchlein, wrote the first book solely on dentistry. It was written for barbers and surgeons who used to treat oral cavity, it covered topics like oral hygiene, tooth extraction, drilling teeth and placement of gold fillings.
	1563	Bartolomeo Eustachius published the first book on dental anatomy, "Libellus de dentibus".
	1683	Antonie van Leeuwenhoek identified oral bacteria using a microscope.
	1685	Charles Allen wrote first dental book in English "The operator for the teeth".
1700–1800	1723	Pierre Fauchard published "Le Chirurgien Dentiste". He is credited as "Father of Modern Dentistry" because his book was the first to give a comprehensive system for the practice of dentistry.
	1746	Claude Mouton described a gold crown and post for root canal treated tooth.
	1764	James Rae gave first lecture on the teeth at the Royal College of Surgeons, Edinburgh.
	1771	John Hunter published "The natural history of human teeth" giving a scientific basis to dental anatomy.
	1780	William Addis manufactured the first modern toothbrush.
	1790	• John Greenwood constructed the first known dental foot engine by modifying his mother's foot-treadle spinning wheel to rotate a drill. • Josiah Flagg invented the first dental chair
1800–1900	1832	James Snell invented the first reclining dental chair.
	1830s–1890s	The "Amalgam War" conflict and controversy generated over the use of amalgam as filling material.
	1855	Robert Arthur introduced the cohesive gold foil method for inserting gold into a preparation with minimal pressure.
	1864	Sanford C Barnum developed the rubber dam.
	1871	James Beall Morrison invented foot engine.
	1877	Basil Manly Wilkerson invented first hydraulic dental chair and named it THE WILKERSON DENTAL CHAIR
	1890	WD Miller formulated his "chemicoparasitic" theory of caries in "Microorganisms of the human mouth".
	1895	Lilian Murray became the first woman to become a dentist in Britain.
	1896	GV Black established the principles of cavity preparation.
1900–2000	1900	Federation Dentaire Internationale (FDI) was founded.
	1903	Charles Land introduced the porcelain jacket crown.
	1907	William Taggart invented a "lost wax" casting machine.
	1930–1943	Frederick S McKay, a Colorado dentist showed brown stains on teeth because of high levels of naturally occurring fluoride in drinking water.
	1937	Alvin Strock develoed Vitallium dental screw implant.
	1950s	First fluoride toothpaste was marketed.
	1949	Oskar Hagger developed the first system of bonding acrylic resin to dentin.
	1955	Michael Buonocore described the acid-etch technique.
	1957	John Borden introduced a high-speed air-driven contra-angle handpiece running up to 300,000 rpm.
	1960s	Lasers were developed.
	1962	Rafael Bowen developed Bis-GMA.
	1989	The first commercial home tooth bleaching product was made available.
	1990s	New advances in aesthetic dentistry including tooth-colored restorative materials, bleaching materials, veneers and implants.

focused on minimal removal of diseased tooth structure but later it evolved for preventive measures to control disease. Current minimally intervention philosophy follows three concepts of disease treatment, viz. identify the risk factors early, prevent disease by eliminating risk factors and restore the health of oral environment.

INDICATIONS OF OPERATIVE DENTISTRY

1. ***Dental caries***: Restoration of carious tooth is most common indication in operative dentistry. Caries can be present on pit and fissures, proximal, and root surface of the teeth **(Fig. 1.1)**.

Fig. 1.1: Dental caries.

2. ***Noncarious loss of tooth structure***: Treatment of lesions like attrition, abrasion, erosion to restore function and aesthetics **(Fig. 1.2)**.

Fig. 1.2: Noncarious loss of tooth structure requiring restorative treatment.

3. ***Traumatic injuries***: Restoration of traumatized or fractured teeth involving the hard dental tissues and pulp **(Fig. 1.3)**.
4. ***Aesthetic improvement***: Aesthetic corrections are needed for teeth affected by caries, stains, fractures, diastema, etc. **(Fig. 1.4)**.
5. ***Replacement or repair of previous defective restoration***: Existing restorations may fail due to various reasons, these restorations can be repaired or replaced in operative dentistry **(Fig. 1.5)**.
6. ***Developmental defects***: Management of enamel and dentin hypoplasia, hypomineralization, amelogenesis, and dentinogenesis imperfecta, tetracycline stains, peg-shaped laterals is done in operative dentistry **(Fig. 1.6)**.

Fig. 1.3: Fractured maxillary central incisor can be corrected by restorative treatment.

Fig. 1.4: Operative dentistry is needed for aesthetic improvement.

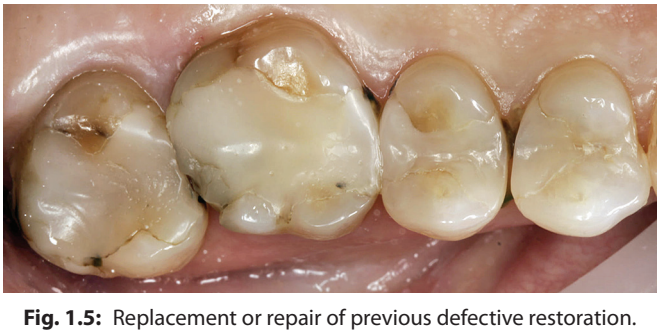


Fig. 1.5: Replacement or repair of previous defective restoration.

Fig. 1.6: Developmental defects.

OBJECTIVES/PURPOSE OF OPERATIVE DENTISTRY

1. Diagnosis

Diagnosis is determination of nature of disease, injury or other defect by examination, test, and investigation.

2. Prevention

To prevent any recurrence of the causative disease and their defects, it includes the procedures done for prevention before the manifestation of any sign and symptom of the disease.

3. Interception

It includes the procedures undertaken after signs and symptoms of disease have appeared, in order to prevent the disease from developing into a more serious or full extent.

4. Preservation

Preservation of the vitality and periodontal support of remaining tooth structure is obtained by preventive and interceptive procedures.

5. Restoration

It includes restoring form, function, phonetics and aesthetics.

6. Maintenance

After restoration is done, it must be maintained for providing service for longer duration.

SCOPE OF OPERATIVE DENTISTRY

Scope of operative dentistry includes the following:
To know the condition of the affected tooth and other teeth.

1. To examine not only the affected tooth but also the oral and systemic health of the patient.
2. To diagnose the dental problem and the interaction of problem area with other tissues.
3. To provide optimal treatment plan to restore the tooth to return to health and function, and increase the overall well-being of the patient.
4. Thorough knowledge of dental materials which can be used to restore the affected areas.
5. To understand the biological basis and function of the various tooth tissues.
6. To maintain the pulp vitality and prevent occurrence of pulpal pathology.
7. To have knowledge of dental anatomy and histology.
8. To understand the effect of the operative procedures on the treatment of other disciplines.

RECENT ADVANCEMENTS

Earlier concept of tooth preparation was the same as given by GV Black for many decades following principles of extension for prevention. But modern concept of operative dentistry is based on the conservation and prevention of the diseases. Many advancements have been made in the area of operative dentistry so as to meet its goals in better ways.

1. **Development in the diagnostic aids**
   - Ultrasonic illumination
   - Fiberoptic transillumination (FOTI)
   - Digital imaging
   - Tuned-aperture computerized tomography (TACT)
   - Magnetic resonance microimaging (MRMI)
   - Qualitative laser fluorescence
   - Diagnodent (quantitative laser fluorescence).
2. **Recent advances in treatment planning**
   - Minimal intervention dentistry
   - Ozone therapy.
3. **Recent advances in tooth preparation**
   - Use of air abrasion technique
   - Chemomechanical caries removal
   - Use of lasers in tooth preparation
   - Use of ultrasonics in tooth preparation
   - Management of smear layer.
4. **Improvements in adhesive dentistry**
   - Packable composites
   - Flowable composites
   - Smart composites
   - Compomers
   - Ceromers
   - Nanocomposites
   - Sonicfill composite
   - Fiber reinforced composites.

an imaginary line, called median line, in two hemiarchs, the right's, and the left's ones. Thus, the set of teeth are described into four quadrants as:

1. Maxillary right
2. Maxillary left
3. Mandibular right
4. Mandibular left.

TOOTH NOTATION SYSTEMS

There are different tooth notations for identifying specific tooth. The three most common systems used are the "FDI World Dental Federation" notation, the "Universal" system and the "Zsigmondy-Palmer" system. The FDI system is used worldwide and the universal is used predominantly in the USA.

1. Zsigmondy-Palmer System/Angular/Grid System

This is the **oldest method of tooth notation** introduced by **Zsigmondy** in 1861. Also known as angular or grid system.

Permanent Teeth

Permanent teeth are numbered 1–8, where 1 is central incisor, 4 is first premolar and 8 is third molar.

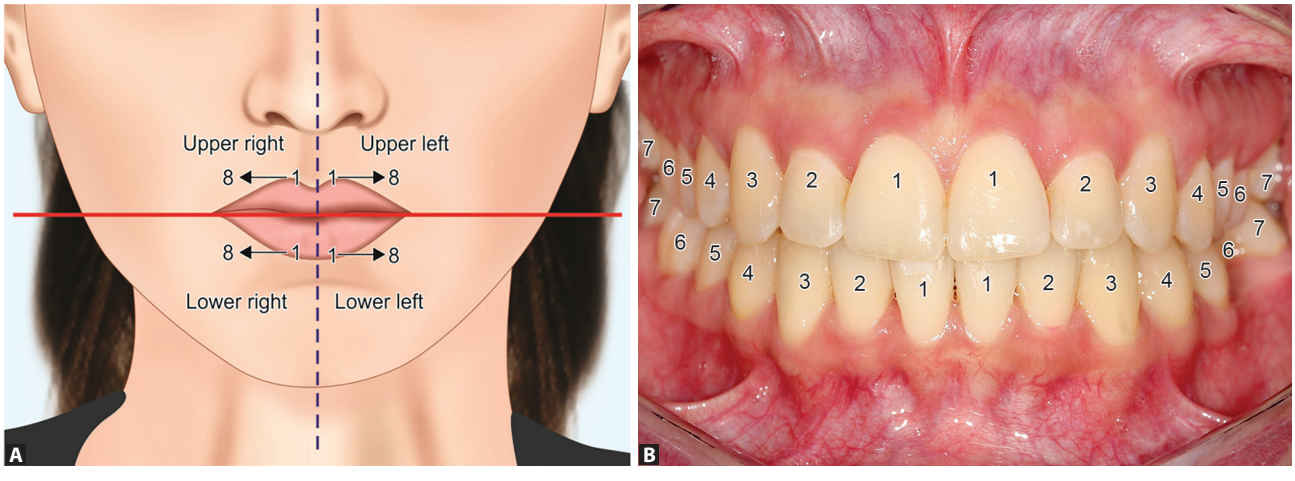
Primary Teeth

Primary teeth are designated as A, B, C, D, E, where A is central incisor and E is second molar **(Figs. 2.3 and 2.4)**.

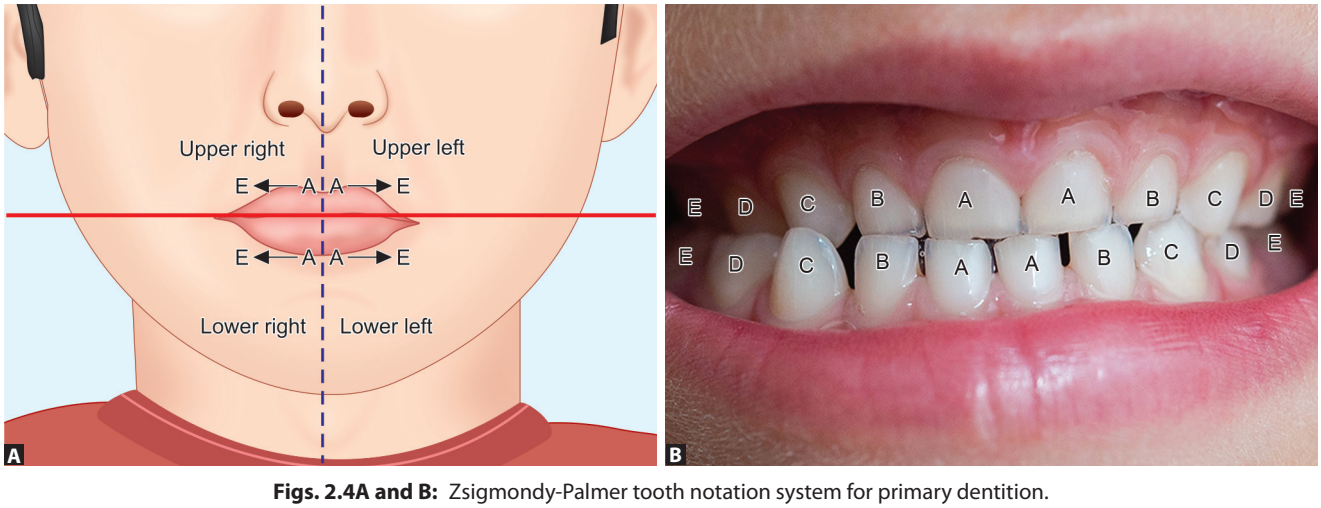
Each quadrant has unique L-shaped symbol to designate the quadrant to which tooth belongs. For example, for maxillary right, maxillary left, mandibular right and mandibular left symbols are ⌟, ⌞, ⌝, ⌜ respectively.

Advantages

- Simple and easy to use
- Less chances of confusion between primary and permanent tooth as there is different notation, e.g. permanent teeth are described by numbers while primary teeth by alphabets.



Figs. 2.3A and B: Zsigmondy-Palmer tooth notation system for permanent dentition.



Figs. 2.4A and B: Zsigmondy-Palmer tooth notation system for primary dentition.

ii. **Undercontouring:** It means too little contouring, so that a space occurs between margins and the cavity walls. It leads to food impaction and trauma to the attachment apparatus (**Fig. 4.2C**).

2. Marginal Ridges

Marginal ridges are defined as rounded borders of enamel which form the mesial and distal margins of occlusal surfaces of premolars and molars and mesial and distal margins of lingual surfaces of the incisors and canines **(Fig. 4.3)**.

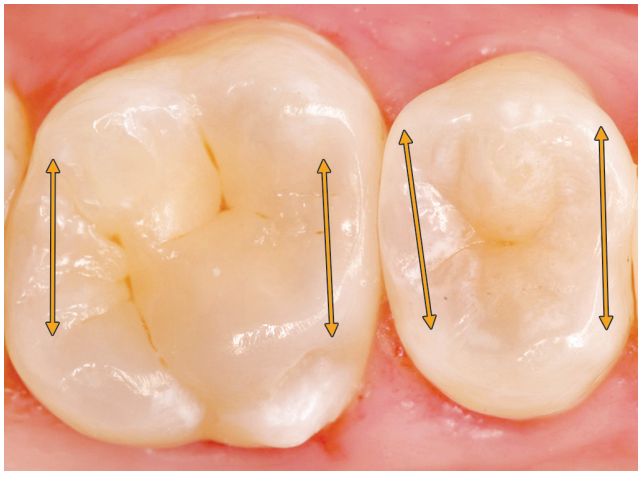


Fig. 4.3: Marginal ridge (orange arrow) in molar and premolar.

Importance

- Help in balancing of teeth in both the arches
- Improve the efficiency of mastication
- Prevent food impaction in interproximal areas.

Clinical Significance

- During restoration, marginal ridges should be restored in two planes, i.e. buccolingually and cervico-occlusally **(Fig. 4.4)**. This feature is essential when an opposing functional cusp occludes with the marginal ridge. Restoring marginal ridges in two planes prevent food lodgement which causes damage to the periodontium.
- Restore adjacent marginal ridges at the same height.

3. Embrasures

Embrasures can be defined as V-shaped spaces that originate at proximal contact areas between adjacent teeth. These are named according to the direction in which they radiate (**Figs. 4.5A and B**). These are:

i. Labial/Buccal and Lingual Embrasures

These are spaces that widen out from the area of contact labially or buccally and lingually.

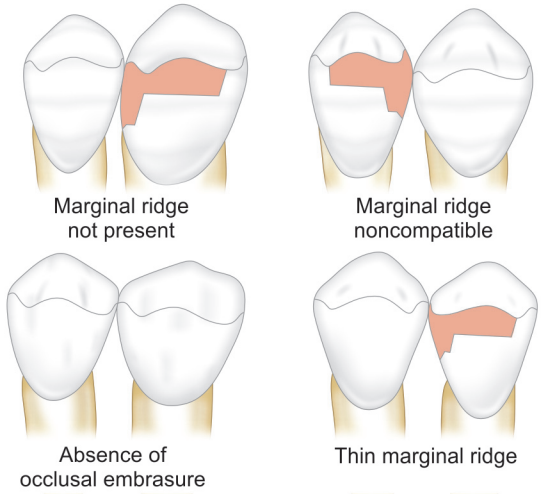
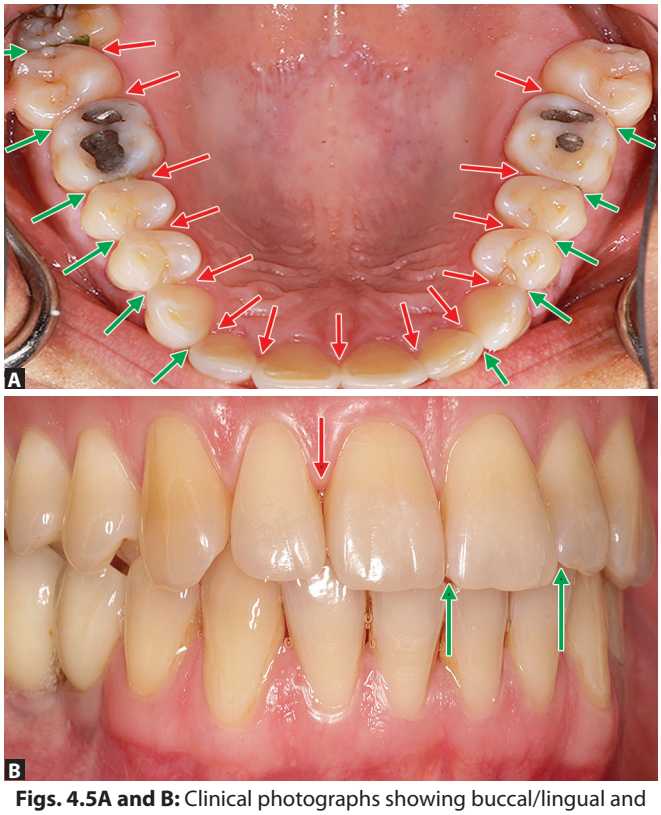


Fig. 4.4: Common faults that occur during the restoration of marginal ridge.



Figs. 4.5A and B: Clinical photographs showing buccal/lingual and incisal/gingival embrasures.

ii. Incisal/Occlusal Embrasures

These are spaces that widen out from area of contact incisally/occlusally.

iii. Gingival Embrasure

These are the spaces that widen out from the area of contact gingivally.

Working side condyle/rotating condyle: The condyle on the working side during lateral excursion.

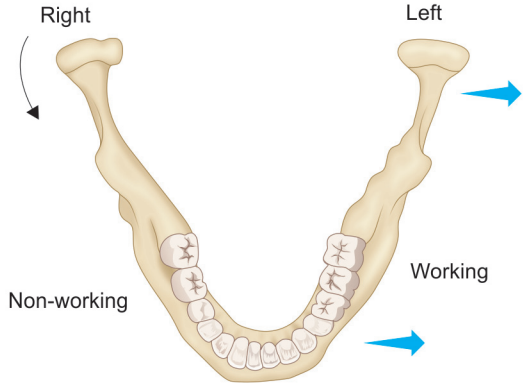


Fig. 5.10: Lateral movement in mandible.

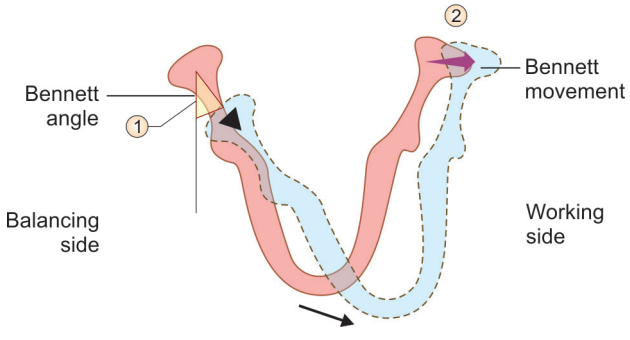


Fig. 5.11: Bennett's movement leads to a shift in the mandible to the working side.

condyles in lateral jaw movements. Bennett angle is angle formed between sagittal plane and average path of advancing condyle at balancing side as seen in horizontal plane during lateral mandible movements during lateral inclines. All these movements occur within an envelope of movement called Posselt's envelope.

Posselt's Motion/Posselt's Envelope

In 1952, Posselt described motion of mandible, the resultant diagram has been termed as Posselt's motion/Posselt's envelope. The path of mandible during each movement in each three directions (sagittal, horizontal and vertical) is described to points beyond which mandible is not capable of further movement. These points are defined as border limitations of mandibular movements, and moving the mandible to these points is called ***border movements*** of mandible **(Fig. 5.12)**.

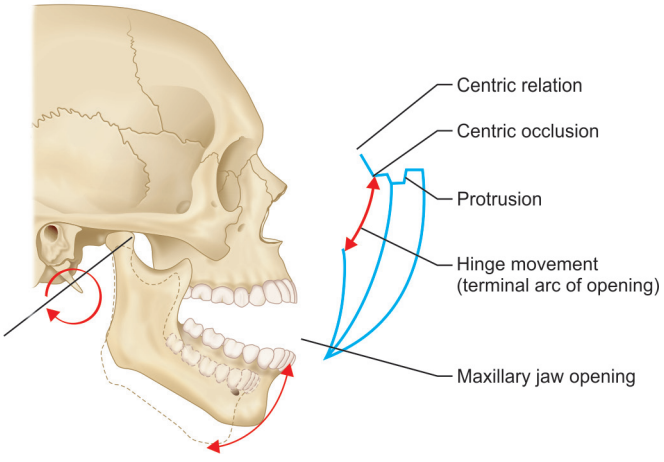


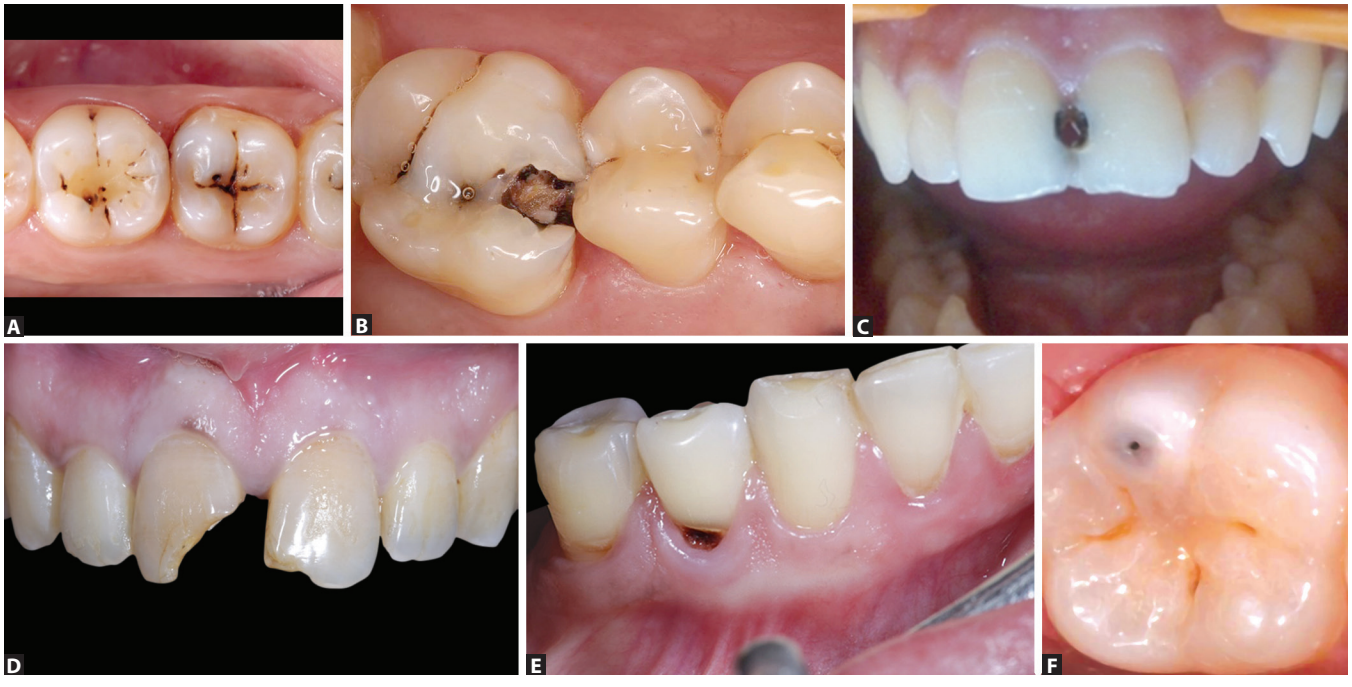
Fig. 5.12: Posselt's motion/Posselt's envelope.

Fig. 5.13: In unilateral balanced occlusion, during lateral movements, the buccal cusps of posterior teeth on working side are in contact.

OCCLUSAL SCHEMES

Three basic schemes of occlusion are:

1. **Group function occlusion/unilateral balanced occlusion:** During lateral movements, the buccal cusps of posterior teeth on working side are in contact **(Fig. 5.13)**. For group function to be effective in reducing the stress, the cusp inclines must be in harmony with lateral border movement of jaw.
2. **Canine guided or protected occlusion:** During lateral mandibular movements, opposing maxillary and mandibular canines of working side contact, thereby, causing disocclusion of all posterior teeth of both sides. It normally serves as corner stone of mutually protected occlusion **(Fig. 5.14)**. When it becomes impossible to distribute stresses over many teeth, disocclusion of teeth is accomplished by using canine in canine protected occlusion. Basically, canines play the role as guidance that causes vertical function rather than as resistor to lateral stresses.
3. **Balanced occlusion**: It is defined as the simultaneous, bilateral contacting of maxillary and mandibular teeth in anterior and posterior occlusal areas in centric



Figs. 6.10A to F: (A) Class I dental caries; (B) Class II dental caries; (C) Class III dental caries; (D) Class IV dental caries; (E) Class V dental caries; (F) Class VI dental caries.

vi. **Class VI**: Caries on incisal edges of anterior and cusp tips of posterior teeth without involving any other surface **(Fig. 6.10F)**.

5. Based on Pathway of Caries Spread

i. **Forward caries**: When the caries cone in enamel is larger or of same size as present in dentin, it is called as forward caries.
ii. **Backward caries**: When spread of caries along dentinoenamel junction exceeds the caries in contiguous enamel, the caries extend into enamel from DEJ. Since spread of caries here is in backward direction. It is called backward caries **(Fig. 6.11)**.

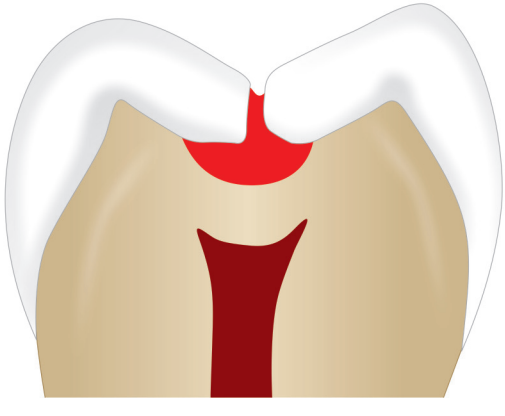


Fig. 6.11: Backward caries means lateral spread of caries exceeds the caries in contiguous enamel and caries occur from DEJ into this enamel.

6. Based on Extent of Caries

i. **Incipient caries**: It is first evidence of caries activity, visible as white spot. It consists of demineralized enamel which has not extended to DEJ. This lesion can be remineralized by proper preventive procedures, hence called as reversible caries.
ii. **Occult caries***:* These are seen in patients with low caries rate commonly suggestive of increased fluoride exposure. Increased fluoride exposure encourages the remineralization of surface enamel, while cavitation continues in the dentin, thus lesion gets masked by relatively intact enamel surface. These hidden lesions are called as ***fluoride bombs or fluoride syndrome***.
iii. **Cavitated caries**: In this, caries extend beyond enamel into the dentin. This lesion cannot be remineralized, so also termed as irreversible caries.

7. Based on Number of Tooth Surfaces Involved

Simple caries: Caries involving only one tooth surface is termed as simple caries.

Compound caries: If two surfaces are involved, it is termed as compound caries.

Complex caries: If more than two surfaces are involved, it is called as complex caries.

Fig. 7.73A: Finishing and polishing carbide burs.

Fig. 7.73B: Brushes for finishing.

abrasive pastes. They are used in polishing cast restorations.

iii. ***Diamond instruments:*** They are available in the form of abrasive rotary instruments and metal backed abrasive strips **(Fig. 7.73C)**. These instruments should always be used with light force and copious water spray. These are mainly used on ceramic and composite materials.

iv. ***Paper-carried abrasives:*** These are usually abrasives, i.e. sand, garnet or boron carbide attached to paper disks or strips **(Fig. 7.73D)**. These are preferably used in back and forth motion polishing (similar to shoe polishing).

v. ***Rubber-ended rotary tools:*** These type of instruments are available in variety of shapes, i.e. cups, wheels, etc. **(Fig. 7.73E)**. These can be attached to handpiece with the help of mandrel or with their own extension. These are used with other abrasive or polishing pastes.

Fig. 7.73C: Abrasive rotary instruments.

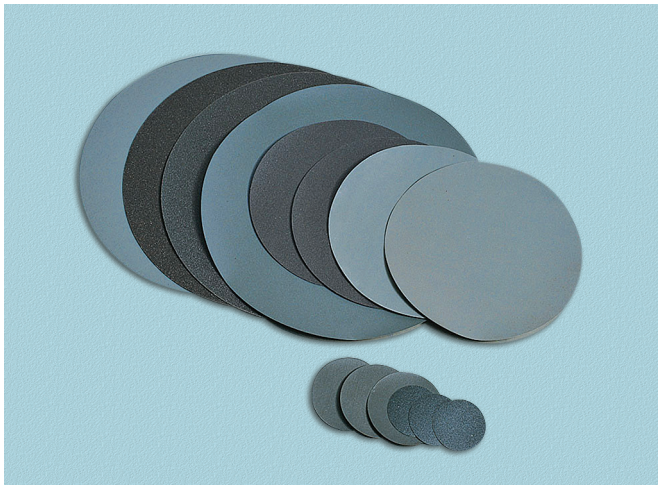


Fig. 7.73D: Abrasive disks.

Fig. 7.73E: Rubber cups.

vi. ***Cloth:*** Cloth, carried on metal wheel can be used in final stages of polishing with/without polishing medium, for exampler; buffing wheel (**Fig. 7.73F**).

vii. ***Felt:*** Felt is used for obtaining luster for metallic restorations with polishing agent. It is available in the different shapes such as wheel, cones and cylinders **(Fig. 7.73G)**.

Fig. 8.18: Ideal class II cavity preparation of mandibular 1st molar.

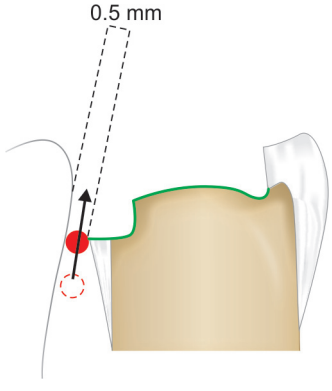


Fig. 8.19: In proximal tooth preparation, gingival margin should clear adjacent tooth by 0.5 mm.

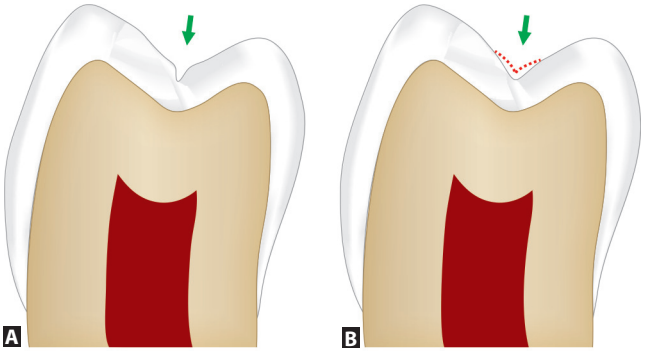
- Restrict the depth of axial wall 0.2–0.8 mm into dentin.
- Axial wall should be parallel to external surface of the tooth.
- In class II tooth preparation, place gingival seat apical to the contact but occlusal to gingival margin and have a clearance of 0.5 mm from the adjacent tooth. This clearance provides space for proper accessibility, visibility, instrumentation, and restoration **(Fig. 8.19)**.

Rules for Class V Cavities

- Outline form is limited by extent of the lesion.
- Extensions are made mesially, distally, occlusally and gingivally till sound tooth structure is reached.
- Axial depth is limited to 0.8–1.25 mm pulpally.

Enameloplasty

Enameloplasty is removal of sharp and irregular enamel margins of the enamel surface by "rounding" or "saucering" it and converting it into a smooth groove making it a self cleansable area **(Figs. 8.20 A and B)**.



Figs. 8.20A and B: Enameloplasty: (A) Tooth with deep pit and fissure; (B) Removal of superficial enamel resulting in rounding of deep pit and fissure caries making it self-cleansable.

Indications

- It is done when caries is present in less than one-third thickness of the enamel.
- Presence of a shallow fissure crossing facial or lingual ridge.

Significance

Enameloplasty does not extend the outline form. This procedure should not be used unless a fissure can be made into saucer shaped area with mild removal of enamel.

2. PRIMARY RESISTANCE FORM

Definition

Primary resistance form is that shape and placement of preparation walls to best enable both the tooth and restoration to withstand, without fracture, the stresses of masticatory forces delivered principally along the long axis of the tooth.

Factors Affecting Resistance Form

1. Amount of occlusal contact.
2. Type of restoration used.
3. Amount of remaining tooth structure.

Features of Resistance Form (Fig. 8.21)

1. Box-shape or mortise form of preparation with flat pulpal and gingival floor **(Fig. 8.21)**. Flat gingival and pulpal floors help in resisting masticatory forces directed along the long axis of the tooth, thereby prevent the tooth fracture from wedging forces resulting from opposing cusps **(Figs. 8.22 A and B).**
2. Adequate thickness of restorative material depending on its respective compressive and tensile strengths to prevent the fracture of both the remaining tooth structure and the restoration **(Fig. 8.23).**
3. Restrict the extension of external walls to allow strong marginal ridge areas with sufficient dentin support.

pH of MTA is 12.5 and sets in a moist environment (hydrophilic in nature). It produces hard-setting nonresorbable surface and low solubility.

Advantages:

- Excellent biocompatibility
- Sets in presence of moisture
- More radiopaque than calcium hydroxide
- Bacteriostatic in nature due to high pH
- Excellent sealing ability.

Disadvantages:

- Difficult handling characteristics
- Long setting time (2 hours 45 minutes)
- Expensive.

C. Biodentine Its powder consists of tricalcium silicate, dicalcium silicate, calcium carbonate, and zirconium oxide. Liquid consists of hydrosoluble polymer and calcium chloride. Biodentine is both a dentin substitute base and a cement for maintaining pulp vitality and stimulating hard tissue formation. **Figures 17.10A to G** show the direct pulp capping using biodentin as pulp capping agent.

D. BioAggregate: It consists of bioceramic nanoparticles. Its powder and liquid are mixed to form a thick paste-like consistency for use.

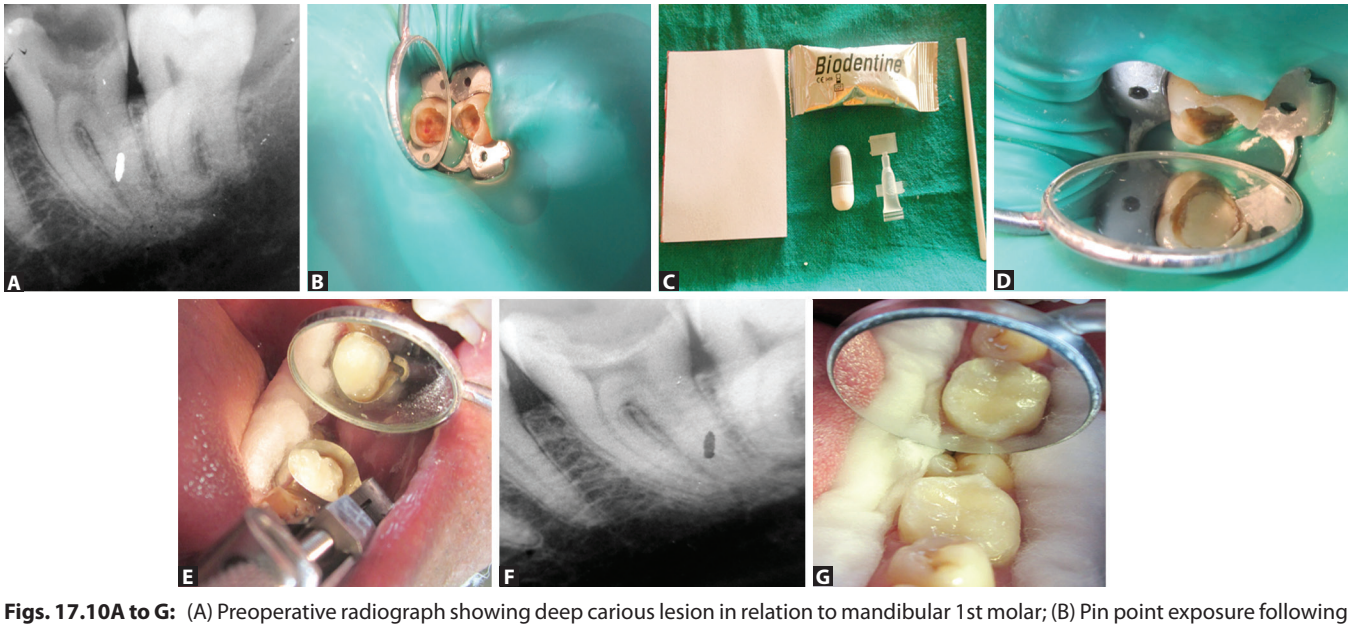
PREVENTION OF PULPAL DAMAGE DUE TO OPERATIVE PROCEDURE

To preserve integrity of the pulp, the following measures should be taken:

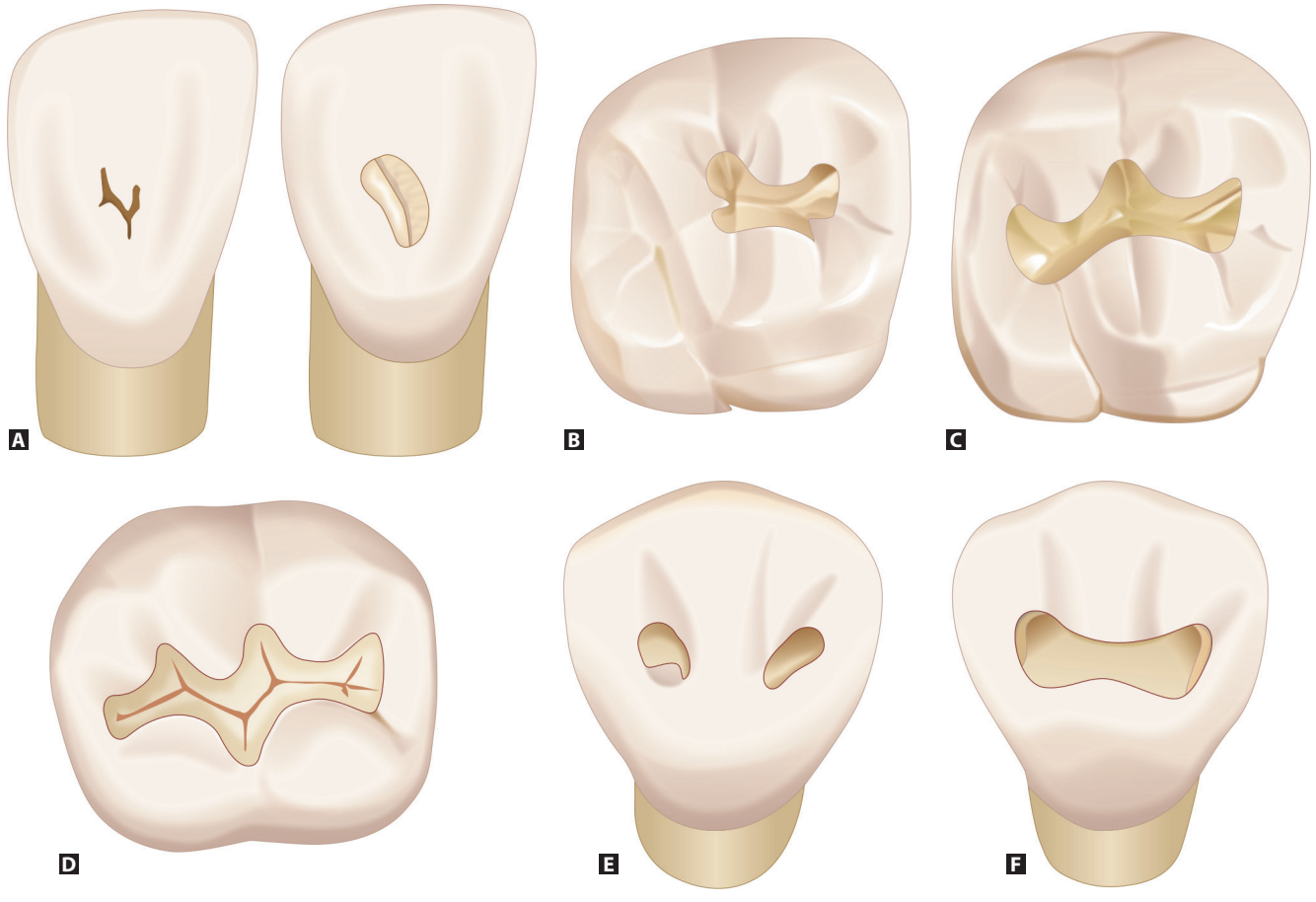
Irritant/procedure	*Methods to prevent pulpal injury*
Tooth preparation	• Effective cooling • High-speed ratio • Intermittent cutting
Restorative material	Use material after considering physical and biological properties according to tooth preparation
Marginal leakage	• Pulp protection using liners and bases • Use of bonding agents
While placing restoration	Avoid application of excessive forces of restoration
While polishing	Effective cooling to avoid heat generation during polishing
Irritants to dentin	Avoid application of any irritant, desiccant on freshly cut dentin

CONCLUSION

Dental pulp can be injured by caries, during operative procedures and during restoration. It needs to be protected from various irritants. Though sound and healthy dentin is the best pulp protective agent, but use of varnish, liner, and/or base is indicated beneath the restorations to protect it from chemical, mechanical, and thermal injuries. In deep carious lesions, there are chances of pulp exposure while removal of the caries. The main aim in management of deep caries is to avoid removing all the infected tissue, and to inactivate or arrest the lesion by changing cariogenic environment, placing pulp protective/therapeutic agent,



Figs. 17.10A to G: (A) Preoperative radiograph showing deep carious lesion in relation to mandibular 1st molar; (B) Pin point exposure following caries excavation; (C) Biodentine used for direct pulp capping; (D) Biodentine placed on exposed pulp; (E) Interim restoration placed using glass ionomer cement; (F) Six months follow up radiograph showing dentin bridge formation; (G) Permanent restoration using composite. *(Courtesy:* Pranav Nayyar).



Figs. 19.12A to F: Cavity preparations on occlusal surfaces of different teeth.

is provided in the distal pit area to prevent mesial displacement of the restoration. Consider enameloplasty wherever required to conserve tooth structure.

ii. Extending Occlusal Step Proximally

While maintaining established pulpal depth, extend the preparation toward proximal surface of tooth, ending 0.8 mm short of cutting through mesial marginal ridge **(Fig. 19.13C)**. Proximal cutting should be sufficiently deep into the dentin (0.5–0.6 mm) so that retentive locks are prepared into axiolingual and axiofacial line angles.

iii. Preparation of Proximal Box

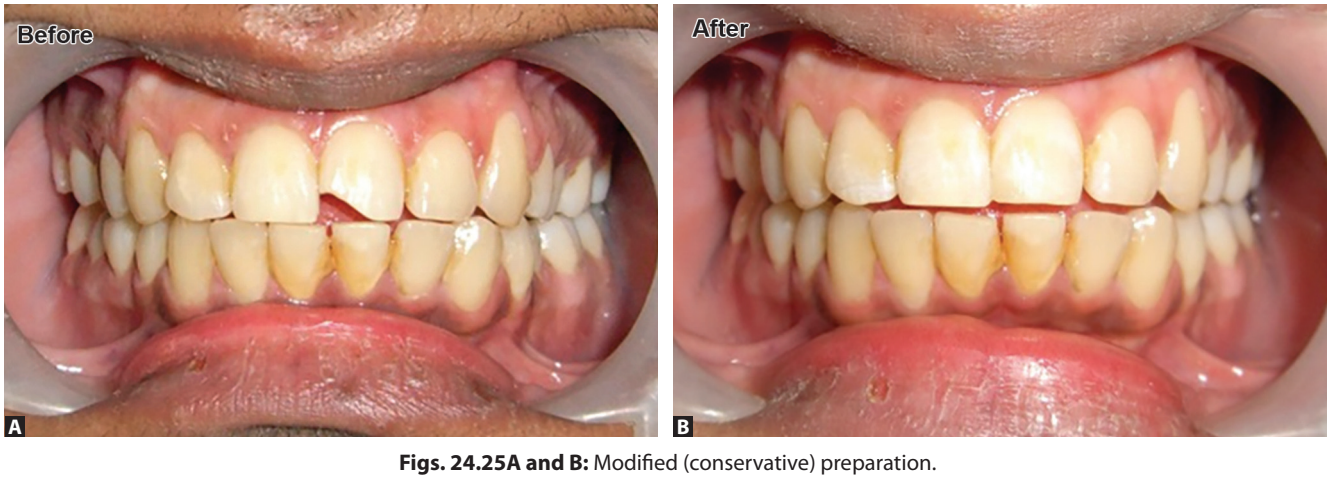
Widen the preparation faciolingually to just clear the contact areas. Proximal cut is diverged gingivally. It results in greater faciolingual dimension at gingival surface than occlusal surface. It provides good retention and conservation of marginal ridge **(Fig. 19.13D)**. Keep a small slice of enamel at the contact area to prevent accidental damage to adjacent tooth **(Fig. 19.13E)**. If there is any doubt that accidental damage to the adjacent tooth can occur, use a metal matrix band interdentally. Fracture the slice of enamel in the region of the contact area with a small chisel or enamel hatchet. Proximal margins should have a cavosurface angle of 90° and when completed, the walls of the proximal box should converge occlusally **(Fig. 19.13F)**. Flatten the gingival floor so that masticatory forces are distributed equally. Flattening of gingival floor is done using enamel hatchet. Ideal width of gingival seat ranges from 0.6 mm to 0.8 mm for premolars and 0.8 mm to 1.0 mm for molars. It consists of 2/3rd of dentin and 1/3rd of enamel. Ideal clearance of facial and lingual margins of the proximal box should be 0.2–0.5 mm from the adjacent tooth **(Fig. 19.13G)**.

2. Primary Resistance Form

This can be obtained by incorporating the following features in the preparation:

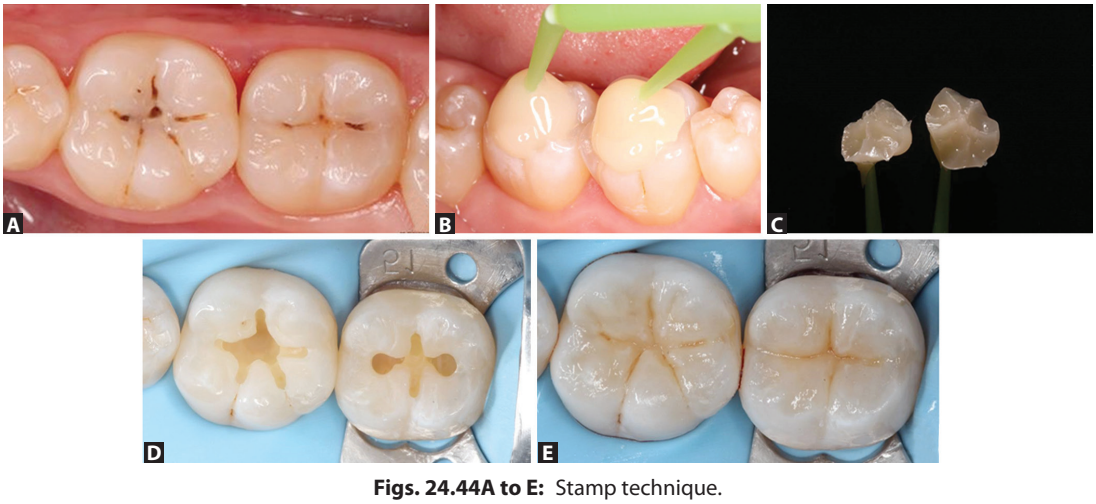
i. Providing enough depth of cavity to have sufficient bulk of amalgam
ii. Flat pulpal and gingival floor
iii. Cavosurface angle of 90°
iv. Maintaining minimal width of the preparation so as to preserve tooth structure
v. Rounding the internal line and point angle
vi. Cusp capping for preserving cuspal strength.

Figs. 24.24A to L: Modified (conservative) preparation: (A) Preoperative photograph; (B) Wax up; (C) Making Index; (D) Putty index; (E) Isolation using rubber dam; (F) Bevelled preparation; (G) Selective etch; (H) Bonding; (I) Putty and shell making; (J) Palatal shell making; (K) Build up using layering technique; (L) Postoperative photograph (*Courtesy:* Priya Titus).

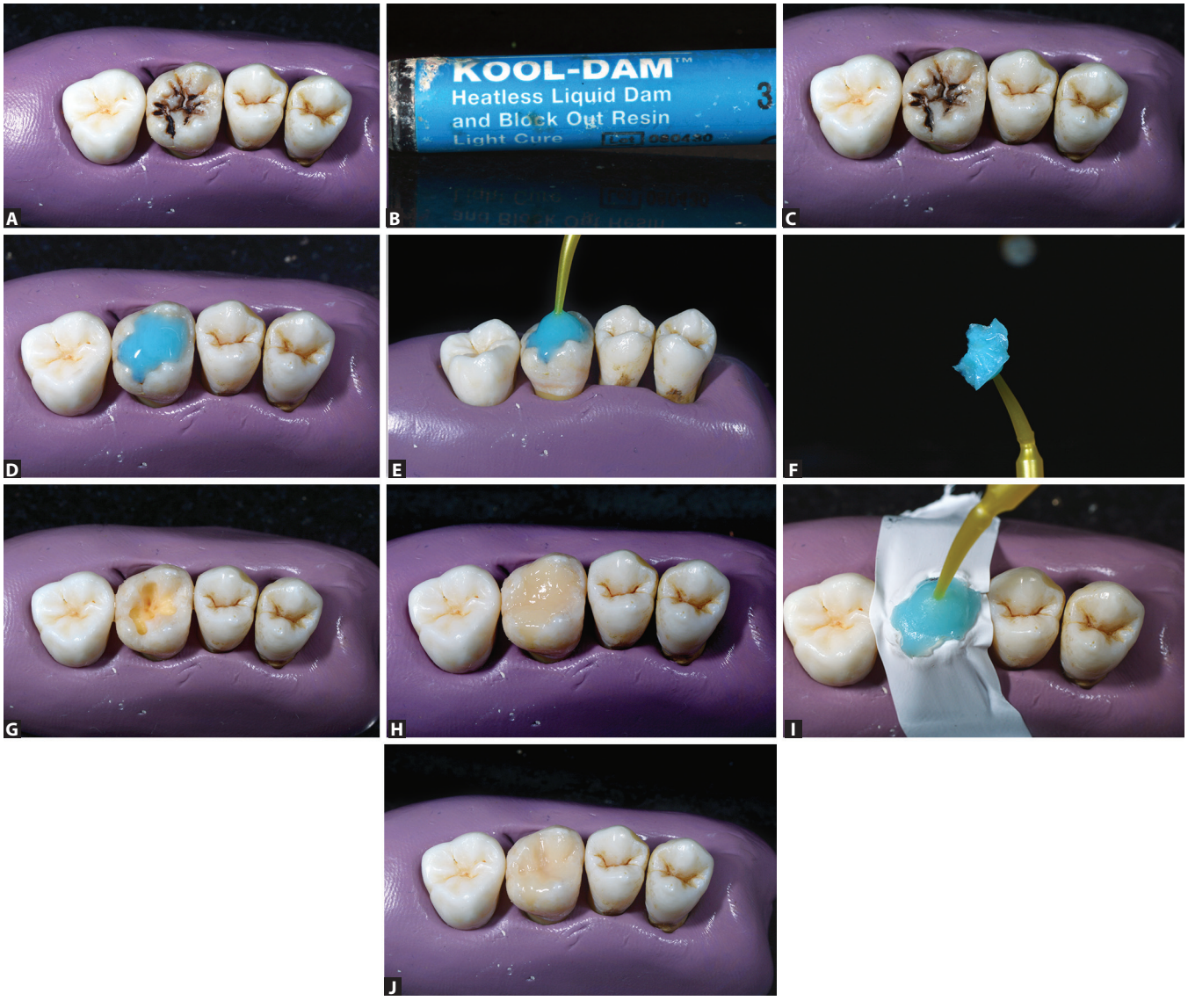


Figs. 24.25A and B: Modified (conservative) preparation.

Figs. 24.43A to G: Management of class II tooth preparations using direct resin restorations. (*Courtesy:* Roma Turetskyi)



Figs. 24.44A to E: Stamp technique. (*Courtesy:* Roma Turetskyi)



Figs. 24.45A to J: Stamp technique of restoration: (A) Preoperative photograph; (B) Liquidam; (C) Application of vaseline; (D) Application of liquidam; (E) Applicator tip attached to liquidam and cured; (F) Stamp prepared; (G) Tooth preparation; (H) Placement of composite on prepared tooth; (I) Placement of Teflon tape and stamp; (J) After removal of stamp and polymerization.
(*Courtesy:* Priya Titus)

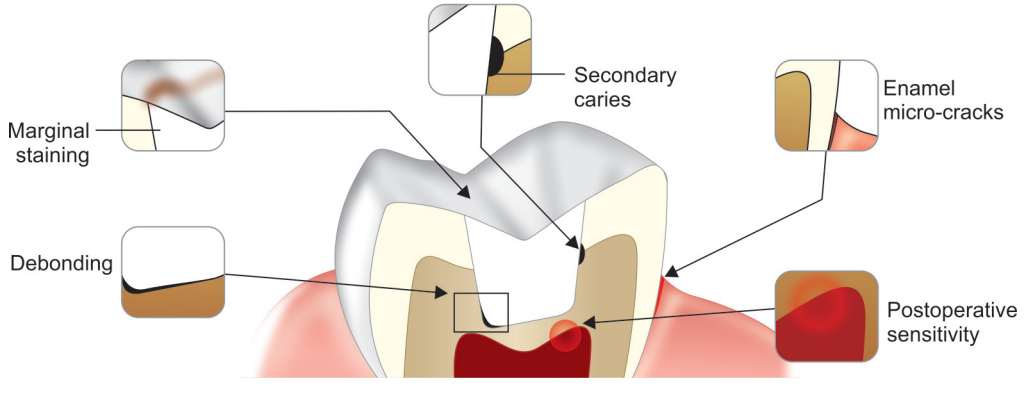
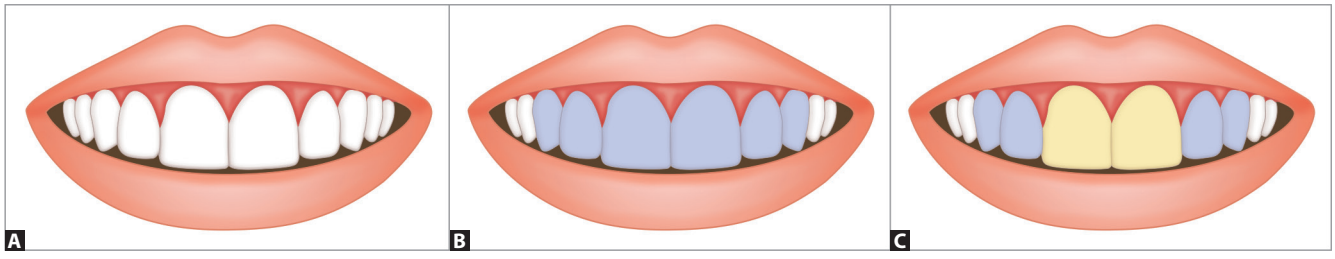


Fig. 24.46: Schematic representation of different failures of composite restorations.



Figs. 25.8A to C: Amount of display of maxillary incisors in relaxed and slightly open mouth.

Figs. 25.9A to D: Phonetics: (A) "Mmm" sound shows incisal display at rest position; (B) "E" sound shows incisal edge midway upper and lower lip; (C) "S" sound shows slight space between maxillary and mandibular teeth; (D) "F" and "V" sounds show maxillary incisor edge position in relation to lower lip.

sound. Minimum tooth display in this position is 2–4 mm.

b. ***E sound***: Widest smile or extended pronunciation of E or saying cheese the space between upper and lower lips should be almost completely filled by maxillary incisors.
c. ***S sound***: Mandibular central incisors should be positioned 1 mm behind and 1 mm below maxillary incisal edge.
d. ***F and V sounds***: Incisal edges of maxillary anterior teeth are positioned directly over the demarcation between wet and dry border of lower lip. These sounds help to determine the labiolingual position and length of the maxillary teeth.

iii. Patient Input

Intraoral cosmetic preview and provisional restorations help to confirm proper placement of the final incisal edge position. The patient input means that his/her expectations for smile must be met in the best possible way, unless they do not interfere with the parameters as discussed above.

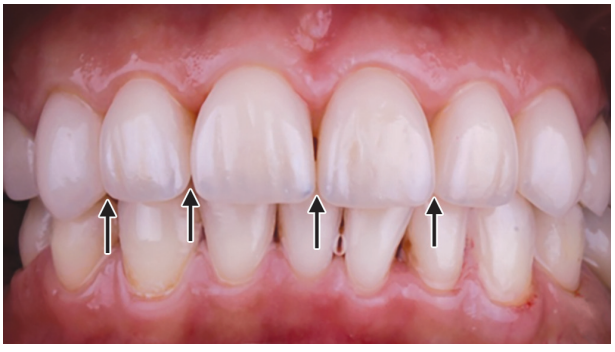


Fig. 25.20: Incisal embrasures.

8. Symmetry and Balance

Symmetry is the harmonious arrangement of several elements to one another. Symmetrical length and width is critical for the centrals. It becomes less concerned as we move further away from the midline. Static symmetry refers to the mirror image of maxillary central incisors whereas dynamic symmetry stands for two similar but distinguishable. Right and left sides of smile are said to be balanced when balance is observed as the eyes move distally from the midline.

SOFT TISSUE COMPONENT OF SMILE DESIGN

1. Gingival Health (Fig. 25.21)

The gingiva acts as the frame for the teeth, thus, final aesthetic outcome of case is influenced by the gingival health. Healthy gingiva should be pale pink in color, stippled, firm in consistency which is paramount for long-term success and aesthetic value of treatment **(Fig. 25.21)**. It should have pointed papillary contour and fill the interdental spaces to the point, because black triangles make the smile unattractive.

2. Gingival Level and Harmony

Setting up precised gingival levels for each individual tooth is the key in creating a balanced smile. The cervical gingival

Fig. 25.21: Healthy gingiva appears pale pink, firm with pointed papillary contour and fills the interdental spaces to the point.

Fig. 25.22: Gingival level and harmony: Differences between the heights of the apical gingival margins of anterior teeth.

height of the centrals should be bilaterally symmetrical and should match the canines. For lateral incisors, it should be cervical to that of centrals and canines **(Fig. 25.22)**.

3. Cervical Embrasure

Embrasure located cervical to interproximal contact area is called as cervical embrasure. Darkness of oral cavity which is visible in the interproximal triangle between the gingiva and the contact area is called black triangle **(Fig. 25.23)**. It is unaesthetic and negatively affects the smile of an individual. It is important to avoid black triangles by considering most apical part of restoration 5 mm or less from alveolar crest so as to encourage the formation of healthy pointed interdental papilla.

4. Smile Line

Smile line is an imaginary line running along the incisal edges of the maxillary anterior teeth and coinciding with

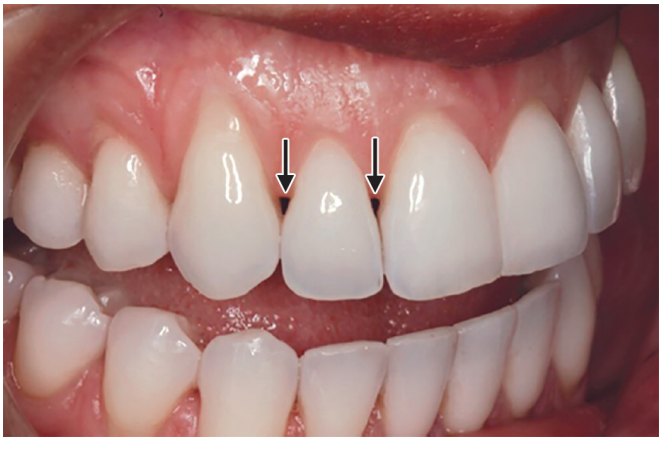


Fig. 25.23: Embrasure present cervical to contact area is cervical embrasure. Black triangle is space visible in interproximal triangle between gingiva and contact area.

the curvature of lower lip **(Fig. 25.24A).** It is also known as ***gull wing course*** while smiling.

Reverse/Inverse Smile Line

It is when maxillary central incisors appear shorter than canines along the incisal plane **(Fig. 25.24B)**. It is usually seen in attrition, erosion, and altered patterns of eruption or poor quality dental treatment.

a. Low Smile Line

Less than 25% of interproximal gingiva is visible while marginal gingiva is invisible. Only 20% of maxillary and mandibular teeth seen **(Fig. 25.25A)**.

b. Medium Smile Line

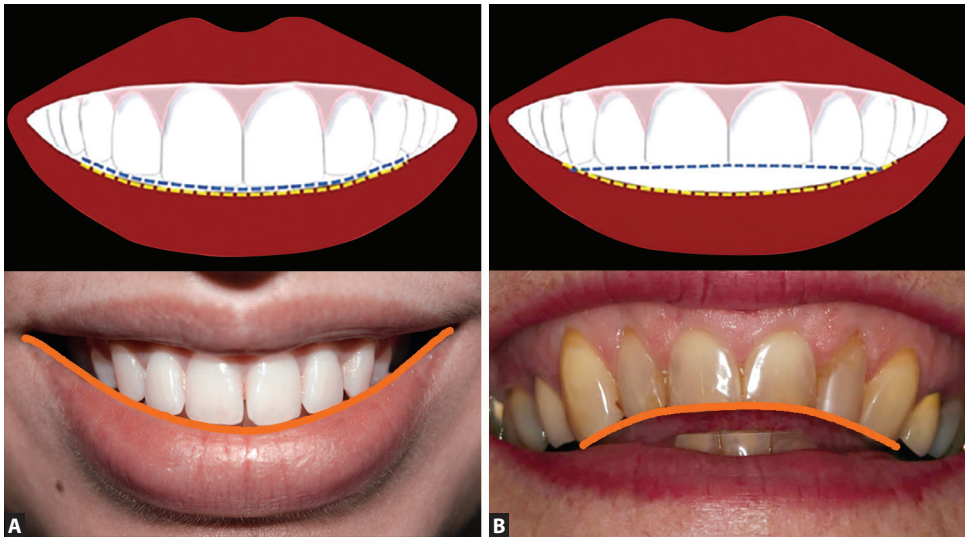
25–75% of interproximal gingiva and marginal gingiva are visible. It is the most perfect and attractive smile **(Fig. 25.25B)**.

c. High Smile Line

75% interproximal gingiva and all marginal gingiva are visible. When greater than 3 mm of gingiva above the cervical line of the tooth is visible, it is a gummy smile **(Fig. 25.25C)**.

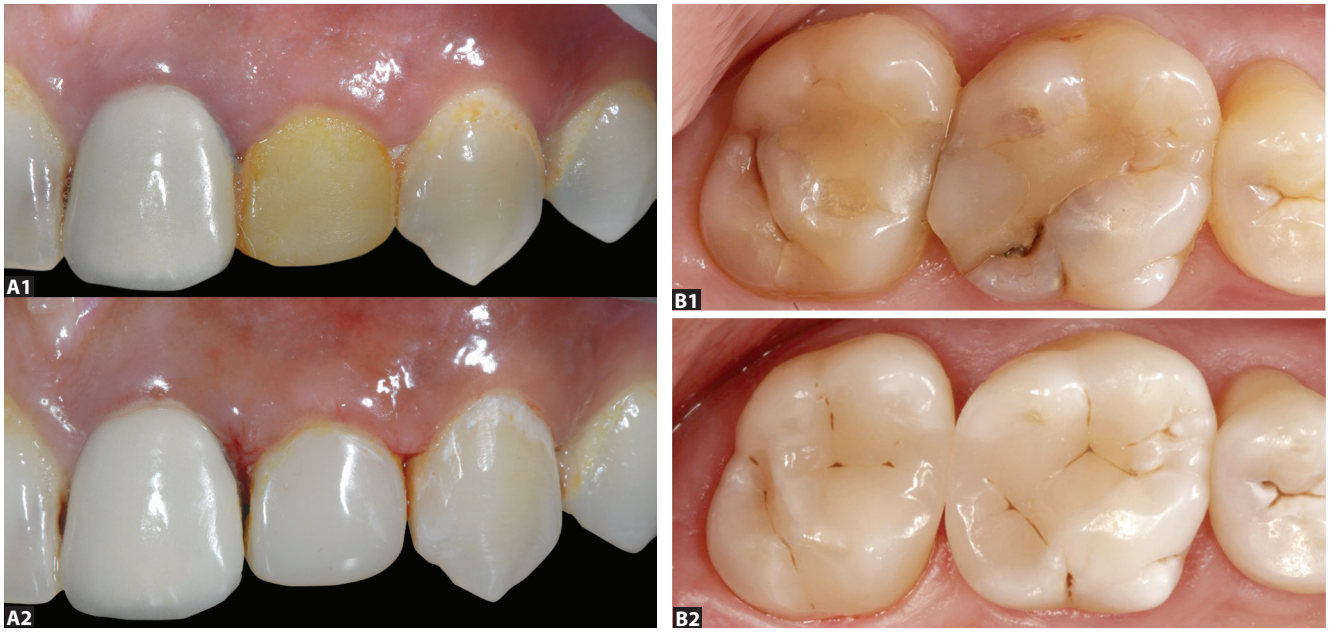
AESTHETICS AND OPERATIVE DENTISTRY

There are number of problems which can alter the aesthetics of anterior teeth like:



Figs. 25.24A and B: (A) Smile line runs along the incisal edges of maxillary anterior teeth and coincides with curvature of lower lip, also known as gull wing course while smiling; (B) Reverse line is when maxillary central incisors appear shorter than canines along the incisal plane.

Figs. 25.25A to C: (A) Low smile line; (B) Medium smile line; (C) High smile line.



Figs. 29.17A and B: Repair of the old restoration; (A1) A discolored lateral incisor with composite restorations needs repair only; (A2) Lateral incisor after polishing only; (B1) Defective retoration with secondary caries needs replacement; (B2) Postoperative photograph showing replacement of restoration.
(*Courtesy*: Priya Titus).

stepwise remineralization using biocompatible dental materials. Before initiating the treatment, clinician must determine the extent of decay and the feasibility of vital pulp therapy. Only the minimal marginal enamel is removed to enter the carious lesion and remove the infected dentin.

CONCLUSION

Minimal intervention dentistry is the natural evolution of dentistry. As new materials and techniques are developed, dentistry is changed to make the use of most conservative techniques. In general, the minimally intervention dentistry should fulfil the following objectives of dental care, which involve:

- Categorizing the patients for risk of developing dental caries depending upon existing oral health conditions.
- Applying aggressive caries preventive measures like implementation of fluoride therapy, antimicrobial therapy, diet modification, and calcium supplementation to reduce the caries risk.
- Conservative use of intervention procedures.

EXAMINER'S CHOICE QUESTIONS

1. Write in detail about the concept of minimal intervention dentistry.
2. Write short notes on:
   a. Concepts of minimal intervention dentistry.
   b. Mount and Hume classification of caries.
   c. Minimal invasive options for carious lesions.
   d. Various tooth remineralization agents.

VIVA QUESTIONS

1. Define minimal intervention dentistry.
2. What are principles of minimum intervention dentistry?
3. What is difference between caries classification given by GV Black and G Mount?
4. What are requirements of an ideal remineralizing agent?
5. What is bioactive glass?
6. What is full form of CPP-ACP?
7. What is mechanism of action of xylitol?
8. What is fissurotomy?
9. What is chemomechanical caries removal?
10. What is tunnel preparation?
11. Discuss tooth preparation using air abrasion.
12. Discuss tooth preparation by lasers.

BIBLIOGRAPHY

1. Azarpazhooh A, Limeback H. Clinical efficacy of casein derivatives: a systematic review of the literature. J Am Dent Assoc. 2008;139(7):915-24.
2. Christensen GJ. The advantages of minimally invasive dentistry. J Am Dent Assoc. 2005;136(11):1563-5.
3. Cury JA, Tenuta LM. Enamel remineralization: controlling the caries disease or treating the early caries lesions? Braz Oral Res. 2009;23 (Suppl 1):23-30.
4. Ericson D. What is minimally invasive dentistry? Oral Health Prev Dent. 2004;2 (Suppl 1):287-92.

with evidence of biochemical or systemic diseases. They may be hypocalcification, hereditary generalized, localized hypoplasia, hypomaturation, or pigmented hypomaturation. The abnormality could be in the matrix formation leading to hypoplasia or it could be in the mineralization leading to hypomineralization.

Clinical Features

Amelogenesis imperfecta affects only one type of dentition and only enamel because it is an ectodermal disturbance.

i. **In hypoplasia type (Figs. 30.7A and B):**
   - Small teeth with short roots, small pulp chamber, and root canal.
   - Delayed eruption of teeth.
   - Sometime, enamel has glassy appearance due to lack of prisms.
   - Change in teeth color from yellow to dark brown.
   - Teeth with irregular shape and abnormal texture.
   - Unsealed or exposed areas.
   - Erosion and abrasion along the edge of the affected tooth.
   - Extreme tooth sensitivity to hot or cold liquids.
   - Pain in the mouth due to secondary infections.
   - Enamel may be discolored, wrinkled, or yellow with signs of severe occlusal wear.

Figs. 30.7A and B: Hypoplasia. Case of amelogenesis imperfecta (A) Before treatment; (B) After treatment. (*Courtesy:* Priya Titus).

ii. **In hypocalcific type (Fig. 30.8):**
   - Enamel is usually stained yellow or black. It may be chalky in early stages of life.
   - Enamel is soft in consistency and get scrapped off easily.

Fig. 30.8: Hypocalcification.

iii. **In hypomaturation:** Enamel can be pierced by an explorer point under firm pressure and can be lost away by chipping from underlying normal appearing dentin.

iv. **Hypomaturation-hypoplastic taurodontism:**
   - Clinically, crown appears white/yellow-brown mottled.
   - Teeth appear smaller than normal and they lack proximal contacts. The enamel thickness is less. The crowns appear to have hypomineralized areas and pits.

Management

Early diagnosis is a key to relatively successful treatment. Selective odontomy is done for esthetically reshaping of the teeth. Full veneers with metallic based or cast restorations for posterior teeth and all ceramic restorations for anterior teeth can be given. Preventive interventions, such as professional cleaning, the use of antimicrobial oral rinses (e.g. chlorhexidine), and excellent oral hygiene help to achieve healthy soft tissue prior to and after restorative care.

DENTINOGENESIS IMPERFECTA

Dentinogenesis imperfecta comprises a group of autosomal dominant genetic conditions characterized by abnormal dentin structure affecting both deciduous and permanent teeth.

a. Shield's Classification of Dentinogenesis Imperfecta (DGI-I)

Dentinogenesis Imperfecta Type I

Individuals with DGI-I also have osteogenesis imperfecta. The teeth are amber and translucent and show significant

Fig. 34.8: Protective eyewear for use of laser.

APPLICATIONS OF LASERS IN OPERATIVE DENTISTRY

1. Caries Detection

The DIAGNOdent is based on the principle that bacterial metabolites within caries produce fluorescence which is enhanced by laser light **(Figs. 34.9 and 34.10)**. It is used for caries detection by emitting a nonionizing laser beam at a wavelength of 655 nm towards a specific darkened groove on patient's tooth. Here, photons of this laser wavelength are absorbed by the bacteria of tooth which give fluorescence called laser-induced fluorescence. The instrument's digital display indicates the number of bacteria in this area of the tooth and it may correspond to the extent of decay. It helps in early detection of fissure caries and calculus.

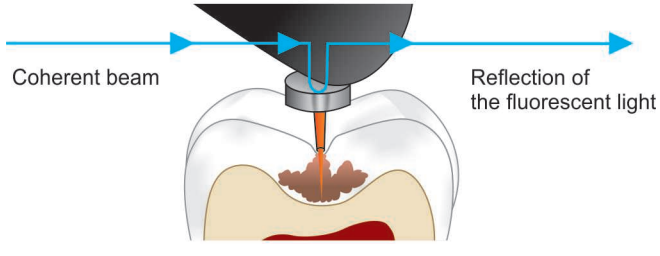


Fig. 34.9: Schematic representation of DIAGNOdent.

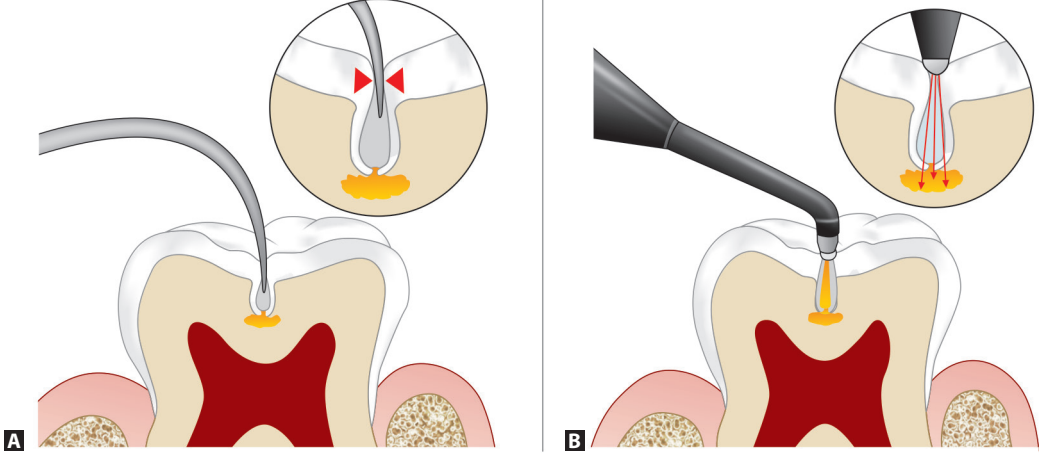
2. Thermal Testing

In this, pulsed Nd:YAG laser is applied on the tooth. Pain produced by laser is mild and tolerable when compared to conventional pulp tester.

3. Cavity Preparation

Nowadays, lasers with similar wavelengths in the middle infrared region of the electromagnetic spectrum are being used commonly for cavity preparation and caries removal. The Er:YAG laser and Er,Cr:YSGG can perform precise cavity preparation by photothermal and photoablation effects (**Fig. 34.11**). Laser beam vaporizes the water present in enamel and dentin, resulting in microexplosions in hydroxyapatite. This forms microcraters on the tooth surface.

Laser cavity preparation	*Conventional cavity preparation*
• No vibration and less noise • Lasers cut at a point of their tip which is to be used with up and down motion • Rough edges that need hand instruments like excavators to remove the ablation products • Removes smear layer • Less traumatic to patient • Prepares highly conservative cavity • Considered safe in cases of unexpected patient movement	• Produce vibration and noise • Burs produce abrasive cutting from their sides and at the end • Produces smooth edges • Produces a smear layer • More traumatic to patient • Burs cut at sides and at end • Considered unsafe in cases of sudden patient movement



Figs. 34.10A and B: (A) Tip of explorer does not detect the cavity until cavity is large enough; (B) DIAGNOdent can detect caries even at early stage.