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FACULTY OF DENTISTRY
DEPARTMENT OF THERAPEUTIC DENTISTRY

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PROPAEDEUTICS OF THERAPEUTIC DENTISTRY

Educational and methodical textbook

for practical classes in propaedeutics of therapeutic dentistry

for 2nd-year students of the dental faculty

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An educational and methodical textbook was prepared for studying the program of discipline "Propaedeutics of therapeutic dentistry" by 2nd-year students of the dental faculty. The guide includes methodological developments for conducting practical classes in conjunction with control tasks and a list of recommended educational and methodological literature. The textbook is designed to improve students' knowledge of tooth structure, tissues and organs of the oral cavity, organization and equipment of dental office, principles, methods and stages of preparation carious cavities of different localization, composition, properties, and methods use of dental filling materials, endodontic treatment of tooth cavities and root canals, materials and methods of their filling.

The educational and methodical textbook was reviewed and approved for publication at the meeting of the department of therapeutic Dentistry, protocol №_1 of January 18, 2024.

CONTENTS

LIST OF ABBREVIATIONS AND TERMS

ALP	Alkaline phosphatase
ART	Atraumatic restorative treatment
CPP-ACP	Casein phosphopeptide-amorphous calcium phosphate
DCJ	Dentinocemental junction
DEJ	Dentinoenamel junction
D.T.	Dentinal tubules
EAL	Electronic apex locators
EDTA	Ethylenediaminetetraacetic acid
NAOCL	Sodium hypochlorite
HERS	Hertwig's epithelial root sheath
RCT	Root canal treatment.
ZOE	Zinc-oxide eugenol cement
ZPC	Zinc phosphate cement

INTRODUCTION

Knowledge of the anatomical and histological tooth structure is necessary for student's deep comprehension of development different pathological processes, which pass in its hard and soft tissues. Ability to determine the approach, plan, type and principle of treatment of dental disease by making an informed decision based on existing algorithms and standard schemes necessary for the future doctor.

Propaedeutic course provides study the composition, properties of filling materials, indications and methods of their use, stages of carious cavities preparation; stages and methods of endodontic root canal treatment; ability to determine the belonging of teeth to a particular group, side, maxilla or mandible, taking into account their clinical and anatomical features, signs.

Future doctors should learn to distinguish and identify the leading clinical symptoms and syndromes; by standard methods, using preliminary anamnesis data patient's history, examination data, knowledge of the person, his/her organs and systems, to establish a probable nosological or syndromic preliminary clinical diagnosis of a dental disease.

Topic 1. Propaedeutics of therapeutic dentistry as a preclinical course of therapeutic dentistry: concept, purpose and objectives, sections. Structure of the tooth: topography of tissues and formations of the tooth.

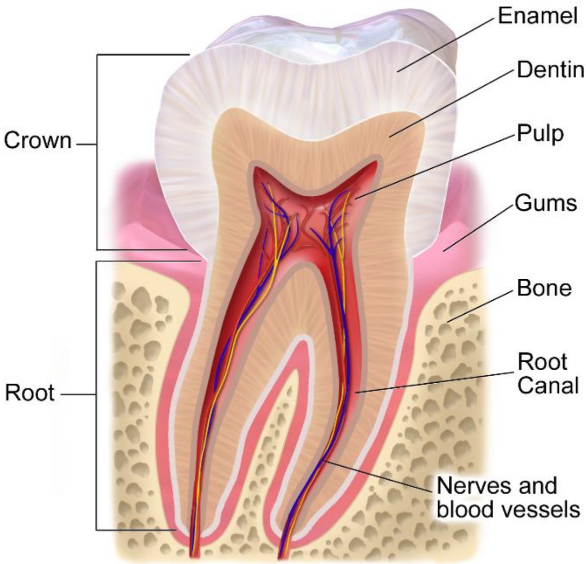
Propaedeutic course - deals with the history of dentistry, study the anatomical and physiological features of the oral cavity, dental instruments and dental office equipment, ergonomics issues, ethics and deontology, structure of Ukraine dental service.

The main objectives of the course:

1. To study the anatomic and topographic features of the permanent teeth and milk occlusion.
2. To study the morphological structure, physiological properties of dental tissues.
3. Examine the equipment and the equipment dental surgeries (dental chair, universal dental units). Master the technique works.
4. Examine the dental tools: forms, functionality, methodology of work, sterilization. To study the structure, the technique of dental handpieces.
5. Master the technique of preparation of cavities.
6. Know the sealing material for stopping teeth: their types, physical and chemical, biological, medicinal properties, the appointment.
7. Master the technique of filling cavities with different localization of all groups of teeth with all kinds of filling materials.
8. Examine the methods and techniques of manipulation in the tooth cavity (endodontic treatment):

- to study the topography of the cavities of primary and permanent teeth;
- to learn the endodontic instruments, working equipment;
- to master the methods of opening and disclosure of cavities of different groups of teeth;
- master the technique of instrumental and pharmacological treatment of root canals.

The tooth is composed of three hard mineralized tissues, i.e. and one soft tissue viz; pulp. The outermost layer of enamel, is mostly inorganic and is the hardest tissue in the body. It covers part or all of the crown of the tooth. The middle layer of the tooth is composed of dentin, which is less hard than enamel and similar in composition to bone. Dentin forms the main bulk of each tooth and extends almost the entire length of the tooth, being covered by enamel on the crown portion and by cementum on the roots. Dentin is nourished by the pulp, which is the innermost portion of the tooth.



Tooth Anatomy

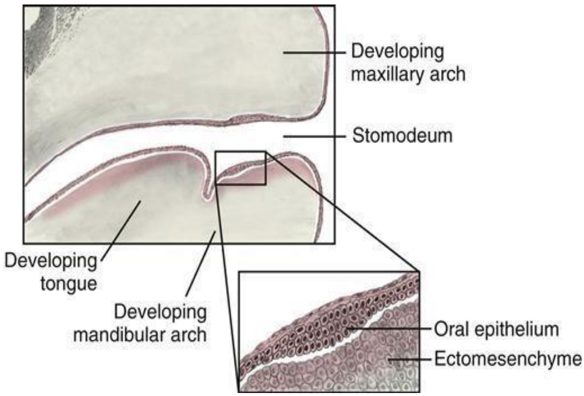
DEVELOPMENT OF TOOTH

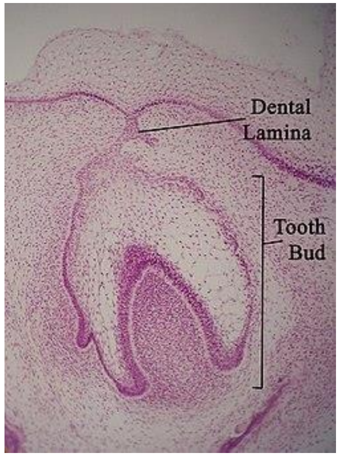
Development of tooth is a complex process initiates, mediated and controlled by the interaction between ectoderm and supporting ectomesenchyme. Tooth development begins at 3rd week of intrauterine life.

Dental lamina (INITIATION)

The dental lamina is a band of epithelial tissue seen in histological sections of a developing tooth. The dental lamina is first evidence of tooth development and begins at the sixth week of intrauterine life.

The dental lamina proliferates into the underlying ectomesenchyme and forms a U-shaped band along the future dental arches in each jaw.





Stages of tooth development

The tooth germ is an aggregation of cells that eventually forms a tooth. These cells are derived from the ectoderm of the first pharyngeal arch and the ectomesenchyme of the neural crest.

The tooth germ is organized into three parts:

- Enamel organ
- Dental papilla
- Dental follicle

The enamel organ is composed of the outer enamel epithelium, inner enamel epithelium, stellate reticulum and stratum intermedium. These cells give rise to ameloblasts, which produce enamel and become a part of the reduced enamel epithelium (REE) after maturation of the enamel. The location where the outer enamel epithelium and inner enamel epithelium join is called the cervical loop.

The growth of cervical loop cells into the deeper tissues forms **Hertwig Epithelial Root Sheath,** which determines the root shape of the tooth. The ***dental papilla*** contains cells that develop into **odontoblasts,** which are dentin-forming cells. The junction between the dental papilla and inner enamel epithelium determines the crown shape of a tooth. **Mesenchymal cells** within the dental papilla are responsible for formation of tooth pulp. The **dental sac or follicle** gives rise to three important entities: **cementoblasts, osteoblasts,** and **fibroblasts**. Cementoblasts form the cementum of a tooth. Osteoblasts give rise to the alveolar bone around the roots of teeth. Fibroblasts are involved developing the periodontal ligament which connect teeth to thealveolar bone through cementum.

PHYSIOLOGICAL PHASES

1. Initiation
2. Proliferation
3. Morphodifferentiation
4. Histodifferentiation
5. Apposition

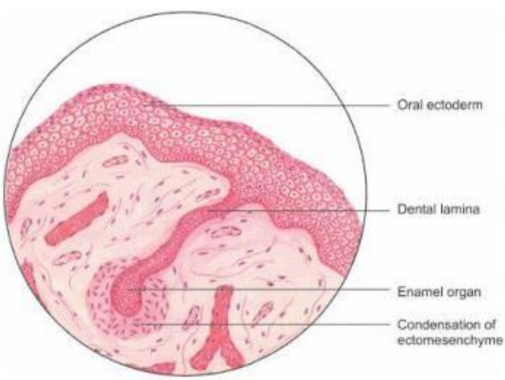
MORPHOLOGICAL STAGES

1. Bud stage
2. Cap stage
3. Bell stage: - Early bell stage
   - Advanced bell stage

BUD STAGE (PROLIFERATION)

Enamel organ resembles a small bud. Enamel organ consists of peripherally located low columnar cells and centrally located polygonal cells. The surrounding mesenchymal cells proliferate, which results in their condensation in two areas.

The area of condensation immediately below the enamel organ is the dental papilla. The ectomesenchymal condensation that surrounds the tooth bud & the dental papilla is the tooth sac.



CAP STAGE (PROLIFERATION)

The tooth bud grows around the ectomesenchymal aggregation, taking on the appearance of a cap, and becomes the enamel organ. A condensation of ectomesenchymal cells called the dental follicle surrounds the enamel organ and limits the dental papilla. Eventually, the enamel organ will produce enamel, the dental papilla will produce dentin and pulp, and the dental follicle will produce all the supporting structures of a tooth.

Histology of cap stage

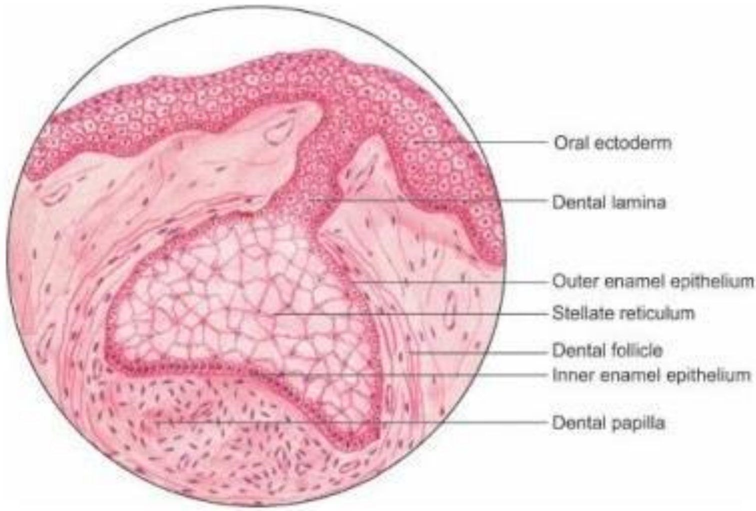
Enamel organ shows three different types of cells:

- **Inner enamel epithelium:** The inner enamel epithelium, also known as the internal enamel epithelium, is a layer of columnar cells located on the rim nearest the dental papilla of the enamel organ in a developing tooth.
- **Outer enamel epithelium:** The outer enamel epithelium, also known as the external enamel epithelium, is a layer of cuboidal cells located on the periphery of the enamel organ in a developing tooth.
- **Stellate reticulum:** The stellate reticulum is a group of cells located in the center of the enamel organ of a developing tooth. These cells are star-shaped and synthesize glycosaminoglycans.

Structures of enamel organ

- **Enamel knot:** It is a transitory cluster of non dividing ectodermal cells present as knob like projection at the deepest part of invagination of enamel organ which partly project into the dental papilla.
- **Enamel cord:** The enamel cord is a localization of cells on an enamel organ that appear from the outer enamel epithelium to an enamel knot.
- **Enamel septum:** sometimes enamel cord becomes thick in a bucco-lingual direction forming a septum partly dividing the enamel organ.
- **Enamel niche:** small invagination seen in the area where the enamel cord joins the outer enamel epithelium.

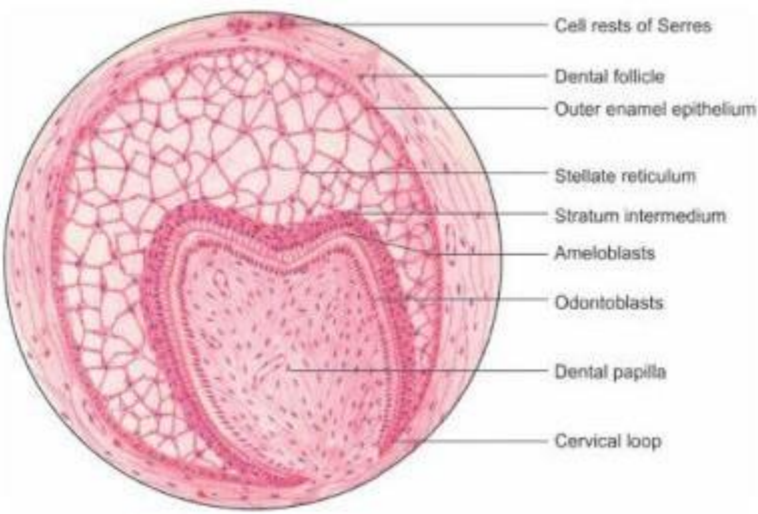
Cap stage



BELL STAGE (HISTODIFFERENTITION)

The dental organ is bell-shaped during this stage, and the majority of its cells are called stellate reticulum because of their star-shaped appearance. The bell stage is divided into the early bell stage and the late bell stage. Cells on the periphery of the enamel organ separate into four important layers. Cuboidal cells on the periphery of the dental organ are known as outer enamel epithelium (OEE). The columnar cells of the enamel organ adjacent to the enamel papilla are known as inner enamel epithelium (IEE). The cells between the IEE and the stellate reticulum form a layer known as the stratum intermedium. The rim of the enamel organ where the outer and inner enamel epithelium join is called the cervical loop. The dental lamina disintegrates, leaving the developing teeth completely separated from the epithelium of the oral cavity.

Early bell stage



ADVANCED BELL STAGE (MORPHODIFFERENTIATION)

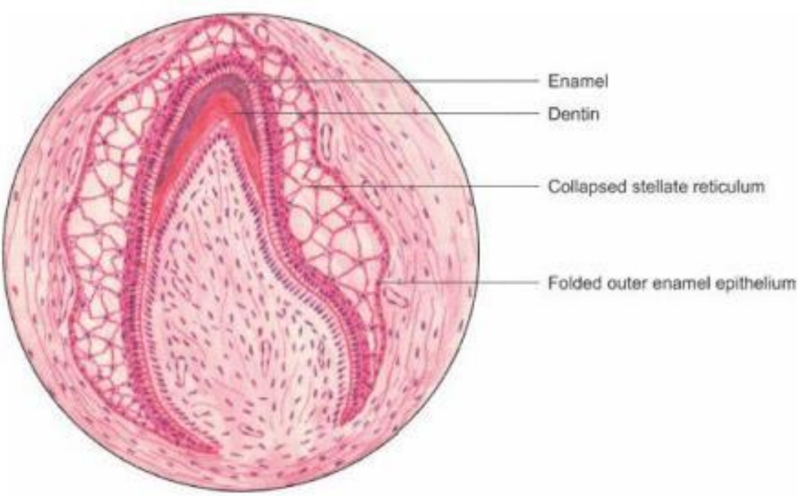
This stage is called the crown, or maturation stage. Important cellular changes occur at this time. In prior stages, all of the IEE cells were dividing to increase the overall size of the tooth bud, but rapid dividing, called mitosis, stops during the crown stage at the location where the cusps of the teeth form.

The first mineralized hard tissues form at this location.

The adjacent layer of cells in the dental papilla suddenly increases in size and differentiates into odontoblasts, which are the cells that form dentin.

After dentin formation begins, the cells of the IEE secrete an organic matrix against the dentin. This matrix immediately mineralizes and becomes the initial layer of the tooth's enamel. Outside the dentin are the newly formed ameloblasts in response to the formation of dentin, which are cells that continue the process of enamel formation; therefore, enamel formation moves outwards, adding new material to the outer surface of the developing tooth.

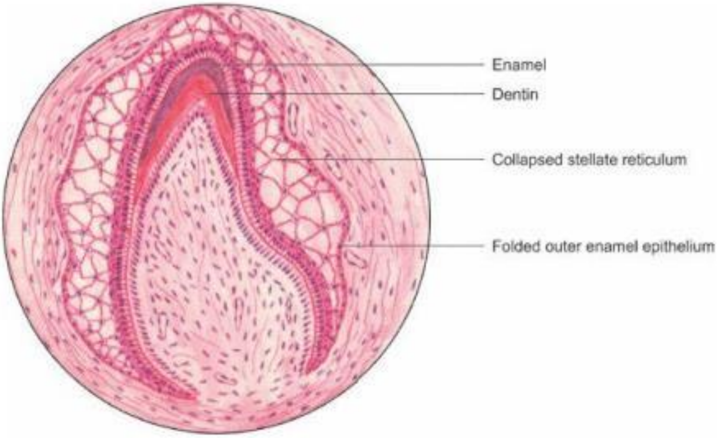
Advanced bell stage



ROOT FORMATION

This stage is called the crown, or maturation stage. Important cellular changes occur at this time. In prior stages, all of the IEE cells were dividing to increase the overall size of the tooth bud, but rapid dividing, called mitosis, stops during the crown stage at the location where the cusps of the teeth form. The first mineralized hard tissues form at this location. The adjacent layer of cells in the dental papilla suddenly increases in size and differentiates into odontoblasts, which are the cells that form dentin. After dentin formation begins, the cells of the IEE secrete an organic matrix against the dentin. This matrix immediately mineralizes and becomes the initial layer of the tooth's enamel. Outside the dentin are the newly formed ameloblasts in response to the formation of dentin, which are cells that continue the process of enamel formation; therefore, enamel formation moves outwards, adding new material to the outer surface of the developing tooth.

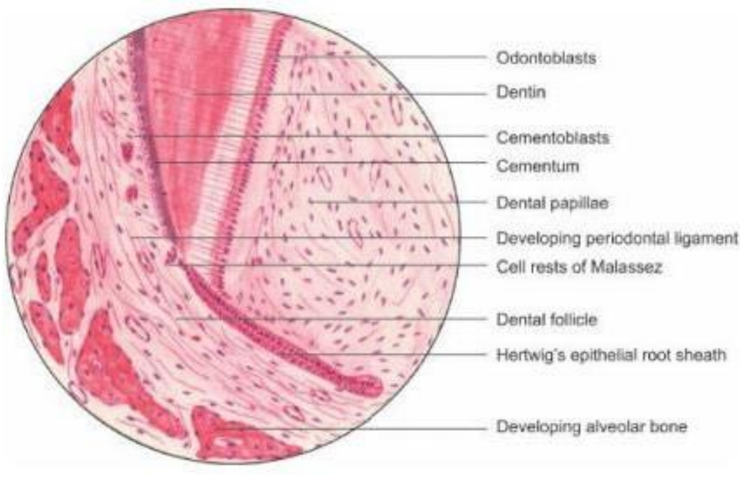
Advanced bell stage



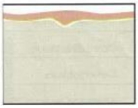
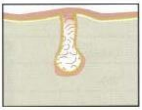
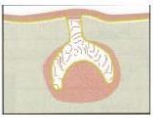
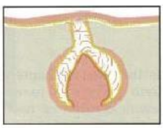
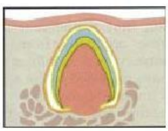
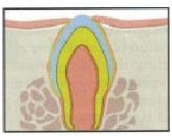
Root formation

At this stage the enamel organ at the cervical loop proliferates giving rise to a structure called ***Hertwig's epithelial root sheath*** (HERS). Hertwig epithelial root sheath is derived from the inner and outer enamel epithelium of the enamel organ.

Root formation



SUMMARY
ARY OF TOOTH DEVELOPMENT

Stage/Time span*	Microscopic appearance	Main processes involved	Description
Initiation stage/6^{th} to 7^{th} weeks		Induction	Ectoderm lining stomodeum gives rise to oral epithelium and then to dental lamina, adjacent to deeper ectomesenchyme, which is influenced by the neural crest cells. These tissues are separated by a basement membrane.
Bud stage/8^{th} week		Proliferation	Growth of dental lamina into bud that penetrates growing ectomesenchyme.
Cap stage/ 9^{th} to 10^{th} weeks		Proliferation, differentiation, morphogenesis	Enamel organ forms into cap, surrounding mass of dental papilla from the ectomesenchyme and surrounded by mass of dental sac also from the ectomesenchyme. Formation of the tooth germ.
Bell stage/ 11^{th} to 12^{th} weeks		Proliferation, differentiation, morphogenesis	Differentiation of enamel organ into bell with four cell types and dental papilla into two cell types.
Apposition stage/ varies per tooth		Induction, proliferation	Dental tissues secreted as matrix in successive layers.
Maturation stage/varies per tooth		Maturation	Dental tissues fully mineralized to their mature levels.

Topic 2. Clinical features of enamel structure: histology, cytology and embryology.

Enamel structures

Enamel is the hardest calcified tissue in the human body, because of its high content of mineral salts and their crystalline arrangement. The function of the enamel is to form a resistant covering of the teeth, rendering them suitable for mastication.

Chemical composition of enamel. Enamel consists of 96–97% inorganic material (by weight), the main inorganic component being hydroxyapatite, 1% organic material (by weight), the main organic component being protein and 2–3% water (by weight).

Physical Properties:

• Unlike other calcified structures in the body enamel is unique as it is totally acellular.

• Hardest substance of human body (like ceramics).

• Brittle and low tensile strength (like ceramics), therefore enamel requires base of dentin to withstand forces during mastication.

• It varies in thickness, with maximum over cusps (2.5 mm) to a knife at the cervical line. Thickness of enamel in primary teeth is nearly half than that in permanent teeth.

• Cracks are often seen in the enamel of teeth.

• Unsupported enamel is subject to easily fracture or cleave along rod boundaries (organic sheath). This is an important concept in cavity preparations which has to do specifically with tooth microstructure.

• Enamel is translucent and varies in color from light yellow to whitish.

Enamel is made up of 3 structures:

1- rods or prisms,
2- rod sheaths,
3- inter-rod substance.

• Each Rod (Prism) is made up of millions of crystallites, and each rod is formed by four ameloblasts.

• Rods run from DEJ to the external surface of the tooth.

• Rods are formed nearly perpendicular to DEJ and curve slightly towards the cusp tip. The follow a wavy course as the traverse from the

DEJ to the surface of the crown. The length of most rods is much longer than the thickness of enamel.

• The diameter of the rod at the outer surface is double the diameter at DEJ.

• Crystals that surround each rod are called interrod enamel. Rod and inter-rod enamel is formed from the Tomes process of Ameloblasts.

• In cross section, the E. rods have a rounded head or body and a tail (look like keyholes) forming a repetitive series of interlocking prisms; rounded head of each prism (rod) lies between the narrow tail portions of 2 adjacent prisms; usually the rounded head is oriented incisally or occlusally, and the tail cervically.

• The crystals making up the rod and interrod enamel have same composition but are oriented in different direction.

• The boundary between rod and interrod enamel is marked by a narrow space filled with organic materials known as rod sheath.

Histological features of enamel:

Gnarled enamel: Most enamel rods follow an undulating pathway from DEJ to the tooth surface. But in the cusps tips of molars groups of enamel rods twist about one another. This twisting pattern of enamel rod is known as Gnarled enamel. Gnarled enamel makes the enamel strong and more resistant to fracture.

Hunter-Schreger bands: Hunter-Schreger bands are an optical phenomena and are seen in reflected light. They can be seen in ground longitudinal sections as alternating dark and light bands. The dark bands correspond to the cross sectional enamel rods and the light bands represent the longitudinally sectioned interrod enamel.

Surface structures of Enamel:

1 – Perikymata. They are transverse, wave like grooves, believed to be the external manifestations of the striae of Retzius. They are continuous around a tooth & usually lie parallel to each other & to the cementoenamel junction. Their course is usually fairly regular, but in the cervical region it may be quite irregular.

2 – Cuticle. Primary enamel cuticle covers the entire crown of the newly erupted tooth, has wavy course and it of no major clinical significance. Is secreted by the ameloblasts when enamel formation is completed. probably soon removed by mastication and its remnants **called Nasmyth's membrane.**

3 – Pellicle. Formed after the tooth is in the oral cavity, acquired from saliva and the oral flora. May contain factors which hinder the attachment of bacteria to tooth surfaces.

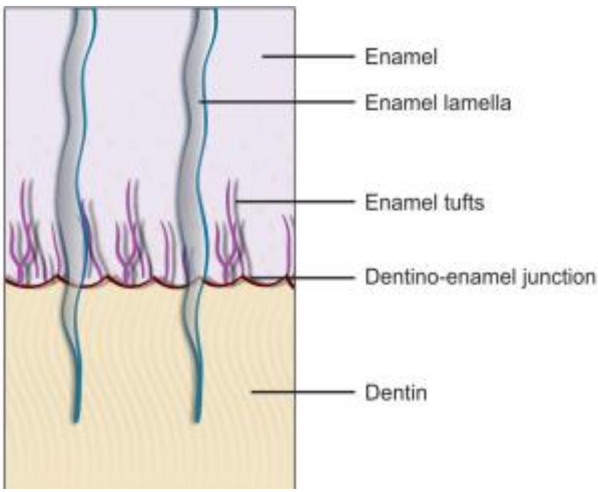
4 – Lamellae. Thin leaf like structures that extend from the enamel surface toward the dentinoenamel junction and may sometimes extend to dentin. Consist of organic material, with but little mineral content. E. lamellae usually developed in planes of tension.

Structures near DEJ:

1 – Enamel spindles: Enamel spindles originate from odontoblastic process which cross the DEJ. Before enamel forms, some developing odontoblastic process extend into the ameloblast layer, and when enamel formation begins become trapped to form enamel spindles (which represent the only ectomesenchymal structure present in the E.).

2 – Enamel tufts: Enamel tufts also originate from the DEJ, run a short distance in the enamel or sometimes to one half of the E. thickness. They represent protein (enamelin) rich areas in the enamel matrix that fail to mature. They are formed during the formative stages of enamel. They are considered to be 'faults' by some researchers while others consider them to be necessary to anchor dentine to enamel.

Schematic representation of different structures present in enamel



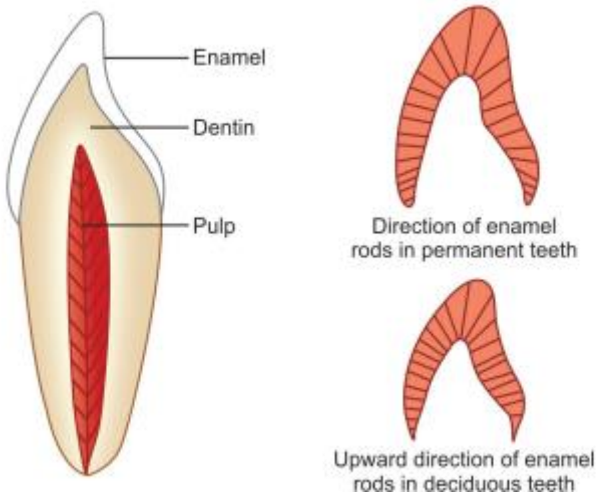
Incremental lines of Enamel:

1 – Cross striations: Cross striations are periodic bands that appear along the full length of enamel rod. Because of this the enamel rod appears like a ladder with cross striations being the rungs of the ladder. They appear at regular intervals that is in agreement with the rate of enamel deposition (which is approximately 4 µ m per day).

2 – Striae of Retzius: Striae of Retzius also represent incremental growth. In ground cross sections they appear like concentric growth rings similar to those found in trees. In ground longitudinal sections they appear to be dark line extending from the DEJ to the tooth surface. Along the Retzius striae fewer enamel crystals are found and this is related to physiologic disturbances in the body. Striae of Retzius often extend from the DEJ to the outer surface of the enamel, where they end in shallow furrows known as perikymata (or imbrication lines).

3 – Neonatal line: Neonatal line is a Striae of Retzius that forms at birth, because it reflects the great physiologic changes occur at birth. So these lines demarcating the boundary between E. formed before and after birth.

Direction of enamel rods in deciduous and permanent teeth



Age changes in enamel:

1– With age enamel becomes worn out because of masticatory attrition.

2– Age also causes a decrease in the permeability of enamel.

3– Other characteristics of aging of enamel are discoloration and a change in the surface layer.

Topic 3. Clinical features of the anatomical and histological structure of dentin, cement. Concepts of structural and functional resistance of hard tooth tissues.

Dentin is a calcified tissue of the body, and along with enamel, cementum, and pulp is one of the four major components of teeth. It is usually covered by enamel on the crown and cementum on the root and surrounds the entire pulp. By weight, 70% of dentin consists of the mineral hydroxyapatite, 20% is organic material, and 10% is water. Yellow in appearance, it greatly affects the color of a tooth due to the translucency of enamel. Dentin, which is less mineralized and less brittle than enamel, is necessary for the support of enamel. Unlike enamel, dentin continues to form throughout life and can be initiated in response to stimuli, such as tooth decay or attrition.

Dentin structural units

1- Dentinal tubules (D.T.) and its odontoblastic process: Dentin consists of microscopic channels, called dentinal tubules, which radiate outward through the dentin from the pulp to the exterior cementum or enamel border. The dentinal tubules extend from the dentinoenamel junction (DEJ) in the crown area, or dentinocemental junction (DCJ) in the root area, to the outer wall of the pulp. These tubules contain fluid and cellular structures (Tomes fiber). As a result, dentin has a degree of permeability, which can increase the sensation of pain and the rate of tooth decay. The strongest held theory of dentinal hypersensitivity suggests that it is due to changes in the dentinal fluid associated with the processes, a type of hydrodynamic mechanism or theory. The course of D.T. is somewhat curved, resembling an S shape known as primary curvature. Starting at right angles from pulpal surface, the first convexity of this doubly curved course directed toward the apex of the root ending perpendicular to D.E.J, this configuration indicate the course taken by odontoblasts during dentinogenesis.

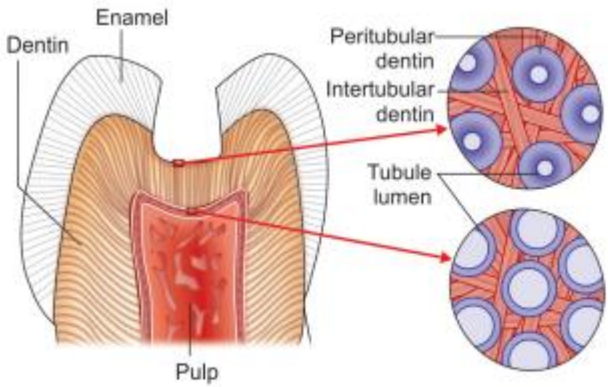
Secondary curvature also can be distinguished over the entire length of D.T., they may reflect the minor changes in the direction of movement of odontoblasts. In the root and in the area of incisal edge or cusps, the dentinal tubules are almost straight. The ratio between surface areas at the outside and inside of the D. is about 5:1, so the tubules are farther apart in the peripheral layers and are more closely packed near the pulp. In addition, D.T. are larger in diameter near the

pulpal cavity (3- 4µm) and smaller at their outer ends(1µm).
The terminal part of D.T. branched into 2-3 branches near D.E.J resulting in the increase number of D.T. in this area. Also, there are lateral branches of D.T. which are called canaliculi.

2-Peritubular D.: It's the D. that surrounds the D.T. and form 1µm thick sheath around each tubule (about 0.75 µm near DEJ and 0.4 µm near the pulp). Peritubular D. is missing in D.T. in interglobular D. indicating that this is a defect of mineralization in this area. Peritubular D. is highly calcified and it's about 40% more calcified than adjacent intertubular D.

3-Intertubular D.: It's the D. located between the D.T., and it formed the most of the body of D. Its less mineralized than the peritubular D., and it consist of network course of collagen fibers in which apatite crystals deposited on it.

Schematic representation of pattern of intertubular and peritubular dentin



Types of dentin

There are three types of dentin, primary, secondary and tertiary.
Primary dentin is the outermost layer of dentin and borders the enamel. **Secondary dentin** is a layer of dentin produced after the root of the tooth is completely formed. **Tertiary dentin** is created in response to a stimulus, such as a carious attack.

Primary dentin. Primary dentin, the most prominent dentin in the tooth, lies between the enamel and the pulp chamber. The outer layer closest to enamel is known as mantle dentin. This layer is unique to the rest of primary dentin. Mantle dentin is formed by newly differentiated odontoblasts and forms a layer approximately 150 micrometers wide. Unlike primary dentin, mantle dentin lacks phosphorylation, has loosely packed collagen fibrils and is less mineralized. Below it lies the circumpulpal dentin, a more mineralized dentin that makes up most of the dentin layer and is secreted after the mantle dentin by the odontoblasts. Circumpulpal dentin is formed before the root formation is completed. Newly secreted dentin is unmineralised and is called predentin. It is easily identified in haematoxylin and eosin-stained sections since it stains less intensely than dentin. It is usually 10-47 micrometer and lines the innermost region of the dentin. It is unmineralized and consists of collagen, glycoproteins and proteoglycans. It is similar to osteoid in bone and is thickest when dentinogenesis is occurring.

Secondary dentin. Secondary dentin is formed after root formation is complete, normally after the tooth has erupted and is functional. It grows much more slowly than primary dentin but maintains its incremental aspect of growth. It has a similar structure to primary dentin, although its deposition is not always even around the pulp chamber. It is the growth of this dentin that causes the decrease in the size of the pulp chamber with age. This is clinically known as pulp recession; cavity preparation in young patients therefore carries a greater risk of exposing the pulp. If this occurs, the pulp can be treated by different therapies such as direct pulp capping.

Tertiary dentin is deposited by odontoblasts or replacement odontoblasts from the pulp (undifferentiated mesenchymal cells) at specific sites in response to injury. Tertiary dentin can be divided into reactionary or reparative dentin. Tertiary dentin secreted by odontoblasts is often due to chemical attack, or by diffusion of toxic bacterial metabolites down the dentinal tubules in the instance of a carious attack with dental decay. This tertiary dentin is called reactionary dentin. This is an attempt to slow down the progress of the caries so that it does not reach the pulp. In the case of an infection breaching the dentin to or very near the pulp, or in the instance of odontoblast death, undifferentiated mesenchymal cells can differentiate into odontoblast-like cells which then secrete another type, reparative dentin, underneath the site of attack. This is not only to slow the progress of the attack, but also prevents the diffusion of bacteria and their metabolites into the pulp, reducing the probability of partial pulp necrosis. The distinction of the two kinds of tertiary dentin is important, because they are secreted by different cells for different reasons.

Reactionary dentin is secreted at varying speeds, dependent on the speed of progression of caries in the outer dentin surface. Histologically, it is easily distinguishable by its disordered tube structure, its the location of the secretion (its protrudes into the pulpal cavity) and its slightly lower degree of mineralization than normal. The tooth is often able to be saved by a simple restoration. In contrast, reparative dentin is secreted when the tooth has a poor prognosis. Tertiary dentin is deposited rapidly, with a sparse and irregular tubular pattern and some cellular inclusions; in this case it is referred to as "osteodentin". However, if the stimulus is less active, it is laid down less rapidly with a more regular tubular pattern and without cellular inclusions.

Stimuli of different nature not only induce additional formation of reparative D. but also lead to changes in the D. itself, calcium salts may be deposited in or around degenerated odontoblastic processes and may obliterate the tubules. This type of D. called **transparent or sclerotic D.,** and can be demonstrated only in ground sections. It appear light in transmitted light and dark in reflected light, because the light passes through the transparent D. but reflected from the normal D. In ground section of D., the odontoblastic process disintegrated as a result of sever stimuli to the pulp like caries, attrition or abrasion, and the empty tubules are filled with air. They appear dark in transmitted light and white in reflected light, this type of D. called dead tracts and its area of decreased sensitivity. Reparative D. seals these dead tracts at their pulpal end.

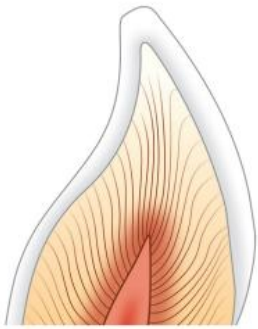
Incremental lines in D.

1- Imbrication or Ebner lines: It appear as fine lines, which in cross section run at right angles to the D.T. The course of the lines indicates the growth pattern of the D. The distance between the lines corresponds to the daily rate of opposition, which in crown varies from 4- 8µm and becomes decreasingly less as root formation progress.

2- Counter lines of Owens: Its hypocalcified line, it distinguish in longitudinal ground section as accentuated few lines. These lines arises due to disturbances in D. matrix and mineralizing process.

3- Neonatal lines: This line separating between prenatal and postnatal D., and mostly found in deciduous and first permanent molar. This line is the result of incomplete calcification, due to metabolic disturbances at the time of birth to the abrupt changes in environment and nutrition.

Course of dentinal tubules–Dentinal tubules follow a gentle ‘S’shaped curve in the tooth crown and are straighter in incisal edges



Interglobular D.: Mineralization of the D. sometimes beings in small globular areas that normally fused to form a uniformly calcified D. layer. If fusion does not take place, hypomineralized regions (only primary mineralization phase occur) remain between the globules, which termed interglobular D. This type of D.is found in the crown in both sections (decalcified and ground sections) near the D.E.J. and in the root near C.D.J. In ground sections is sometimes lost and replaced by air, so they appear black.

Tomes’ granular layer: In the ground sections a thin layer of D. adjacent to the cementum almost appears granular and only found in the root, this is known as Tomes’ granular layer. Its thought to represent an interference with mineralization of the entire surface layer of the root D. prior to the beginning of cementum formation.

Dentinoenamel junction: The junction between enamel & dentin termed dentinoenamel junction. Is scalloped which assures the firm hold of the enamel cap on the dentin. The convexities of the scallops are directed toward the dentin. In addition to scalloping DEJ, other features like enamel spindles & fine branching of the terminal tubules are found within the junction.

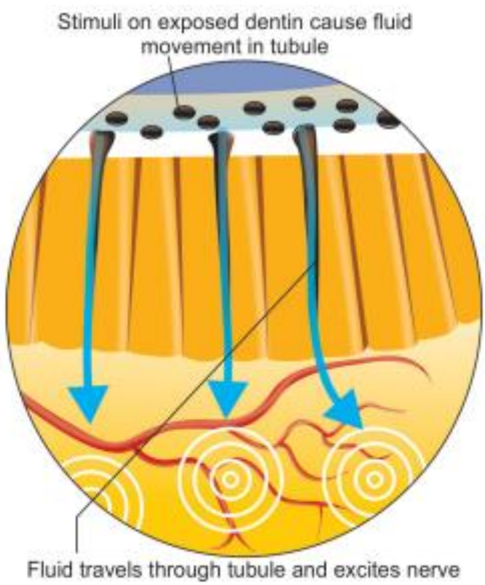
Clinical consideration:

1-Odontoblasts should not be exposed to bacterial toxins, strong drugs, operative trauma, unnecessary thermal changes, or irritating restorative materials, because 1mm2 of dentin when exposed about 30000 living cells are damaged.

2-The rapid penetration & spread of caries in the dentin is the result of the tubules provide a passage for invading bacteria & their products.

3-Dentin sensitivity of pain, unfortunately, may not be a symptom of caries until the pulp is infected & responds by the process of inflammation, leading to toothache.

Fluid movement in dentinal tubules resulting in dentin hypersensitivity



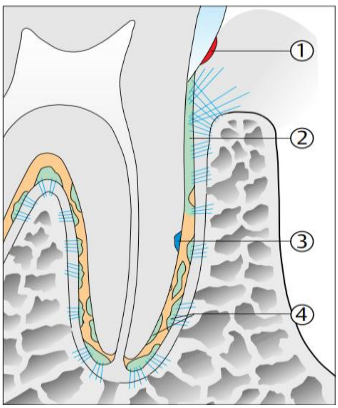
Cementum - is a mineralized dental tissue that covering the anatomic roots of human teeth. Cementum furnishes a medium for the attachment of collagen fibers that bind the tooth to surrounding structures. Unlike bone, however, human cementum is avascular and noninnervated. Cementum is thinnest at the cemento-enamel junction and thickest toward the apex. Like dentin, cementum can form throughout the life of a tooth.

Composition:

• Inorganic content—45 to 50 percent (by wt.).
• Organic matter—50 to 55 percent (by wt.).
• Water.

Types:

1. Acellular, Afibrillar Cementum (AAC; red) AAC is formed at the most cervical enamel border following completion of pre-eruptive enamel maturation, and sometimes also during tooth eruption. It is probably secreted by cementoblasts.
2. Acellular, Extrinsic-fiber Cementum (AEC; green) AEC forms both pre- and post-eruptively. It is secreted by fibroblasts. On the apical portions of the root, it comprises a portion of the mixed-fiber cementum.
3. Cellular, Intrinsic-fiber Cementum (CIC; blue) CIC is formed both pre- and posteruptively. It is synthesized by cementoblasts, but does not contain extrinsic Sharpey’s fibers.
4 Cellular, Mixed-fiber Cementum (CMC; orange/green) CMC is formed by both cementoblasts and fibroblasts; it is a combination of cellular intrinsic-fiber cementum and acellular extrinsic-fiber cementum.



• Acellular cementum:
– Covers the cervical third of the root.
– Formed before the tooth reaches the occlusal plane.
– As the name indicates, it does not contain cells.
– Thickness is in the range of 30 to 230 µm.
– Abundance of Sharpey’s fibers.
– Main function is anchorage.
• Cellular cementum:
– Formed after the tooth reaches the occlusal plane.
– It contains cells.
– Less calcified than acellular cementum.
– Sharpey’s fibers are present in lesser number as compared to acellular cementum.
– Mainly found in apical third and inter-radicular.
– Main function is adaptation.

Two types of hard tissue cover tooth roots. The first, called **intermediate cementum,** is a homogenous layer originating from inner epithelial root sheath cells. The second, called **cellular-acellular cementum,** is a thicker deposit of a bonelike substance produced by cementoblasts that differentiate from the periodontal ligament fibroblasts. The latter is laid down in increments, usually an acellular layer followed by a cellular layer. Cementum simulates bone by displaying cells within lacunae and cell processes within canaliculi.

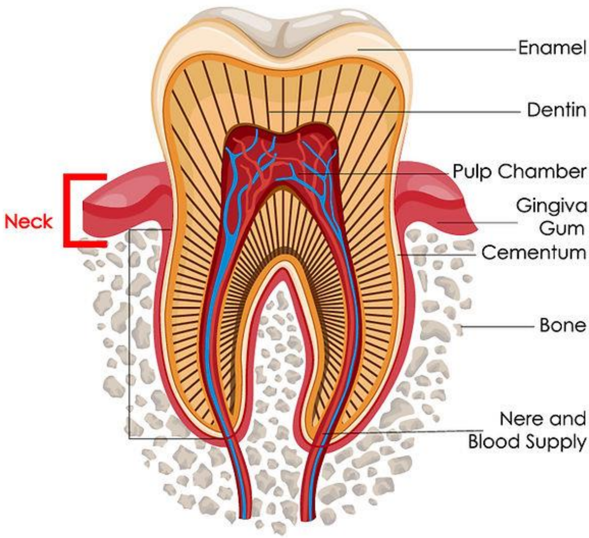
Cementum also exhibits incremental lines but does not have a vascular and neural supply that is characteristic of bone. As a result, the cementum has unique characteristics, such as lack of neural sensitivity and a greater ability than bone to resist resorption.

Both are important clinical features. Aging cementum exhibits a rough and irregular surface caused by resorption of the cemental surface. This cementum also is associated with free, attached, or embedded cementicles. These oval to round stones are similar to the denticles in pulp. They are calcified bodies that may be embedded, attached to cementum, or free in the periodontal ligament.

Topic 4. Clinical features of the anatomical and histological structure of the pulp, periodontium. Age-related changes in them. The concept of periodontium, its functions.

Dental pulp is soft tissue of mesenchymal origin located in the center of the tooth. It consists of specialized cells, odontoblasts arranged peripherally in direct contact with dentin matrix. This close relationship between odontoblasts and dentin is known as 'Pulp–dentin complex'.

Schematic representation



Histology

Pulp is divided into the central and the peripheral region. Central region of both coronal and radicular pulp contains nerves and blood vessels.

Peripheral region contains the following zones:

- Odontoblastic layer.
- Cell free zone of Weil.
- Cell rich zone.

Odontoblastic Layer

- Odontoblasts consist of cell bodies and their cytoplasmic processes.
- Odontoblastic cell bodies form the odonto-blastic zone whereas the odontoblastic processes are located within predentin matrix.
- Capillaries, nerve fibers and dendritic cells may be found around the odontoblasts in this zone

Cell-free Zone of Weil

- It is central to odontoblastic layer.
- It contains plexuses of capillaries and fibers ramification of small nerve.

Cell-rich Zone

- It lies next to subodontoblastic layer.
- It contains fibroblasts, undifferentiated cells which maintain number of odontoblasts by proliferation and differentiation

Structural or Cellular Elements

Odontoblasts

- They are first type of cells encountered as pulp is approached from dentin.
- The number of odontoblasts range from 59,000 to 76,000/ mm2 in coronal dentin with lesser number in root dentin.
- Ultrastructure of the odontoblast shows large nucleus which may contain up to 4 nucleoli.
- Odontoblasts synthesize mainly type I collagen, proteoglycans.
- Irritated odontoblast secretes collagen, amorphous material and large crystals into tubule lumen which result in dentin permeability to irritating substance.

Fibroblasts

- Fibroblasts are found in greatest numbers.
- These are spindle-shaped cells which secrete extra-cellular components such as collagen and ground substance
- They also eliminate excess collagen by action of lysosomal enzymes.

Undifferentiated Mesenchymal Cells

- Undifferentiated mesenchymal cells are descendants of undifferentiated cells of dental papilla which can dedifferentiate and then redifferentiate into many cell types.

Defence Cells

- Histiocytes and macrophages.
- Polymorphonuclear leukocytes.
- Lymphocytes.
- Mast cells .

Extracellular Components

The extracellular components include fibers and the ground substance of pulp:

Fibers. Fibers are principally type I and type III collagen. Collagen is synthesized and secreted by odontoblasts and fibroblasts.

Ground Substance. It is a structure less mass with gel-like consistency consisting of glycosaminoglycans, glycoproteins and water.

Functions of ground substance:

• Forms the bulk of the pulp.
• Supports the cells.
• Acts as medium for transport of nutrients from the vasculature to the cells and of metabolites from the cells to the vasculature.

Anatomy

Pulp lies in the center of tooth and shapes itself to miniature form of tooth. This space is called pulp cavity which is divided into pulp chamber and root canal.

Pulp Chamber. It is that portion of pulp cavity present in crown portion. The roof of pulp chamber consists of dentin covering the pulp chamber occlusally.

Root Canal. It is that portion of pulp cavity which extends from canal orifice to the apical foramen. Shape of root canal varies with size, shape, number of the roots in different teeth.

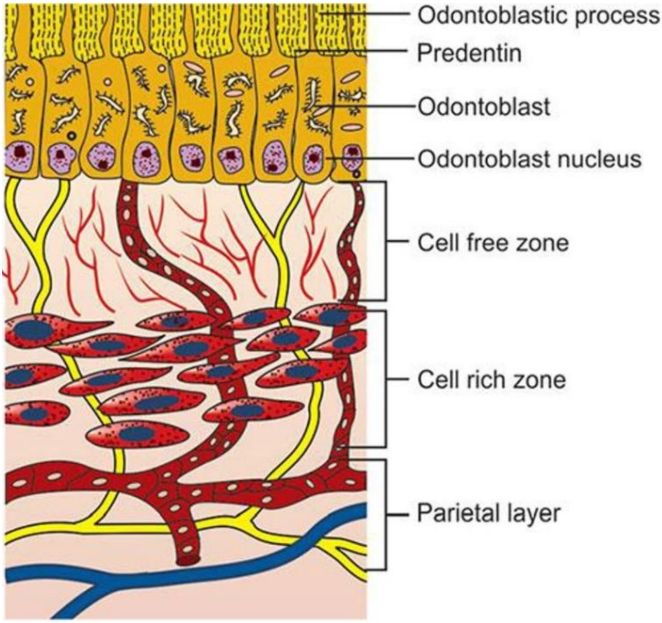
Functions

1. *Formation of Dentin*. Pulp primarily helps in:
   - Synthesis and secretion of organic matrix.
   - Initial transport of inorganic components to newly formed matrix.
   - Creates an environment favorable for matrix mineralization.
2. *Nutrition of Dentin*. Nutrients exchange across capillaries into the pulp interstitial fluid, which in turn, travels into the dentin through

the network of tubules.

3. *Innervation of Tooth*. Through the nervous system, pulp transmits pain, sensations of temperature and touch.
4. *Defense of Tooth*. Odontoblasts form dentin in response to injury particularly when original dentin thickness has been compromised as in caries, attrition, trauma or restorative procedure.

Different zones of dental pulp



Age Changes

Morphologic Changes (Changes in Appearance)

• Continued deposition of intratubular dentin-reduction in tubule diameter.
• Reduction in pulp volume due to increase in secondary dentin deposition.
• Presence of dystrophic calcification and pulp stones.
• Decrease in sensitivity.
• Reduction in number of blood vessels.

Physiologic Changes (Changes in Function)

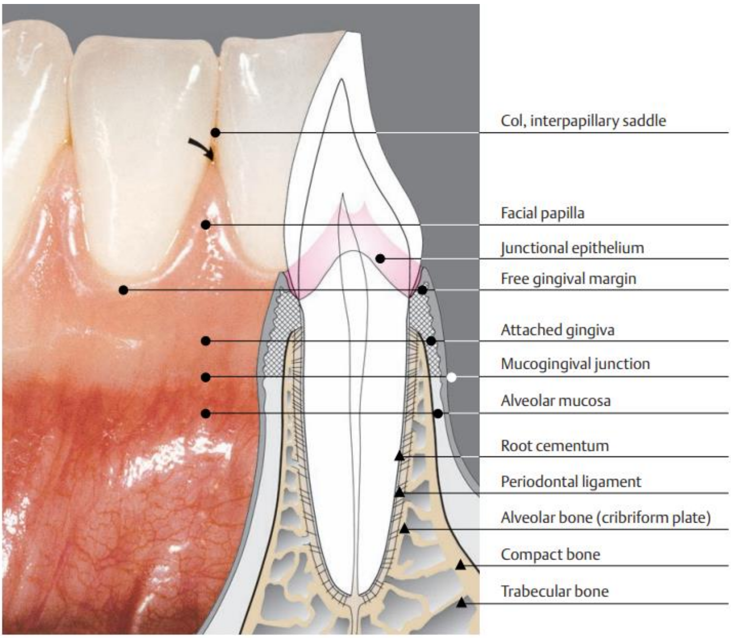
• Decrease in dentin permeability provides protected environment for

pulp-reduced effect of irritants.
• Possibility of reduced ability of pulp to react to irritants and repair itself.

Periodontium

Anatomically, the periodontium is the collective term used for those structures that support the teeth in the jawbone, and traditionally includes the following tissues:

- **Cementum** – hard tissue covering of the root that anchors the periodontal ligament to the tooth.
- **Periodontal ligament** – connective tissue attachment between the tooth and the alveolar bone.
- **Alveolar bone** – specialized ridge of bone over each jaw, where the teeth sit in their sockets.
- **Gingivae** – specialized soft tissue covering of the alveolar processes, that are also in attachment with the teeth at their necks.



The gingiva is one portion of the oral mucosa. It is also the most peripheral component of the periodontium. Gingiva begins at the mucogingival line, and covers the coronal aspect of the alveolar process. On the palatal aspect, the mucogingival line is absent; here, the gingiva is a part of the keratinized, non-mobile palatal mucosa. The gingiva is demarcated clinically into the free marginal gingiva, ca. 1.5 mm wide; the attached gingiva, which may be of varying width; and the interdental gingiva.

The fibrous connective tissue structures provide the attachment between teeth (via cementum) and their osseous alveoli, between teeth and gingiva, as well as between each tooth and its neighbor.

***These structures include*:**

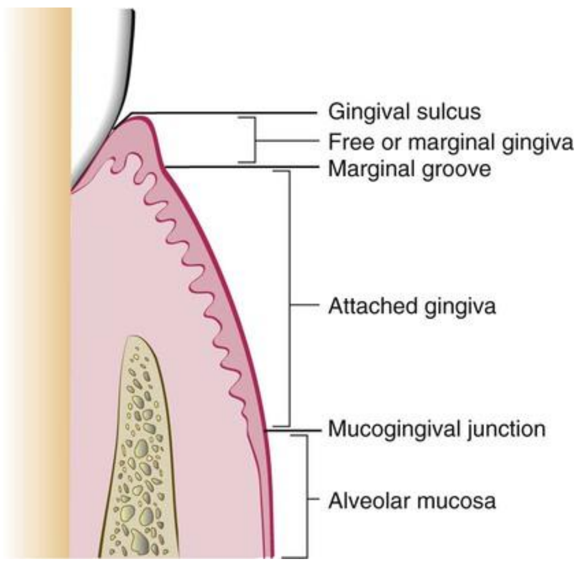
- Gingival fiber groups.
- Periodontal fiber groups (periodontal ligament).

Root cementum is part of the tooth, but also part of the periodontium.

Alveolar Process (Alveolar Bone). The alveolar processes of the maxilla and the mandible are tooth-dependent structures. They develop with the formation of and during the eruption of the teeth, and they atrophy for the most part after tooth loss.

Three structures of the alveolar process may be discriminated:

- Alveolar bone proper.
- Trabecular bone.
- Compact bone.



Topic 5. Saliva, oral fluid: composition, properties, functions.

Oral liquid. In the mouth there is a biological fluid, called oral fluid, which in addition to secretion of salivary glands, including flora and the products of its life, the contents of periodontal pockets. The most commonly collected **oral fluid** is expectorated whole saliva, which is a mixture of major and minor salivary gland secretions.

The secretions of the major and minor salivary glands, together with the gingival crevicular fluid, constitute whole saliva which provides the chemical process of the teeth and oral soft tissues. Saliva formation can be evoked by sympathetic and parasympathetic stimulations. The critical function of saliva is required for the preservation and maintenance of oral tissue. Saliva is a complex secretion.

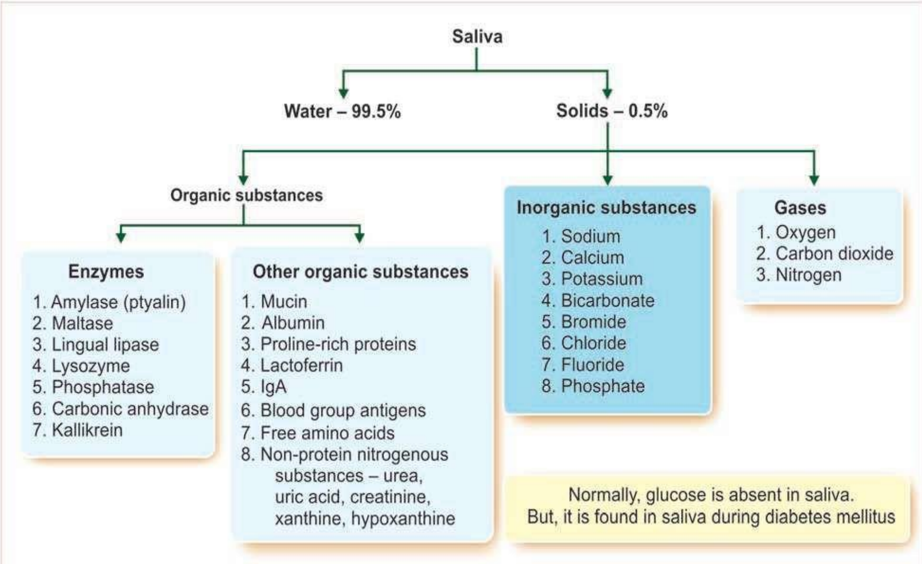
About 93% by volume is secreted by the major salivary glands and the remaining 7% by the minor glands. About 99% of saliva is water and the other 1% is composed of organic and inorganic molecules.

Composition of saliva

Saliva is composed of a variety of electrolytes, including sodium, potassium, calcium, magnesium, bicarbonate, and phosphates. Also found in saliva are immunoglobulins, proteins, enzymes, mucins, and nitrogenous products, such as urea and ammonia. These components interact in related functions in the following general area:

1. bicarbonates, phosphates, and urea act to modulate pH and the buffering capacity of saliva;
2. macromolecule proteins and mucins serve to cleanse, aggregate, and/or attach oral microorganisms and contribute to dental plaque metabolism;
3. calcium, phosphate, and proteins work together as an antisolubility factor and modulate demineralization and remineralization;
4. immunoglobulins, proteins, and enzymes provide antibacterial action.

The components listed above generally occur in small amounts, varying with changes in flow; however they continually provide an array of important functions. It is important to stress that saliva, as a unique biologic fluid, must be considered as a whole that is greater than the sum of its parts.



CLASSIFICATION OF SALIVARY GLANDS

1.Based on anatomic location:

– Parotid gland.
– Sub mandibular gland.
– Sub lingual gland.
– Accessory glands (labial, lingual, palatal buccal, glossopalatine and retromolar).

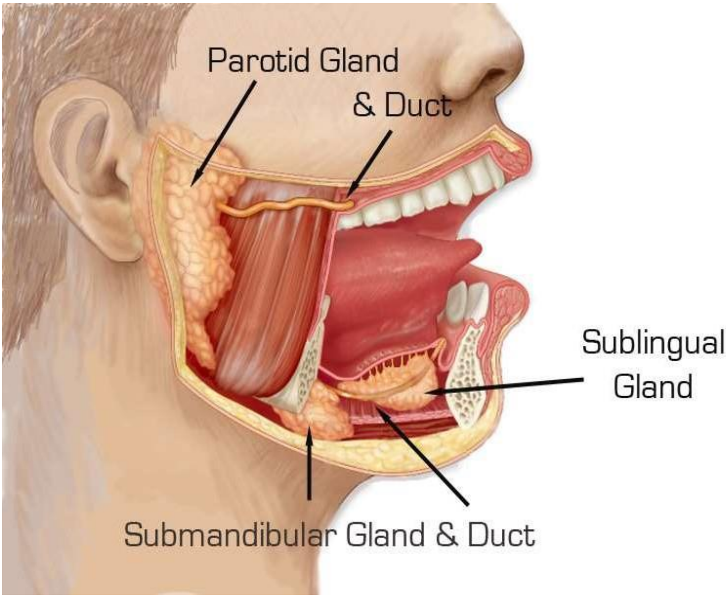
2. Based on size and amount of secretion:

– Major salivary glands.
– Minor salivary glands.

3. Based on type of secretion:

– Serous.
– Mucous.
– Mixed.

Salivary glands are a group of exocrine, and tubulo-acinar glands that secrete saliva. The glands are formed of parenchymal components constituted by secretory acini and excretory ducts as well as extra-parenchymal components constituted by connective tissue formed of collagen fibres, ground matrix, and neurovascular bundle



Organic and inorganic constituents of saliva

The organic and inorganic compositions of saliva can supply information about alterations in enzymatic activity in response to periodontal inflammation. Alkaline phosphatase (ALP) is a calcium-phosphate binding protein and a phosphor-hydrolytic enzyme. ALP is considered to be an important indicator of bone formation and is a phenotypic marker for osteoblast cells. ALP was detected in the parotid, submandibular, and minor salivary glands, as well as in desquamated epithelial cells, leucocytes, and bacteria from dental plaque.

Saliva functions

Immune functions. The components like lysozyme, lactoferrin, salivary peroxidase, myeloperoxidase, and thiocyanate concentrations act as a defense mechanism in the whole saliva. The natural defense properties of salivary secretions through clinical modalities such as the development of (1) diagnostic reagents and tests for local and systemic disease, (2) artificial salivas for the treatment of salivary dysfunction, and (3) topical vaccines to combat against oral diseases.

The salivary flow rate influences to a high degree the rate of oral and salivary clearance of bacterial substrates included in foods and snacks. Salivary IgA and lysozyme were inversely correlated with self-perceived work-related stress. As these salivary biomarkers are reflective of the mucosal immunity, results support the inverse relation between stress and mucosal immunity.

Role of lubrication. The complex mix of salivary constituents provides an effective set of systems for lubricating and protecting the soft and hard tissues. The lubricating and antimicrobial functions of saliva are maintained mainly by resting; saliva results in a flushing effect and the clearance of oral debris and noxious agents.

Role of digestion. A high quality of saliva is an essential factor to protect the dental elements against attrition and promote the digestion process. Saliva is the principal fluid component of the external environment of the taste receptor cells which is involved in the transport of taste substances and protection of the taste receptor. The role of human saliva and its compositional elements in relation to the GI functions of taste, mastication, bolus formation, enzymatic digestion, and swallowing.

Antimicrobial, antiviral, and antifungal functions. A group of salivary proteins like lysozyme, lactoferrin, and lactoperoxidase working in conjunction with other components of saliva can have an immediate effect on oral bacteria, interfering with their ability to multiply or killing them directly. Lysozyme can cause lysis of bacterial cells, especially Streptococcus mutans, by interacting with anions of low charge density chaotropic ions (thiocyanate, perchlorate, iodide, bromide, nitrate, chloride, and fluoride) and with bicarbonate

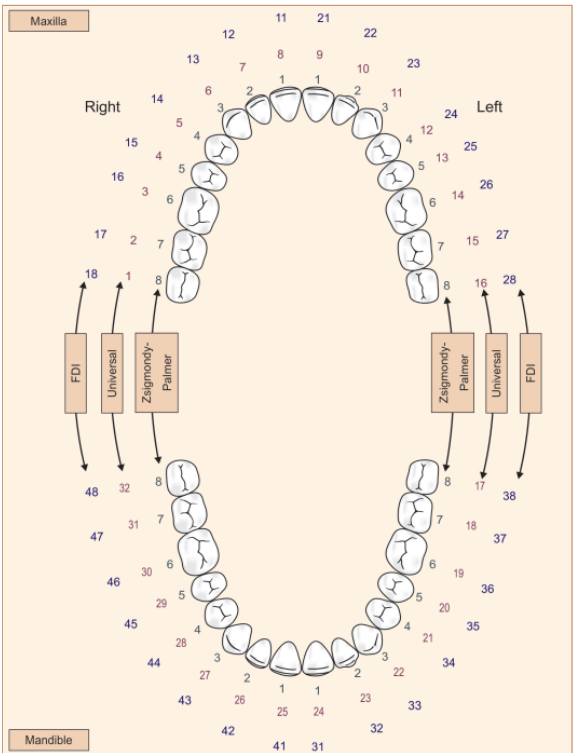
Topic 6. Dental formulas. Signs of teeth.

Mouth has two arches - maxillary and mandibular. Each arch has two quadrants, i.e. right and left. Thus the set of teeth has four quadrants:

1. Upper (maxillary) right.
2. Upper (maxillary) left.
3. Lower (mandibular) right.
4. Lower (mandibular) left.

There are different tooth notations for identifying specific tooth. The three most common systems 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.

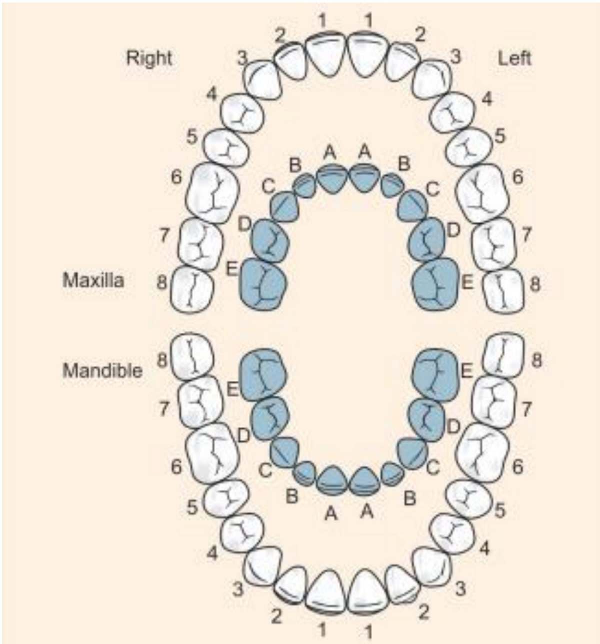
From inner to outer ring. First row (Inner row)—Zsigmondy Palmer; Second row (middle row)—Universal; Third row (Outer row)—FDI



Zsigmondy-Palmer System/Angular/Grid System

• This is the oldest method introduced by Zsigmondy in 1861.
• Also known as angular or grid system.
• Adult teeth are numbered 1 to 8, where 1 is central incisor and 8 is third molar.
• Primary teeth are designated as A, B, C, D, E, where A is central incisor and E is second molar.

Presentation of Zsigmondy-Palmer notation of both deciduous and permanent dentitions



Universal (National) System/ADA System

• This system was introduced by the American Dental Association in 1968. It is most popular in the United States.
• Universal numbering system uses a unique letter or number for each tooth.

• Numbering starts from maxillary right posterior tooth where tooth number 1 is the patient's upper right third molar and follows around the upper arch to the upper left third molar, tooth 16, descending to the lower left third molar, tooth 17, and following around the lower arch to the lower right third molar, tooth 32.
• If a third molar ("wisdom tooth") is missing, the first number will be 2 instead of 1, acknowledging the missing tooth.
• If teeth have been extracted or teeth are missing, the missing teeth will be numbered as well.
• In the original system, children's 20 primary teeth were numbered in the same order, except that a small letter "d" followed each number, thus a child's first tooth on the upper right side would be 1d and the last tooth on the lower right side would be 20d.

Photograph showing tooth notation according to universal system

Federation Dentaire International (FDI) System

• This two-digit system was first introduced in 1971 and subsequently adopted by theAmerican DentalAssociation (1996).
• FDI system is known as a 'Two-Digit' system because it uses two digits; the first number represents a tooth's quadrant, and the second number represents the number of the tooth from the midline of the face.

• Both digits should be pronounced separately in communication. For example, the lower left permanent second molar is '37'; it is not termed as 'thirty-seven', but 'three seven'.

Permanent Teeth

• In FDI notation, teeth are numbered as 1, 2,….8 where; 1- central incisor, 2- lateral incisor, 3- canine, 4 and 5 - 1st and 2nd premolars respectively 6, 7, and 8- 1st, 2nd and 3rd molars.

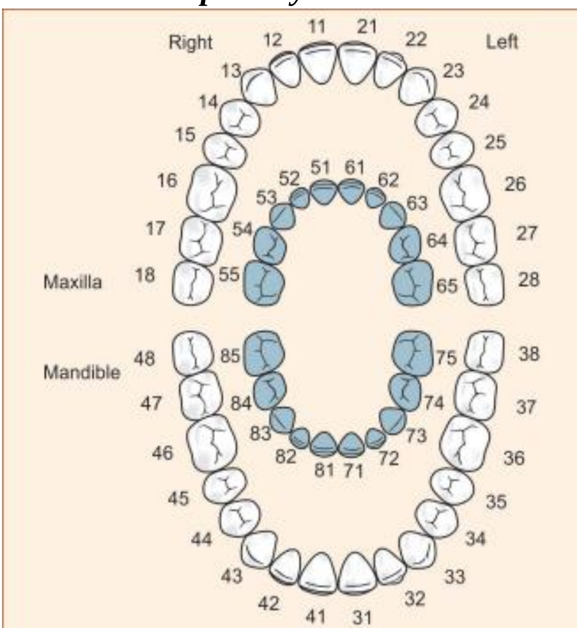
• Quadrants are designated 1 to 4, 1- upper right, 2- upper left 3- lower left 4- lower right.

• This results in tooth identification a two-digit combination of the quadrant and tooth, e.g. the upper right canine is '13' (one three) and the upper left canine is '23' (two three).

Deciduous Teeth

• In the deciduous dentition the numbering is correspondingly similar except that the quadrants are designated 5, 6, 7 and 8. Teeth are numbered from number 1 to 5, 1 being central incisor and 5 is second molar

Presentation of FDI system of tooth nomenclature for permanent and primary teeth



NOMENCLATURE OF TOOTH SURFACES

The clinical crown of each tooth is divided into surfaces that are designated according to their related anatomic structures and landmarks.

- Buccal surface: Tooth surface facing the check.
- Labial surface: Tooth surface facing the lip.
- Facial surface: Labial and buccal surface collectively form the facial surface.
- Mesial surface: Tooth surface towards the anterior midline.
- Distal surface: Tooth surface away from the anterior midline.
- Lingual surface: Tooth surface towards the tongue.
- Occlusal surface: Masticating surface of posterior teeth (in molars and premolars).
- Incisal surface: Functioning/cutting edge of anterior tooth of incisors and canines (cuspids).
- Gingival surface: Tooth surface near to the gingiva.
- Cervical surface: Tooth surface near the cervix or neck of the tooth.

Anatomic crown: It is part of tooth that is covered with enamel. It extends from cementoenamel junction (CEJ) to occlusal or incisal surface

Clinical crown: It is part of tooth that is visible in oral cavity. In case of gingival recession, the clinical crown is longer than anatomical crown.

Topic 7. Clinical features of the structure of incisors and canines of the upper and lower jaw.

Each incisor has five surfaces, each one named according to the anatomical structure that it faces:

- Labial surface - faces the lips.
- Lingual surface - faces of the mandibular incisors face the tongue. The corresponding maxillary incisors have a palatal surface instead of a lingual one that faces the hard palate of the oral cavity.
- Mesial surface - medial surfaces of the incisors. This surface is located closer to the front of the mouth and midline.
- Distal surface - the surface located lateral or distal to the midline and closer to the back of the mouth. The mesial and distal surfaces of two adjacent incisors create a contact zone. The exceptions are the central incisors, where the contact zone is formed by their two mesial surfaces.
- Biting or incisal surface - the portion of the crown furthest away from the apex. This portion of incisors is sharp and straight to facilitate cutting food. The junction of the incisal and labial surfaces is called the incisal edge.

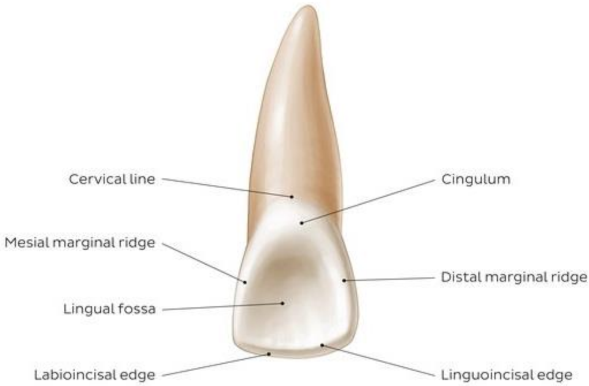
Maxillary central incisor

The two maxillary central incisors are part of the maxillary dental arcade, either side of the midline. They are the most prominent teeth, having a rectangular or square shape. Each maxillary central incisors measures approximately 22.5 mm in length, half of which (10-11 mm) represents the crown.

Labial surface. Maxillary central incisors have the largest mesiodistal distance out of all members of this group, but the least convex labial surface. However, the crown surface of the labial face is smooth. The mesial and distal crests of curvature on this face provide the contact points between neighboring incisors. The crown portion located mesially on the labial face has a small degree of convexity. In turn, the portion located distally is a lot more convex than the mesial part. The mesial and distal portions of the crown contribute to the formation of the mesioincisal and distoincisal angles, respectively.

The incisal portion of the crown may have protuberances (mamelons), but they are usually obliterated in adults. Therefore, this portion is usually straight and regular. The cervical portion of the crown is semicircular, following the curvature of the root. The root appears conical when viewed from the labial surface, with a blunt apex. The mesial and distal outlines of the root are regular.

Lingual surface. In contrast to the smooth labial surface, the lingual surface is full of convexities and concavities. In addition, a convexity (cingulum) is located below the cervical portion of the crown. Marginal ridges extend mesially and distally away from the cingulum. The shallow lingual fossa is located between the marginal ridges and below the cingulum. Apart from that, the remaining crown lines are identical to the ones on the labial surface, discussed previously.



Mesial surface. The mesial aspect of the maxillary central incisors is triangular. The base is located at the cervix and the apex at the incisal ridge. A characteristic feature of these specific incisors is that the incisal ridge of the crown and the center of the tooth are perfectly aligned.

The crests of curvature of the mesial surface are coronal to the cervical line of the crown. They are located on the labial and lingual portions of the mesial aspect. After curving for 0.5 mm, the crests of curvature continue as the labial and lingual outlines. The former is slightly convex. However, the lingual outline is convex above the intersection point with the cingulum, then becomes concave, and ultimately finishes convex again close to the incisal edge. The cervical line of the mesial surface has the greatest curvature out of all surfaces and teeth in the oral cavity. The line points incisally. From the perspective of the mesial surface, the root appears cone shaped with a bluntly rounded apex.

Distal surface. The crown outlines present on the distal surface are almost identical to the ones on the mesial surface. The main difference is the curvature of the cervical line, which is less on the distal surface. In addition, the maxillary central incisors appear bigger when viewed from this perspective because a greater portion of the labial surface is visible from this angle.

Incisal surface. The crown of the maxillary central incisors appear bulkier when viewed from the incisal surface. The mesial and distal contact areas are marked by broad surfaces. The triangular outline of the incisal surface is quite uniform, except at the lingual portion which exhibits some irregularities.

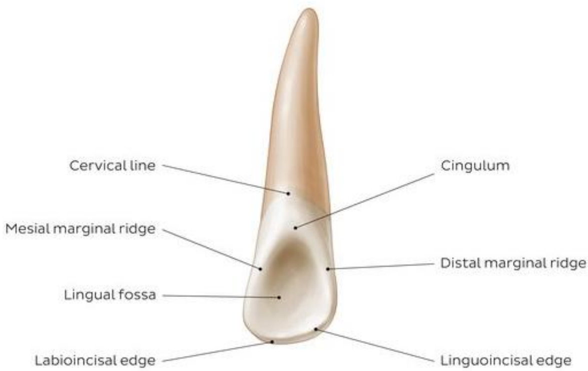
Maxillary lateral incisors

They have a very similar structure to their group neighbors, but are smaller. To be exact, the maxillary lateral incisors measure 21 mm in length. In addition, the proportion of root to crown lengths is greater in the maxillary lateral incisors. They have the second most varied structure in the entire oral cavity, after the third molar.

Labial surface. The labial surface is more curved compared to the maxillary central incisors. However, they have similar proportions. The incisal ridge and angles are rounded on the mesial and distal portions of the labial surface of the crown. The mesial outline has a rounded mesioincisial angle and a crest. The distal outline is round, having a cervical crest of contour in the center of the middle third. The labial portion of the crown has a greater convexity compared to the maxillary central incisors.

The root of these teeth tapers off apically from the cervical line. Two thirds down its length, the root curves distally, becoming pointed at its apex.

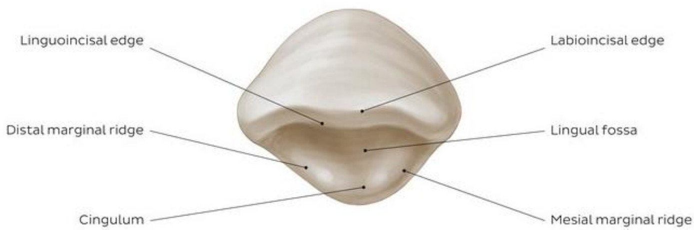
Lingual surface. The lingual aspect of the crown contains prominent distal and mesial marginal ridges. In addition, the cingulum is also markedly developed and joins the lingual fossa. The latter exhibits several deep developmental grooves and it is more concave and circumscribed than its counterpart on the maxillary central incisors. The cingulum can also contain developmental grooves, especially on its distal side. They can extend up to the entire root.



Mesial surface. The mesial surfaces of the maxillary lateral incisors share similar features to their central neighbors, with some exceptions. They have slightly shorter crowns and labiolingual distances, but longer roots. The cervical line of the mesial surface curves towards the incisal ridge, but to a lesser extent than the one on the maxillary central incisors. The incisal ridge is also thicker. If you take a look at the root from the mesial surface, it resembles a cone with a rounded apex. Its labial outline also appears straight.

Distal surface. From the distal surface, the crown appears wide compared to the other surfaces. It also contains a developmental groove distally, which projects onto the root.

Incisal surface. The incisal surface of the maxillary lateral incisors is almost identical to the corresponding surface on the maxillary central incisors. However, their labial and lingual convexities are more pronounced, hence it is not as straight or uniform. In addition, the incisal surface of these teeth can resemble small canines.



Mandibular central incisors

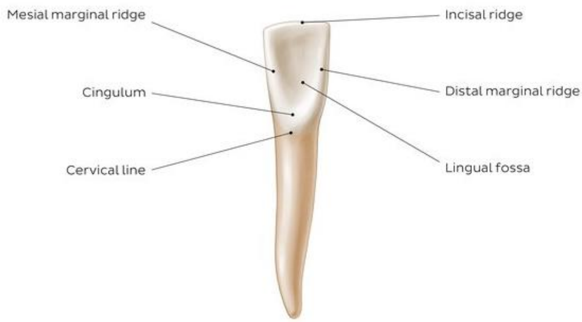
Mandibular incisors are part of the mandibular dental arch and correspond to the maxillary ones. Upon normal occlusion of the mouth, the incisal surfaces of the four pairs of incisors end up parallel to each other. The mandibular central incisors are located on either side of the midline of the mandible. They are the smallest teeth out of all of them, averaging approximately 21 mm in length.

Labial surface. The labial surface is regularly shaped and smooth. As it travels towards the root, it flattens and then becomes convex. The labial surface contains sharp distal and mesial incisal angles which taper off into the apical part of the root.

The incisal ridge travels straight and perpendicular to the long axis of the tooth. The distal and mesial portions of the crown connect the incisal angles to the contact areas of the teeth. Then, they taper off below the contact areas until the cervix. They continue straight until the apical portion of the root, where they usually curve distally. The labial surface of the root is convex and regular.

Lingual surface

The smooth lingual surface of the crown features a concavity at the incisal third between the marginal ridges. As the surface progresses towards the cervical third, it first becomes flat, then convex. The maxillary central incisors is almost devoid of developmental lines and grooves.



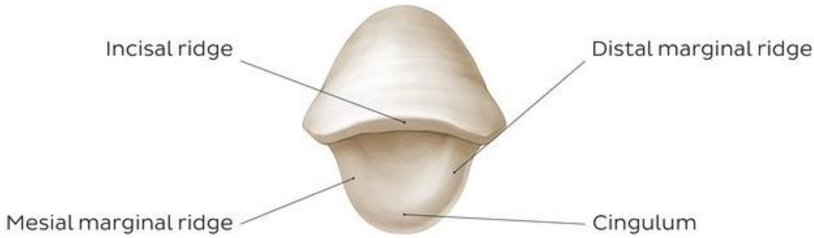
Mesial surface. The mesial surface of the crown is quite varied, ranging from convex and smooth to broad and flat cervical to the contact area. It becomes concave up until a point above the cervical line. When looking at the mesial surface, the outline of the labial face starts off straight, before sloping between the crest of the curvature and incisal ridge.

The lingual outline is partially inclined labially above the cingulum, continuing straight further down the crown. The shape of the incisal ridge is round and its center is located lingually with regards to the centre of the tooth. The cervical line shows a distinguishable curvature.

From the perspective of the mesial surface, the root appears straight, flat and with a uniform diameter. However, the root tapers off close to the apical third, becoming round or pointed at the end. The mesial surface of the root has developmental depressions along its length

Distal surface. The distal surface has a cervical line that curves in an incisal direction. On the root, there is a developmental depression with a deeply marked central groove. Apart from that, the distal surface is very similar to the incisal surface described below.

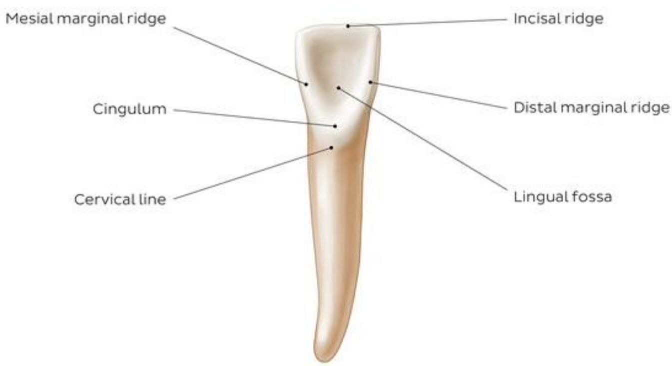
Incisal surface. The two mesial halves of the crown are identical, meaning that this entire surface of the mandibular central incisor is symmetrical. The incisal edge runs perpendicular to the labiolingual axis. The latter has greater dimensions compared to the mesiodistal axis. In the cervical third of the crown, the labial portion is wide. The lingual area of the crown contains the cingulum. In contrast, the labial surface of the incisal third is convex, while the lingual surface of the same region is concave.



Mandibular lateral incisor

They are located on the same mandibular dental arch but more laterally. They closely resemble the mandibular central incisors and perform their function as a team, hence only the differences will be pointed out. The mandibular lateral incisors measure approximately 21 mm in length.

Labial and lingual surfaces. These two crown surfaces have a greater mesiodistal diameter in the distal half, by about 1 mm, compared to the mandibular central incisors.



Incisal surface and internal structure. The mandibular lateral incisors contain an identifiable feature on their incisal surfaces. In contrast to their central counterparts, the incisal edge of these incisors is straight, following the trajectory of the mandibular dental arch. Apart from these, their incisal surfaces are almost identical.

The pulp chambers of the mandibular lateral incisors are identical to the mandibular central ones. The only exception is that they are larger. These incisors also have either one or two roots that can curve either labially or distally.

The maxillary and mandibular canines bear a close resemblance to each other, and their functions are closely related. The four canines are placed at the "corners" of the mouth; each one is the third tooth from the median line, right and left, in the maxilla and mandible. They are commonly referred to as the cornerstone of the dental arches.1 They are the longest teeth in the mouth; the crowns are usually as long as those of the maxillary central incisors, and the single roots are longer than those of any of the other teeth. The middle labial lobes have been highly developed incisally into strong, well-formed cusps. Crowns and roots are markedly convex on most surfaces.

The shape of the crowns, with their single pointed cusps, their locations in the mouth, and the extra anchorage furnished by the long, strongly developed roots, makes these canines resemble those of the carnivore. This resemblance to the prehensile teeth of the carnivore gives rise to the term canine.

Because of the labiolingual thickness of crown and root and the anchorage in the alveolar process of the jaws, these teeth are perhaps the most stable in the mouth. The crown portions of the canines are shaped in a manner that promotes cleanliness. This self-cleansing quality, along with the efficient anchorage in the jaws, tends to preserve these teeth throughout life. When teeth are lost, the canines are usually the last ones to go. They are very valuable teeth, when considered either as units of the natural dental arches or as possible assistants in stabilizing replacements of lost teeth in prosthetic procedures.

In function, the canines support the incisors and premo-lars, since they are located between these groups. The canine crowns have some characteristics of functional form, which bears a resemblance to incisor form and also to the premolar form.

Maxillary Canine

The maxillary canine (dens caninus maxillae) has a long, sturdy root with a stress-resistant periodontium. The root apex is slightly curved distally, reflecting the root characteristic. The pulp cavity widens in the coronal region. Viewed approximally, it is noticeable that the labiopalatal diameter is largest at the cervix. This gives the tooth its statically favorable chisel shape.

The vestibular surface exhibits the striking angular form: The cutting edge is made up of two sides of differing length inclined toward each other. The mesial side is shorter and does not recede as steeply as the longer distal side. The transitions between the cutting edge and the approximal surfaces thus lie at different heights. The mesial edge is shifted incisally, while the distal edge is displaced in a cervical direction; the mesial contact point is displaced more toward the incisal. One angle characteristic can be identified because the distal transition of the incisal margin is clearly rounded, unlike the sharp-edged mesial transition.

From the tip of the incisal edge, the sturdy medial ridge runs cervically as it changes into the prominent transverse convexity of the cervix. Poorly developed cervical grooves are found here. The medial ridge divides the labial surface into a narrow mesial and a broad distal facet.

The horizontal curvature of the canine is strongly developed, with both facets receding from the central ridge to the adjacent teeth. Both facets contain a distinct marginal ridge in the vertical direction.

The neck of the tooth is arched and contains the strong vertical curvature to protect the marginal periodontium. The approximal edges run closely together from the contact points in a cervical direction; in the middle, the distal approximal edge is rather concave centrally, whereas the mesial edge runs virtually straight.

The mesial approximal surface exhibits the pronounced wedge shape of the canine. The mesial incisal edge lies inferior to the tip of the tooth. The vertical convexities of the vestibular and lingual surfaces that protect the marginal periodontium can be seen. While the vestibular convexity runs evenly incisocervically, the lingual surface in the cervical third bends inward and only achieves the outer convexity through the tubercle. The heavy tubercle gives the tooth its bulky appearance. The cervical margin curves in an incisal direction. The tip of the canine lies centrally in relation to the base of the crown. Weak cervical grooves can be seen labially.

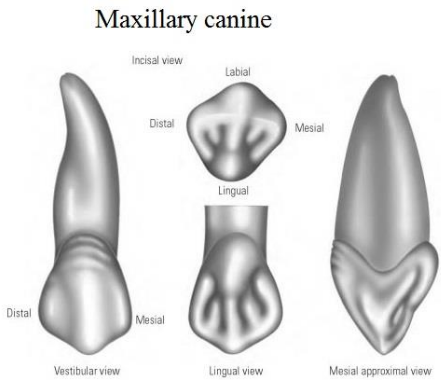
The lingual surface is smaller than the labial surface but with the same basic triangular shape. The tubercle is strongly developed. The marginal ridges are very prominent, as is a central ridge starting from the tubercle. This ridge is described as the canine guidance ridge because it is here that a certain guidance of the opposing teeth (antagonists) takes place during mandibular movement. The distal marginal ridge is developed into a strong masticatory edge incisally.

The central ridge develops cusplike into the incisal tip, which approximates to a masticatory surface in the distal portion of the crown. The cervical line is arched, and the tooth bulges out below the line to protect the gingiva.

The incisal view of the maxillary canine shows the strongly developed curvature characteristic, ie, the mesial facet is narrower than the distal, and both facets recede laterally, following the curvature of the dental arch. The strong medial ridge can be seen labially, and the cusplike tubercle is visible palatally.

The approximal surfaces are acutely angled mesially and slightly curved distally. A gentle internal curvature of the distal approximal surface serves as the contact area to the premolar. The incisal margin is curved in line with the curvature characteristic and in the distal portion is wider than the masticatory edge.

The root of the maxillary canine is usually the longest of any root with the possible exception of that of the mandibular canine, which may be as long at times. The root is thick labiolingually, with developmental depressions mesially and distally that help furnish the secure anchorage this tooth has in the maxilla.



Mandibular canine

The mandibular canine crown is narrower mesiodistally than that of the maxillary canine, although it is just as long in most instances and in many instances is longer by 0.5 to 1 mm. The root may be as long as that of the maxillary canine, but usually it is somewhat shorter. The labiolingual diameter of crown and root is usually a fraction of a millimeter less.

The lingual surface of the crown is smoother, with less cingulum development and less bulk to the marginal ridges. The lingual portion of this crown resembles the form of the lingual surfaces of the mandibular lateral incisors.

The cusp of the mandibular canine is not as well developed as that of the maxillary canine, and the cusp ridges are thinner labiolingually. Usually the cusp tip is on a line with the center of the root, from the mesial or distal aspect, but sometimes it lies lingual to the line, as with the mandibular incisors.

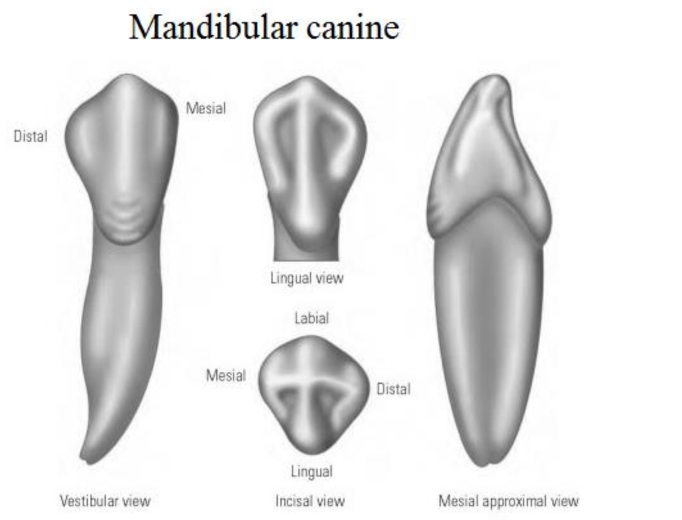
The mandibular canine (dens caninus mandibulae) resembles the maxillary canine in all characteristics; in terms of form and function, the canines bear the closest resemblance to each other of any teeth. However, the mandibular canine is much more slender and narrower than the maxillary canine, both in the crown and in the root. It has a stronger angle characteristic, with the distal transition from the incisal margin to the approximal surface located more apically than the mesial. Its root is not only much shorter, but in some cases it can be divided. The tooth may even become two-rooted. The stronger horizontal curvature characteristic is also evident; the canine tip generally is in line with the middle of the crown base. The tip of the mandibular canine abrades the tubercle and palatal medial ridge of the maxillary canine, and the teeth show corresponding wear facets.

The vestibular surface shows the typical canine shape but is narrower at the contact points in comparison with the maxillary canine; the approximal edges do not run parallel. The mesial incisal margin is shorter and higher than the distal margin, which also recedes more sharply than in the maxillary canine. This means that the distal approximal surface is extremely small. The medial ridge, marginal ridges, vertical grooves, and cervical grooves are prominent. The horizontal transverse convexity is more pronounced on the mandibular than on the maxillary canine.

The lingual surface is not as strongly developed and is less concave than in the maxillary tooth. There is a weak medial ridge, hardly any marginal ridges, and a very flattened dental tubercle; variations in ridge formation are very rare.

From the mesial approximal view, the crown appears to be inclined lingually. However, the tip of the mandibular canine, like that of the corresponding maxillary tooth, is aligned with the midline of the crown base. The appearance of an incline results from the flattened dental tubercle and the vertical curvature of the labial surface.

The incisal view shows the stronger horizontal curvature of the labial surface. The lingual surface appears to taper considerably, and the approximal surfaces are depressed. The incisal margin is more strongly angled than in the maxillary canine; the mesial edge faces the anterior teeth, while the distal edge is far more curved toward the posterior teeth. The strong development of the labiolingual diameter at the crown base is noticeable.



Topic 8. Clinical features of the structure of premolars and molars of the upper and lower jaw. Maxillary premolars

The premolars are so named because they are anterior to the molars in the permanent dentition. The primary difference in development is the well-formed lingual cusp, developed from the lingual lobe, which is represented by the cingulum development on incisors and canines.

The middle buccal lobe on the premolars, corresponding to the middle labial lobe of the canines, remains highly developed, with the maxillary premolars resembling the canines when viewed from the buccal aspect. The buccal cusp of the maxillary first premolar, especially, is long and sharp, assisting the canine as a prehensile or tearing tooth. The mandibular first premolar assists the mandibular canine in the same manner. The maxillary premolar crowns are shorter than those of the maxillary canines, and the roots are also shorter. The root lengths equal those of the molars. The crowns are a little longer than those of the molars.

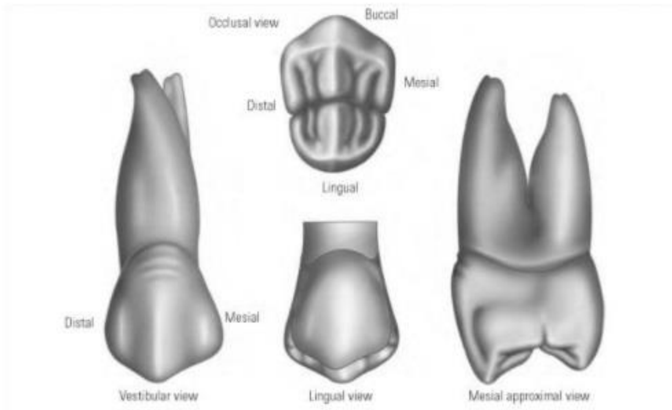
Maxillary First Premolar

The maxillary first premolar has two cusps, a buccal and a lingual, each being sharply defined. The buccal cusp is usually about 1 mm longer than the lingual cusp. The crown is angular, and the buccal line angles are prominent. The crown is shorter than that of the canine by 1.5 to 2 mm on the average. Although this tooth resembles the canine from the buccal aspect, it differs in that the contact areas mesially and distally are at about the same level. The root is shorter. If the buccal cusp form has not been changed by wear, the mesial slope of the cusp is longer than the distal slope. The opposite arrangement is true of the maxillary canine. Generally, the first premolar is not as wide in a mesiodistal direction as the canine. Most maxillary first premolars have two roots and two pulp canals. When only one root is present, two pulp canals are usually found anyway. The maxillary first premolar (dens praemolaris medialis) usually has a divided root apex, and in some cases there may be two roots. Very rarely three root apices may be found. A buccal and palatal (lingual) root can be distinguished with independent, very branched root canals, which makes root canal treatment very difficult. The vestibular (buccal) surface strongly resembles the labial surface of the canine but is slightly smaller. Curvature and angle characteristics are reversed. The medial ridge is displaced distally, the mesiobuccal cusp ridge is longer than the distal, and the mesial facet is larger than the distal. The cervical margin is curved apically, and cervical grooves are present. The lingual surface is smaller than the vestibular surface and more curved; the horizontal curvature is more pronounced and more rounded. The medial ridge and the lingual cusp are displaced mesially so that the distolingual cusp ridge appears longer. The cervical line is curved buccally. The approximal surface is almost rectangular. The contours of the buccal, lingual, and occlusal surfaces can be seen.

The occlusal surface (masticatory or chewing surface) has an oval outline and is wider buccally and rounded and narrower palatally. The horizontal curvature characteristic is reversed. The cusps are located on half of the buccal and lingual portions of the masticatory surface. The buccal cusp is larger, higher, and more angular, with prominent triangular ridges, cusp ridges, and crests, whereas the lingual cusp is rounded and looks more delicate. There may be displacement of the tip of the lingual cusp distally and the central developmental groove lingually.

The central developmental groove branches before the marginal ridges into two small supplemental developmental grooves running crosswise, giving the whole groove formation the appearance of a broad. Growth-related fossae are formed in the branching points of the central developmental groove; these are the deepest parts of the occlusal surface. The mesial approximal marginal ridge is concave for contact with the canine, whereas the distal ridge is convexly shaped. Growth-related depressions form on the triangular ridges, which can sometimes reach the same depth as a supplemental developmental groove.

Maxillary 1st premolar

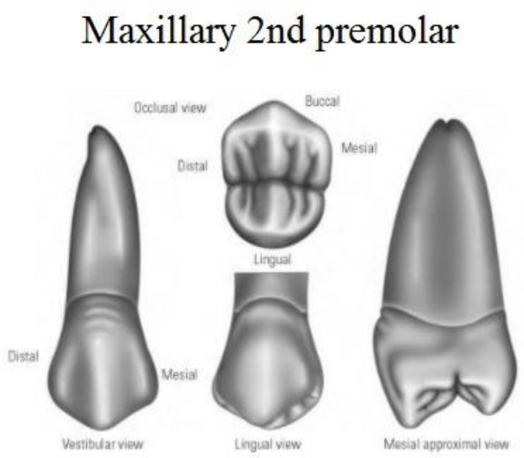


Maxillary Second Premolar

The maxillary second premolar may have a crown that is noticeably smaller cervico-occlusally and also mesiodistally; however, it may also be larger in those dimensions. Usually the root of the second premolar is as long as, if not a millimeter or so longer than, that of the first premolar. The two teeth have about the same dimensions on the average, except for the tendency toward greater length of the second premolar root.

The maxillary second premolar (dens praemolaris lateralis) is smaller, more compact, and more symmetric than the first premolar; the cusps are almost of the same height and virtually the same size, and the central developmental groove lies in the middle. The second premolar is a rudimentary tooth. It has only a single developed root. The vestibular (buccal) surface is similar to that of the first premolar but smaller and without pronounced angle and curvature characteristics. The lingual surface is also similar to that of the first premolar, although the middle ridge lies centrally.

The approximal surface shows cusps of unequal height, the buccal cusp being more angular than the rounded lingual cusp. The central developmental groove lies in the middle and is very deep, which indicates a risk of caries. Buccal and lingual curvatures are normal. The occlusal surface is more symmetric than on the first premolar but with the same characteristics: prominent buccal and rounded lingual cusps. The central development groove lies in the middle of the occlusal surface.



Mandibular Premolars

The main difference between the mandibular and maxillary premolars is that the mandibular ones have an almost circular crown outline. Furthermore, they are always single-rooted. Unlike the maxillary premolars, the mandibular first and second premolars differ considerably from each other.

The first premolar has a large buccal cusp, which is long and well formed, with a small, nonfunctioning lingual cusp that in some specimens is no longer than the cingulum found on some maxillary canines. The second premolar has three well-formed cusps in most cases, one large buccal cusp and two smaller lingual cusps. The form of both mandibular premolars fails to conform to the implications of the term bicuspid, a term that implies two functioning cusps. The mandibular first premolar has many of the characteristics of a small canine, because its sharp buccal cusp is the only part of it occluding with maxillary teeth. It functions along with the mandibular canine. The mandibular second premolar has more of the characteristics of a small molar, because its lingual cusps are well developed, a fact that places both marginal ridges high and produces a more efficient occlusion with antagonists in the opposite jaw. The mandibular second molar functions by being supplementary to the mandibular first molar.

Mandibular First Premolar

The vestibular (buccal) surface of the first premolar is very similar to that of the mandibular canine. The first premolar is only slightly more compact, and the contact areas may be rather tapered. Overall the surface is highly convex. The ridge shaped cusp has a rounded tip, while the mesial cusp ridge is shorter than the distal (angle characteristic). One prominent central ridge divides the buccal surface again into two unequally sized facets with vertical depressions. The mesial contact area lies higher than the distal. In the cervical third, a short transverse and longitudinal convexity can be seen with poorly developed cervical grooves. The arched line of the cervix converges with concave, curved approximal margins. The curvature characteristic, like the angle characteristic, is well developed.

The lingual surface is very small and narrow and shows the very slightly developed lingual cusp. It tapers more cervically than buccally. The buccal cusp can be seen from the lingual aspect; only the central developmental groove is concealed by the small lingual cusp.This cusp has no opposing contact. As a result of the tooth inclination, the lingual cusp greatly overhangs the cervix; however, it is highly concave in the incisal third, so that a pronounced vertical curvature is visible. The approximal surface reveals both the large buccal and the small lingual cusps. The lingual bend in the crown axis corresponding to the tooth inclination is most clearly visible approximally, as is the prominent longitudinal convexity—buccally in the cervical area and lingually in the occlusal. The approximal surfaces are prominent at the contact area and concave cervically.

The occlusal surface shows the circular outline of the crown. The lingual cusp is much smaller than the buccal and also more truncated. The occlusal surface is therefore markedly inclined toward the floor of the mouth. A sturdy cusp crest runs lingually from the buccal cusp; as a result, the central developmental groove is sometimes interrupted. The central developmental groove is markedly displaced lingually.

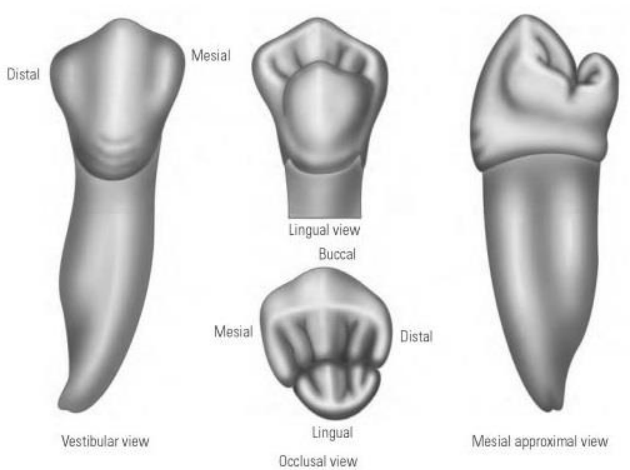
The approximal marginal ridges are sturdy and recede in a lingual direction. This produces two distinct fossae, with the mesial one being more superior. The distal marginal ridge also lies more inferiorly. There are three variations on the arrangement of the lingual cusp:

There is a very regular arrangement of the lingual cusp, where the line connecting the two cusps divides the tooth symmetrically.

The lingual cusp is small and rudimentary like a tubercle; there is only a suggestion of a central developmental groove.

The lingual cusp is displaced distally so that the crown takes on a triangular shape with the buccal cusp tip displaced mesially.

Mandibular 1st premolar



Mandibular Second Premolar

The mandibular second premolar resembles the mandibular first premolar from the buccal aspect only. Although the buccal cusp is not as pronounced, the mesiodistal measurement of the crown and its general outline are similar. The tooth is larger and has better development in other respects. This tooth assumes two common forms. The first form, which probably occurs most often, is the three-cusp type, which appears more angular from the occlusal aspect. The second form is the two-cusp type, which appears more rounded from the occlusal aspect. The single root of the second premolar is larger and longer than that of the first premolar. The root is seldom, if ever, bifurcated, although some specimens show a deep developmental groove buccally. Often a flattened area appears in this location

The mandibular second premolar is larger than the first premolar, but the resemblance is not as strong as that seen between the first and second premolar in the maxilla. The occlusal surface is more horizontal; there is only a slight difference in height between buccal and lingual cusps.

The tooth assumes two common forms. One has two cusps, and the other has three cusps, with one buccal and two lingual cusps. Very rarely there may be a four-cusp type with one buccal and three lingual cusps. The root of this tooth is roundish and, consistent with the stronger development of the second premolar, is longer and thicker than the root of the first premolar. The root is only bifurcated in rare cases.

The vestibular (buccal) surface resembles a compact, broad canine, with a ridge-shaped cusp ridge and rounded tip. The angle characteristic is pronounced so that the mesial angle lies slightly higher than the distal, as do the contact points. The formation of ridges and depressions is normal, and a curvature characteristic is present. The approximal margins are indented and taper down to the curved cervical margin.

The lingual surface is narrower and slightly shorter and has a pronounced transverse convexity. In the three-cusp type, the two lingual cusps are recognizable and make the surface appear divided. It is noticeable that the distolingual cusp is smaller and lower than the mesial.

The surface also appears to overhang in the cervical area because of the tooth inclination and the strong vertical convexity. The buccal cusp can be seen in the lingual view because it rises above the lingual cusps.

The occlusal surface has all the features of a masticatory surface: cusps, cusp crests and ridges, marginal ridges, and grooves. The two-cusp type resembles the form of the maxillary second premolar. In the three-cusp type, the buccal cusp is the largest, while the linguodistal is the smallest.

The three cusps are formed by a large main developmental groove that diverges at a right angle from the central developmental groove: This main groove often originates in the middle or slightly more distally. As a result, the groove formation appears to create a Y-shape, which divides the three cusps. A third, very rare form is the four-cusp occlusal surface with three lingual cusps.

The approximal surface shows the crown-root angulation, ie, the lingual incline of the crown. In this view, the tooth inclination of the second premolar is also identifiable, but it is less developed than on the mesial neighbor.

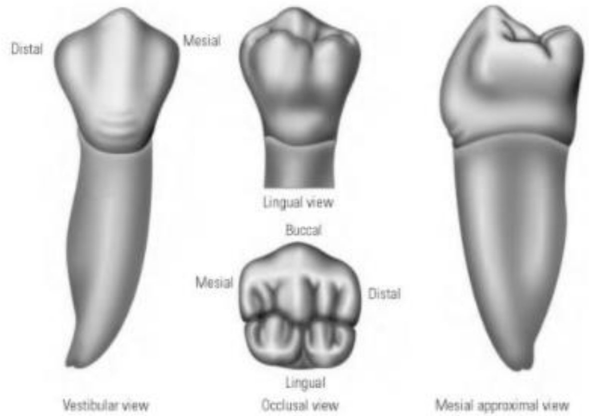
The vertical curvatures of the buccal and lingual surfaces can also be seen. The lingual contour overhangs in the occlusal area. The occlusal surface is only slightly tilted lingually. The buccal part of the occlusal surface is wider, so that the central developmental groove is displaced slightly lingually.

The approximal marginal ridge contains the contact point and tapers so that the approximal surface is concavely indented.

The occlusal characteristics of the two-cusp type are as follows:

1. The outline of the crown is rounded lingual to the buccal cusp ridges.
2. Some lingual convergence of mesial and distal sides occurs, although no more than is found in some variations of the square type.
3. The mesiolingual and distolingual line angles are rounded.
4. One well-developed lingual cusp is directly opposite the buccal cusp in a lingual direction.

Mandibular 2nd premolar



The maxillary molars differ in design from any of the teeth previously described. These teeth assist the mandibular molars in performing the major portion of the work in the mastication and comminution of food. They are the largest and strongest maxillary teeth, by virtue both of their bulk and of their anchorage in the jaws. Although the crowns on the molars may be somewhat shorter than those on the premolars, their dimensions are greater in every respect. The root portion may be no longer than that of the premolars, but instead of one root or a bifurcated root, the maxillary molar root is broader at the base in all directions and is trifurcated into three well-developed prongs that are actually three full-size roots emanating from a common broad base above the crown.

Generally speaking, the maxillary molars have large crowns with four well-formed cusps. They have three roots, two buccal and one lingual. The lingual root is the largest. The crowns have two buccal cusps and two lingual cusps. The outlines and curvatures of all the maxillary molars are similar. Developmental variations will be set forth under descriptions of the separate molars.

Maxillary First Molar

The crown of this tooth is wider buccolingually than mesiodistally. Usually the extra dimension buccolingually is about 1 mm. This, however, varies in individuals. From the occlusal aspect, the inequality of the measurements in the two directions appears slight. Although the crown is relatively short, it is broad both mesiodistally and buccolingually, which gives the occlusal surface its generous dimensions.

The maxillary first molar is normally the largest tooth in the maxillary arch. It has four well-developed functioning cusps and one supplemental cusp of little practical use. The four large cusps of most physiological significance are the mesiobuccal, the distobuccal, the mesiolingual, and the distolingual.

A supplemental cusp is called the cusp or tubercle of Carabelli. This morphological trait can take the form of a well-developed fifth cusp, or it can grade down to a series of grooves, depressions, or pits on the mesial portion of the lingual surface. This trait has been used to distinguish populations. This supplemental cusp is found lingual to the mesiolingual cusp, which is the largest of the well-developed cusps. Usually, a developmental groove is found, leaving a record of cusp development, unless it has been erased by frictional wear. The fifth cusp or a developmental trace at its usual site serves to identify the maxillary first molar. A specimen of this tooth showing no trace of its typical characteristic would be rare.

The three roots of generous proportions are the mesiobuccal, distobuccal, and lingual. These roots are well separated and well developed, and their placement gives this tooth maximum anchorage against forces that would tend to unseat it. The roots have their greatest spread parallel to the line of greatest force brought to bear against the crown diagonally in a buccolingual direction. The lingual root is the longest root. It is tapered and smoothly rounded. The mesiobuccal root is not as long, but it is broader buccolingually and shaped (in cross section) so that its resistance to torsion is greater than that of the lingual root. The distobuccal root is the smallest of the three and smoothly rounded.

The curvature characteristic clearly stands out. The vestibular and lingual surfaces converge distally to create the typical rhomboid shape of the maxillary first molar. The occlusal surface recedes distally. The maxillary first molars have three roots, two buccal and one palatal.

The vestibular (buccal) surface gives the impression of being two premolars fused together because it is divided by a distinct longitudinal groove. The mesial and the distal portions of the surface have virtually the same form as a premolar. The occlusal border shows the ridge-shaped cusp form, with the mesial cusp higher and more pronounced than the rounded distal cusp. The medial ridges of the mesial and distal parts of the surface divide each of these into two facets. The mesial part of the surface is more bulging and prominent, while the distal part recedes posteriorly (curvature characteristic). The cervix curves in the middle in an occlusal direction. The cervical grooves are poorly developed.

The approximal surface has an almost rectangular shape. The typical vertical curvatures of the buccal and lingual surfaces can be seen. The buccal surface has its greatest curvature cervically, whereas occlusally it has a rather sloping and relatively sharp-edged course up to the cusps. The lingual surface bulges considerably so that the lingual cusps appear to be inclined toward the occlusal surface. The cusp tips on this tooth are also about half the tooth width apart. The mesial approximal surface is much larger (and particularly higher) than the distal; the mesial marginal ridge and hence the contact point are higher.The cervix curves evenly in an occlusal direction.

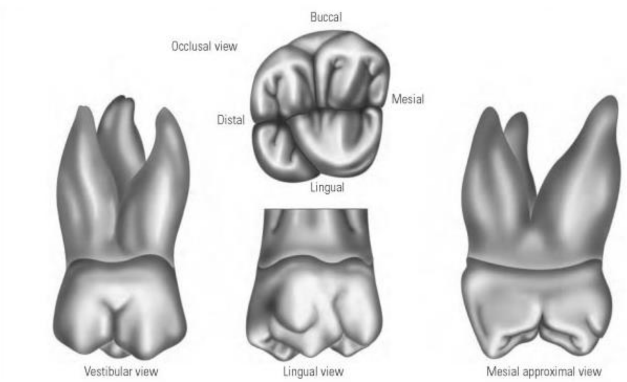
The lingual surface is smaller than the buccal surface, in keeping with the constriction caused by the dental arch. There is also some tapering toward the cervix.The longitudinal groove, which separates the two cusps, is displaced distally because the distopalatal cusp is generally only half the size of the mesial. The mesial cusp is again higher, more angular, and more noticeable. Both cusps, however, bulge inward toward the occlusal surface. The occlusal contour recedes distally. The cervical margin curves occlusally, as on the buccal surface.

The cusp of Carabelli (tuberculum anomale) is an additional, small, low-lying cusp on the mesial part of the lingual surface of the maxillary first molar.

The occlusal surface displays typical functional characteristics with four pronounced, differently sized cusps: two buccal shearing cusps and two palatal crushing cusps. Cusps in order of decreasing size are: mesiolingual, mesiobuccal, distobuccal, and distolingual.

The structure of the individual cusps reflects the described features. The buccal cusp ridge and crests are angular, whereas the lingual cusps appear rounded. The developmental grooves form small pits at their crossover points. Where the central developmental groove comes into contact with the buccal groove, the compact central fossa is formed. The supplemental grooves at the marginal ridges also form pronounced pits at the branching points with the central groove. The shape of the grooves produces a skewed. The marginal ridges in the approximal area are noticeable, while the mesial approximal edge is rather higher, almost straight, but the distal edge is curved outward.

Maxillary 1st molar



Maxillary Second Molar

The maxillary second molar (dens molaris laterali) has the same form as the first molar, with the only difference being that its lingual surface is less developed. The outline of the crown is often modified so that the rhomboid shape appears more acutely angled and the whole crown is far smaller than that of the maxillary first molar.

The cusp of Carabelli is absent, and the distolingual cusp is smaller, sometimes shrunken to a marginal ridge so that the occlusal surface has only three cusps. The three tooth roots are often fused.

Two types of maxillary second molars are found when the occlusal aspect is viewed: (1) The type that is seen most has an occlusal form that resembles that of the first molar, although the rhomboidal outline is more extreme. This is accentuated by the lesser measurement lingually. (2) The second type bears more resemblance to a typical third molar form. The distolingual cusp is poorly developed and makes the development of the other three cusps predominate. This results in a heart-shaped form from the occlusal aspect that is more typical of the maxillary third molar

The vestibular (buccal) surface is divided by a distinct longitudinal depression as in the maxillary first molar. The mesial cusp is higher and more pronounced than the rounded distal cusp, which recedes sharply. The mesial aspect of the surface is much more convex and prominent than the part that recedes distally. The cervical line bends occlusally in the middle. Cervical grooves are only poorly developed.

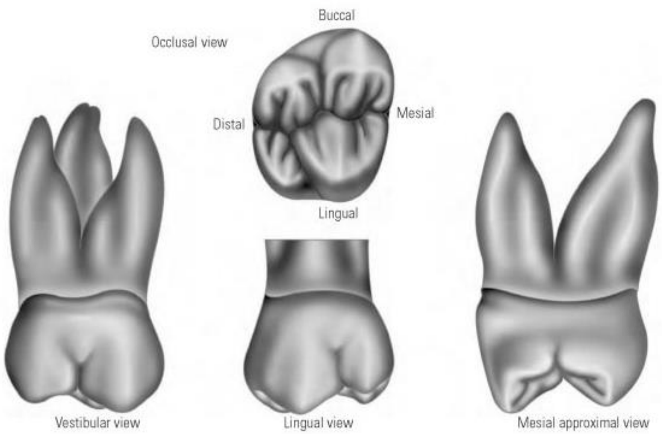
The lingual surface is much smaller than the buccal surface, tapering sharply to the cervix. The distolingual cusp may be rudimentary so that the occlusal contour sharply recedes distally. The mesial cusp is again higher, more sharp-edged, and more developed. There is rarely a cusp of Carabelli present.

The approximal surface has an almost rectangular shape. The typical vertical curvatures of the buccal and lingual surfaces can be seen. The mesial approximal surface is also much larger here than the distal surface, with the mesial contact point located much higher. The cervical line bends occlusally.

The occlusal surface also displays typical functional characteristics, usually with four differently sized cusps: two buccal shearing cusps, one lingual crushing cusp, and one distolingual cusp shortened at the marginal ridge. The central developmental groove with the main buccal groove forms the central pit. The mesial approximal marginal ridge is more pronounced and higher, almost straight, while the distal margin curves outward again.

The rhomboidal type of second maxillary molar is most common, although in comparison with the first molar, the acute angles of the rhomboid are less and the obtuse angles greater. The buccolingual diameter of the crown is about equal, but the mesiodistal diameter is approximately 1 mm less. The mesiobuccal and mesiolingual cusps are just as large and well developed as in the first molar, but the distobuccal and distolingual cusps are smaller and less well developed. Usually, a calibration made of the crown at the greatest diameter buccally and lingually of the distal portion is considerably less than one made at the greatest diameter buccally and lingually of the mesial portion, so that more convergence distally is seen than in the maxillary first molar.

Maxillary 2nd molar



Maxillary Third Molar

The maxillary third molar often appears as a developmental anomaly. It can vary considerably in size, contour, and relative position to the other teeth. It is seldom as well developed as the maxillary second molar, to which it often bears resemblance. The third molar supplements the second molar in function, and its fundamental design is similar. The crown is smaller, and the roots are shorter as a rule, with the inclination toward fusion with the resultant anchorage of one tapered root.

The predominating third molar design, when the occlusal surface is viewed, is that of a heart-shaped type of second molar. The distolingual cusp is very small and poorly developed in most cases, and it may be absent entirely.

All third molars, mandibular and maxillary, show more variation in development than any of the other teeth in the mouth. Occasionally they appear as anomalies bearing little or no resemblance to neighboring teeth.

The mandibular molars are larger than any other mandibular teeth. They are three in number on each side of the mandible: the first, second, and third mandibular molars. They resemble each other in functional form, although comparison of one with another shows variations in the number of cusps and some variation in size, occlusal design, and the relative lengths and positions of the roots.

The crown outlines exhibit similarities of outline from all aspects, and each mandibular molar has two roots, one mesial and one distal. Third molars and some second molars may show a fusion of these roots. All mandibular molars have crowns that are roughly quadrilateral, being somewhat longer mesiodistally than buccolingually. Maxillary molar crowns have their widest measurement buccolingually.

The mandibular molars perform the major portion of the work of the lower jaw in mastication and in the comminution of food. They are the largest and strongest mandibular teeth, both because of their bulk and because of their anchorage.

The crowns of the molars are shorter cervico-occlusally than those of the teeth anterior to them, but their dimensions are greater in every other respect. The root portions are not as long as those of some of the other mandibular teeth, but the combined measurements of the multiple roots, with their broad bifurcated root trunks, result in superior anchorage and greater efficiency.

Usually the sum of the mesiodistal measurements of mandibular molars is equal to or greater than the combined mesiodistal measurements of all the teeth anterior to the first molar and up to the median line.

Mandibular first molar

Normally, the mandibular first molar is the largest tooth in the mandibular arch. It has five well-developed cusps: two buccal, two lingual, and one distal. It has two well-developed roots, one mesial and one distal, which are very broad buccolingually. These roots are widely separated at the apices.

The dimension of the crown mesiodistally is greater by about 1 mm than the dimension buccolingually. Although the crown is relatively short cervico-occlusally, it has mesiodistal and buccolingual measurements that provide a broad occlusal form.

The mesial root is broad and curved distally, with mesial and distal fluting that provides the anchorage of two roots. The distal root is rounder, broad at the cervical portion, and pointed in a distal direction. The formation of these roots and their positions in the mandible serve to brace the crown of the tooth efficiently against the lines of force that might be brought to bear against it.

The vestibular (buccal) surface has the three ridge-shaped, rounded cusps that are divided by slight longitudinal grooves. The tooth recedes distally, in keeping with the angle characteristic. A pronounced longitudinal and transverse convexity can be seen in the cervical area, where there are also slight cervical grooves. The line of the cervix appears to be wavy. The distal contact point lies far more apically than the mesial one, so that the mesial approximal edge has a greater longitudinal convexity than its distal counterpart.

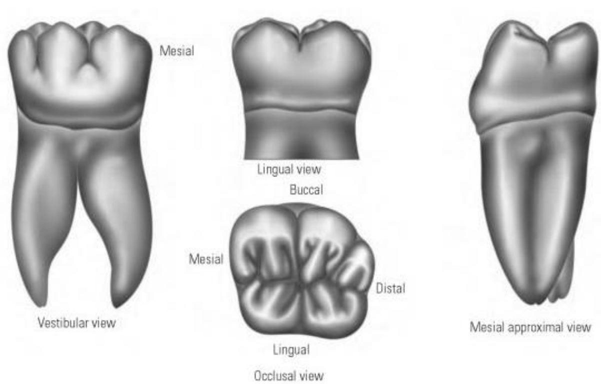
The lingual surface is divided by a longitudinal groove; it shows both of the rounded, ridgeshaped cusps. The markedly smaller surface has only a slight transverse and longitudinal convexity. The cervical line is located more coronally on the lingual side than on the buccal aspect and is undulating. The lingual surface is slightly overhanging because of the tooth inclination.

The approximal surfaces are rhomboid in keeping with the tooth inclination. The vertical curvature of the buccal surface is greatest cervically, whereas the lingual surface contour appears to be overhanging occlusally and displays no appreciable curvature. The buccal cusps are shorter and more rounded than the lingual ones. The distal approximal surface is considerably smaller. The contact points are overhanging.

The occlusal surface is almost rectangular but rounded and becomes narrower distally. It is made up of five differently sized cusps, in order of decreasing size: mesiolingual, mesiobuccal, dis-tolingual, centrobuccal, and distobuccal. The features of the cusps are typical, as is the pattern of the grooves.

The central developmental groove is divided medially by a distinct main developmental groove, which produces a cross. This is where the central pit is located. Distally another distinct main groove branches off buccally, which separates the distobuccal cusp. The central groove divides into pronounced supplemental grooves before reaching the approximal marginal ridges.

Mandibular 1st molar



Mandibular second molar

Normally, the second molar is smaller than the first molar by a fraction of a millimeter in all dimensions. It does not, however, run true to form. It is not uncommon to find mandibular second molar crowns somewhat larger than first molar crowns, and although the roots are not as well formed, they may be longer.

The crown has four well-developed cusps, two buccal and two lingual, of nearly equal development. Neither a distal nor a fifth cusp is evident, but the distobuccal cusp is larger than that found on the first molar.

The tooth has two well-developed roots, one mesial and one distal. These roots are broad buccolingually, but they are not as broad as those of the first molar, nor are they as widely separated.

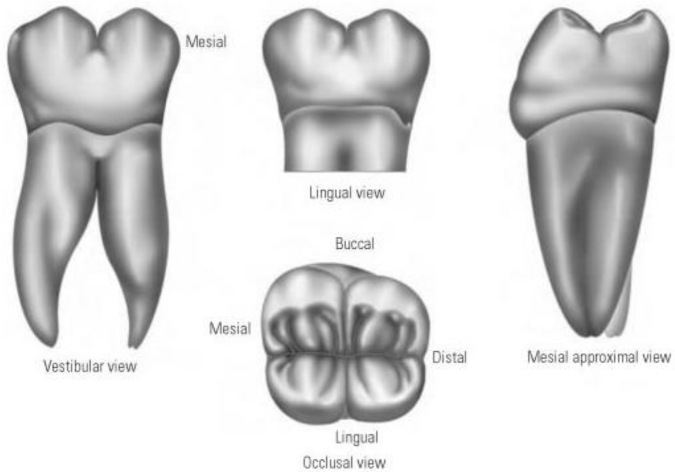
From the buccal aspect the crown is somewhat shorter cervico-occlusally and narrower mesiodistally than is the first molar

The occlusal aspect of the mandibular second molar differs considerably from that of the first molar. These variations serve as marks of identity.

The small distal cusp of the first molar is not present, and the distobuccal lobe development is just as pronounced, and sometimes more so, than that of the mesiobuccal lobe.

No distobuccal developmental groove is evident occlusally or buccally. The buccal and lingual developmental grooves meet the central developmental groove at right angles at the central pit on the occlusal surface. These grooves form a cross, dividing the occlusal portion of the crown into four nearly equal parts.

Mandibular 2nd molar



Mandibular Third Molar

The mandibular third molar varies considerably in different individuals and presents many anomalies both in form and in position. It supplements the second molar in function, although the tooth is seldom as well developed, with the average mandibular third molar showing irregular development of the crown portion, with undersized roots, more or less malformed. However, its design usually conforms to the general plan of all mandibular molars, matching more closely the second mandibular molar in the number of cusps and occlusal design than it does the mandibular first molar.

Occasionally, mandibular third molars are seen that are well formed and comparable in size and development to the mandibular first molar. Many instances of mandibular third molars with five or more cusps are found, with the crown portions larger than those of the second molar. In these cases, the alignment and occlusion with other teeth is not normal, because insufficient room is available in the alveolar process of the mandible for the accommodation of such a large tooth, and the occlusal form is too variable.

Topic 9. Equipment of the dental office. Sanitary and hygienic requirements for its organization. Types of dental drills. Dental unit: structure, purpose of the components. The concept of ergonomics in dentistry. Work safety techniques. Occupational diseases of the dentist, their prevention.

Dental care is one of the most massive types of specialized medical care. The management of dental care is carried out by the Ministry of Health of Ukraine, regional, provincial, city and district health departments. In the organization of medical and preventive care of the administrative territory an important role belongs to the external chief dentist of the Ministry of Health of Ukraine, the region, etc.

The network of dental clinics has the following nomenclature:

- independent dental clinics (regional, city, district);
- dental offices in the multidisciplinary polyclinics;
- dental offices;
- self-supporting dental clinics;
- private.

Dental clinic, as a rule, consists of: surgical, therapeutic, orthopedic departments with dental laboratory, can have a periodontal office. Each dental clinic has a registry. If there is a children's department in the clinic, then it should have separate entrance, a wardrobe, a waiting room, a bathroom and not communicate with the adult department. The therapeutic department includes medical rooms, a physiotherapy room and sometimes an X-ray room. Often in the therapeutic department, a periodontist room is allocated.

According to existing regulations, the area of the dental office for one doctor should be at least 14 m2. If several chairs are installed in the office, then its area is calculated based on 7 m2 for each subsequent chair. If an additional chair has a universal dental unit, the area of the additional chair is increased to 10 m2.

The height of the cabinets must be at least 3 m, and the depth with unilateral natural light should not exceed 6 m. In therapeutic and orthopedic dental offices should be placed no more than three chairs with the obligatory separation of doctors' workplaces with opaque partitions up to 1.5 m high.

Walls of dental offices should be smooth, without cracks. All corners and junctions of walls, ceilings and floors should be rounded, without cornices and ornaments.

All materials used for interior decoration of premises must be only from the number of authorized Ukrainian Ministry of Health for use in construction. The color of the surfaces of walls and floor in treatment rooms should be light tones with a reflection coefficient of at least 40%.

Floors in dental offices should be covered with roll PVC material (vinyl plastic, linoleum) and do not have any gaps, for which all seams are welded with special burners or high-frequency welding. Covering the floor of the linoleum should climb to the walls at a height of 5 - 10 cm and be sealed with a wall flush. Plinth should be internal (under linoleum).

Doors and windows in all rooms are painted with enamels or oil paint in white. Door and window fittings must be smooth, easy to clean.

The walls and ceilings of the cabinets are plastered (brick) or rubbed (panel) with 5% sulfur powder added to the solution to bind the sorbing mercury vapor to a strong compound that is not desorbed and stained with water-based or oil paints.

In the newly organized dental clinics, the windows of the dental offices should be oriented to the northern directions in order to avoid significant differences in brightness at workplaces due to direct sunlight in other types of orientation, as well as overheating of the premises in summer, especially in Southern regions of the country.

When installing dental chairs in existing rooms in two rows in one-sided natural lighting, one should use artificial light even in the daytime in the second row of chairs and physicians should periodically change their workplaces.

In offices with one-sided natural lighting, dental chairs are installed in one row along the light-bearing wall. Dental offices should be equipped with a centralized system of compressed air, vacuum, oxygen supply, depending on the capacity of the clinic.

Disinfection and sterilization are essential for preventing transmission of infectious pathogens to patients and your staff. Cleaning is an essential first step before sterilization and disinfection. Cleaning is defined as the removal of visible soil, blood, proteins, microorganisms, and other debris from surfaces, crevices, serrations, joints, and lumens, or instruments, devices, and equipment. This step prepares items for safe handling and/or further decontamination. Debris removal is usually accomplished through use of detergent and water, or enzyme cleaner and water, by a manual or mechanical process.

Disinfection is a process that eliminates many or all pathogenic organisms, except bacterial spores. It's usually accomplished with liquid chemicals.

A disinfectant is defined as a physical or chemical agent that removes, inactivates, or destroys pathogens on a surface or item to the point where the surface or item is no longer capable of transmitting infectious particles, thereby rendering the surface or item safe for handling, use, or disposal.

Sterilization is a process that kills all forms of microbial life.

Note: Many liquid disinfectants and sterilants are used alone or in combinations in the healthcare setting. These include alcohols, chlorine compounds, formaldehyde, glutaraldehyde, hydrogen peroxide, iodophors, peracetic acid, phenolics, and quaternary ammonium compounds.

Surfaces must be cleaned of debris prior to disinfection. Surfaces cannot be adequately covered with disinfecting solution if dirt and debris remain on the surfaces. After cleaning surfaces with a cleaning solution, coat with a chemical disinfectant for the recommended contact time, and then wipe dry if necessary. Dental staff must follow product label and safety data sheet (SDS) instructions for safety, efficacy and proper disinfection.

Walls and floors should be cleaned using a detergent or a product that combines a cleaner and disinfectant on a regular basis, when spills occur, and when surfaces are visibly soiled. Housekeeping surfaces only need to be disinfected if they were potentially contaminated with blood or other infectious material.

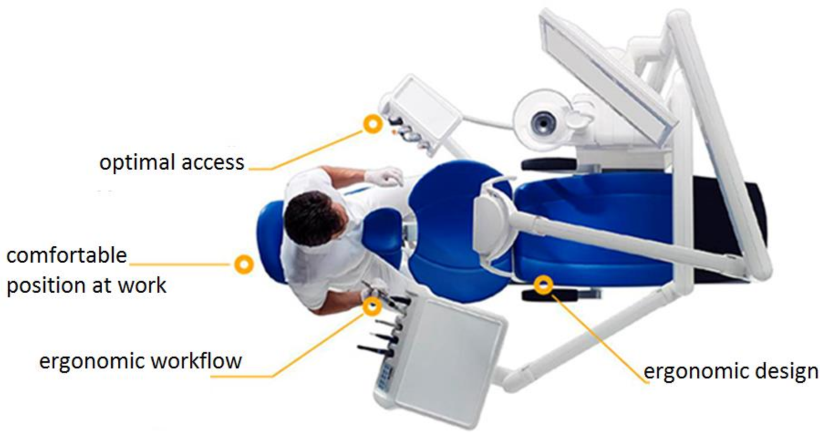
Clinical contact surfaces such as countertops, dental units, should be disinfected with an EPA-registered surface disinfectant (low-level or intermediate-level), or barrier-protected and cleaned at the end of the day.

There are five acceptable sterilization methods in the dental setting :

1. Steam sterilization use pressure to produce steam that is hotter than the 100C at which water normally vaporizes, increasing the autoclave water's boiling point up to 127C. The sterilization cycle generally runs 15 to 20 minutes.
2. Chemical vapor sterilization occurs when a liquid chemical, usually formaldehyde, is heated to produce a vapor that kills all microorganisms on the dental instruments.
3. Dry-heat sterilization requires a higher temperature, 149 C_0 and up, and a longer cycle time than steam sterilization since dry air contains less heat than steam.
4. Ethylene oxide gas (ETO) can be used for sterilizing heat-sensitive or moisture-sensitive instruments. Because they have long cycle times, are costly, and pose potential hazards, ETO sterilizers are not frequently used in dental offices.
5. Chemical Sterilants (often referred to as cold sterile solutions) should be used on heat-sensitive items only. Such items should be soaked in the chemical sterilant for the required duration—often eight to ten hours—and then rinsed with sterile water.

Sterilized instruments should be stored in a clean, dry environment to maintain the integrity of the package. It's a good practice to rotate the packages so that those sterilized first are used first. However, instruments remain sterile until the package is opened or compromised. If packaging is compromised, instruments should be re-cleaned, repackaged, and re-sterilized. While not required, it's recommended that all packages be marked with the date of sterilization and the sterilizer that processed the package to facilitate easy identification and recall of affected packages, should there be a sterilization failure.

Ergonomics - a science that studies the functional capabilities of man in labor processes in order to create optimal working conditions for him. The task of ergonomics, on the one hand, is to make work highly productive and efficient, on the other hand, to provide a person with comfortable work, preservation of his strength, health and ability to work.



The main tasks of ergonomics in dentistry:

1. Ensuring the maximum convenience of the doctor and other medical staff. This provision provides for the use of comfortable and efficient ergonomic equipment, tools, overalls. Hand tools must be balanced for efficient, safe and comfortable operation. In a properly balanced tool, the working part is within 2 mm of the extension of the central longitudinal axis of the tool. The balance of the tool is important for the following reasons: when working with a balanced tool, the tension of the brush is reduced, tactile sensitivity is improved; when rotating the handle, the tip of the working part describes the circle; near a balanced tool, its radius is small, and if the tool is sharp, the likelihood of soft tissue injury is reduced.

Another important factor in the convenience of working with a hand tool is the thickness of its handle. For example, in the Satin Steel and Satin Steel Colors series produced by Hu-Friedy, the handles have a diameter of 9.5 mm, which is much thicker than traditional stainless steel tools (the thickness of the handle is from 4 up to 6 mm).

The increased diameter of the handle (9.5 mm) was developed by Hu-Friedy together with physiologists and is considered optimal for the prevention of carpal tunnel syndrome. Carpal Tunnel Syndrome (CTS) is a chronic disease caused by compression of the median carpal nerve (Nervus medianus) between the inelastic carpal ligament and the tendons of the forearm muscles. This disease is manifested by pain, paresthesias and numbness of the fingertips, night pains and increased muscle fatigue. The development of this disease in dentists leads to work associated with increased, repetitive loads on the flexor muscles of the fingers. First of all, it is the use of blunt, non-centered tools and tools with thin handles.

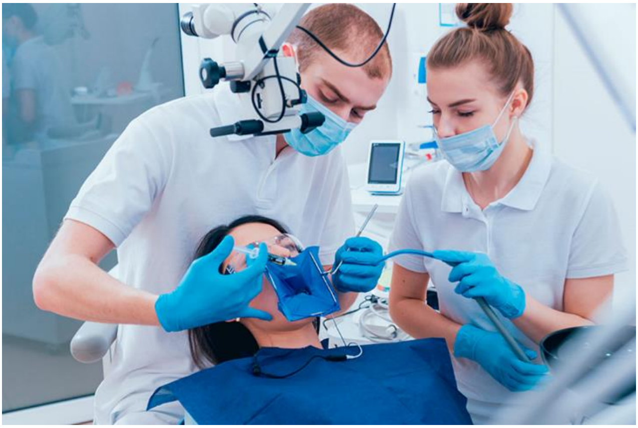
2. Rational device of the office and placement of equipment, reducing the physical load on the doctor.

This provision provides for the organization of workplaces of dentists and other medical staff so that the doctor works in the correct ergonomic position, to minimize unnecessary, irrational movements and manipulations, so that there are no unproductive movements of staff around the office.

Depending on the nature of the treatment, the dentist may work in a sitting or standing position. Optimal for a dentist-therapist is work sitting. According to the provisions of ergonomics, sitting is most effective to perform long manipulations that require neat, precise movements with good access. Standing is performed only operations that are accompanied by significant physical effort, short-term, with difficult access.

Currently, it is believed that the requirements of ergonomics best meet the work of a dentist-therapist with an assistant "four hands" in a horizontal position of the patient. In addition to saving time, this organization of work gives the doctor a number of technological advantages.

When organizing work on the principle of "four hands", the patient is in a chair "lying down". In the treatment of masticatory teeth of the lower jaw, the angle of the back of the chair is 20-25 °. In the treatment of teeth of the upper jaw or front teeth of the lower jaw, the angle of the back of the chair does not exceed 5-10 °, and sometimes the patient is placed horizontally (so that the nose and knees of the patient were approximately at the same level).



The doctor sits directly behind the patient's head in the "8-12 hours" position on an abstract dial, moving within this area to ensure a good view and maximum comfort.

The doctor's chair should be adjusted so that the doctor's feet are on the floor, the legs are bent at the knees at an angle of 90 degrees, and the doctor's torso is upright, resting his back on the back of the chair.

The doctor's thigh is slightly below the headrest of the chair, so the patient seems to be lying on the doctor's lap.

In the process, the dentist must follow the "rule of parallel": the front surface of the doctor's face should be parallel to the surface of the prepared tooth. The assistant is located in the position "2-5 hours". The assistant's desk is to his right. For a better examination and ease of operation, the assistant should sit 10-12 cm above the doctor. To provide an ergonomic position to the assistant (bending the legs at the knees at an angle of 90 °, a circular footrest is made on the leg of the assistant's chair. Instead of the traditional back, the assistant's chair has an "abdominal emphasis" and provides additional support for the torso. The tool transfer area is located "between 5 and 8 o'clock".

3. Providing staff with comfort in the treatment room and ancillary facilities.

This task involves creating a comfortable air climate, optimal lighting, combating noise and vibration (for example, placing a compressor and vacuum devices in a separate room).

This also includes the appropriate interior design. For example, in medical offices, especially where the color of the teeth is determined, it is not recommended to paint the walls in bright colors, place in the field of view of the doctor bright objects (paintings, additional light sources, etc.).

Reducing the psychological and emotional burden on the doctor and support staff.

It is also important to create a favorable psychological climate in the team: the relationship between employees should be built on cooperation, mutual assistance and "team spirit".

4. Professional selection of doctors and staff. This task is aimed at staffing the clinic with specialists with the appropriate level of training, interpersonal skills with patients and mastery of technologies for the sale of dental services. Criteria for professional selection of staff also take into account the level of physical and psychological health (vision, hearing, physical development, manual abilities, character traits, etc.). In addition, in the process of work requires constant training of dentists and support staff, improving their theoretical and practical training, training in new techniques and technologies.

Professional diseases of dentist:

• Biological health hazards: HBV & HIV, other micro-organisms such as: Cytomegalo virus, Hepatitis B virus, Hepatitis C virus, Herpes simplex virus types 1 and 2, Mycobacterium tuberculosis, Other viruses and bacteria, especially those that infect the upper respiratory tract.

• Allergic reactions: Latex hypersensitivity (The clinical symptoms of latex allergies include: a. Urticaria b. Conjunctivitis accompanied by lacrimation and swelling of eyelids c. Mucous rhinitis d. Bronchial asthma e. Anaphylactic Shock.)

• Occupational respiratory hypersensitivity (Allergic contact dermatitis caused by acrylate compounds is common in dental personnel; they also often complain of work- related respiratory symptoms).

• Radiation (Harmful radiation like Non-ionizing radiation (visible and UV light) and ionizing radiation (X-rays) can cause damage to various body cells).

A direct infection occurs when microorganisms enter through a cut on the skin of hand while performing a dental procedure, Any dental procedure resulting in an accidental biting of the patient, By the patient, or through a needle wound created while imparting anaesthesia.

An indirect infection occurs when an infectious agent is transmitted into the dental care giver through the so-called carrier. The following are the main sources of indirect infection: aerosols of saliva, gingival fluid, dental caries tissue mixed with air and water, accidental breakage of dental instruments and devices.

Infectious agents may gain access to the human host through a wide variety of exposure events

Area of exposure	Risks	Protection
Head	Inhalation, ingestion, irritation, needlestick, absorption through cuts, open sores, skin pores	Masks, shields, protective head coverings
Eyes	Splashes, squirts, irritation	Protective eyewear
Hands	Absorption, irritation, needlestick, absorption through cuts, open sores, skin pores	Protective gloves, protective barrier substance (cream, lotion)
Feet	Irritation, needlestick, absorption through cuts, open sores, skin pores	Protective footwear
Whole body	Inhalation, ingestion, irritation, needlestick, absorption through cuts, open sores, skin pores	Protective clothing, aprons, gaiters

Ergonomics Musculoskeletal Disorders (MSD) and diseases of the peripheral nervous system. Muscular pain is a common affliction in dentists which begins at the time they start their professional studies and it stays with them during their professional practice affecting the spine, neck, shoulders and hands, among others. It has been proven that postures which may exert a higher pressure on intervertebral disk as well as prolonged spinal hypomobility are among important factors leading to degenerative changes in the lumbar spine and subsequent lower back pain.

Cumulative trauma disorders (CTDS) are health disorders arising from repeated biomechanical stress to the hands, wrist, elbows, shoulders, neck and back. Most common CTDS are Carpal tunnel syndrome and Low back pain. CTS is defined as symptomatic compression of the median nerve within the carpal tunnel, which is the space between the transverse carpal ligament on the palmar aspect of the wrist and the carpal bones on the dorsal aspect of the wrist.

Routine precautions

1. Immunisation: All dental health care workers are advised to be immunized against HBV unless immunity from natural infection or previous immunization had been documented.

2. Protective coverings:

- Uniforms: uniforms should be changed regularly and whenever soiled. Gowns or aprons should be worn during procedures that are likely to cause spattering or splashing of blood.
- Hand protection. A new pair of gloves should be used for each patient. If a glove is damaged, it must be replaced immediately. Hands should be washed thoroughly with a proprietary disinfectant liquid soap prior to and immediately after the use of gloves. Disposable paper towels are recommended for drying of hands.
- Protective glasses, masks or face shields. Protective glasses, masks or face shields should be worn by operators and close-support dental surgery assistants to protect the eyes against the spatter and aerosols which may occur during cavity preparation, scaling and the cleaning of instruments.

- Sharp instruments and needles. Sharp instruments and needle should be handled with great care to prevent unintentional injury. Needles should never be recapped by using both hands or by any other technique that involves moving the point of a used needle towards any part of the body. The 'one-handed' technique for recapping a needle.

Topic 10. Types of dental handpieces, burs. Dental instruments, its purpose, methods of work in mirror image.

Main dental instruments:

Mirror. The mirror is an essential dental instrument that allows dentists to explore the patient's oral cavity, both for direct viewing and indirect vision techniques, as well as to act as a mouth separator. Its little size and adaptability make it a basic but highly practical instrument for a perfect working vision.

There are three main functions of a mouth mirror – indirect vision, retraction, and light reflection.

- **Indirect vision:** there are many areas in the mouth where direct vision is impossible. Using a mouth mirror will allow dentists to view specific locations where visibility is a challenge. Without a mouth mirror, a dentist will have to bend upside down which could lead to postural problems. The lingual surfaces of the anterior maxillary teeth are one of the most common areas where dental mirrors are used.
- **Retraction:** dentists need to retract the surrounding tissue like cheek and tongue to gain better visualization and accessibility for instrumentation. With the use of a mouth mirror, retraction of tongue and cheek is more accessible and more convenient. The patient will not feel any irritation during retraction because the mirror is smooth.
- **Light Reflection:** there are some parts of the mouth where it is difficult to illuminate. A dental mirror is used to reflect light from

the dental chairs light and illuminate some of the deep and detailed areas of the oral cavity.

Probes. The probe is the instrument that ends with a long and thin tip and which can be found in two different types:

1. Dental probe for examination of fissures, surfaces, fillings, cavities, etc.

2. Periodontal probe for measurement of periodontal pocket depth.

Forceps. A dental forceps is another basic instrument used in dentistry for a multitude of tasks. They are used to separate tissues, hold them together, suture them, and to transport small objects to the oral cavity or out of it. Depending on the task to be performed, there are different types of forceps: surgical, ligatures, hemostatic etc.

Spoon excavators. A spoon-shaped working end for 'spooning' out dentinal caries from the cavity preparation. Edges of working end are sharp.

Mixing spatulas. Used to mix dental materials. Anodised aluminium spatula will not stick to any composite materials or discolour materials

Flat plastic instrument. Used to deliver materials to the cavity preparation or to remove excess materials.

Round-ended plastic. Used to create anatomical shapes in composite material during restorations. The ball-ended plastic instrument can also be used to pack and condense composite materials.

Dental carver. Used to create anatomical shapes in composite material during restorations

Rotary instruments make up those instruments that enable rotation movements at different speeds in order to move a dental bur placed at its end. They must be connected to the hoses of other dental equipment for these kinds of operations, for which there are different couplings depending on the type of connection.

Turbines. A dental turbine is a rotary instrument that is driven by air compression directly through the dental unit's hose via a coupling. Of all the rotary equipment, it has the highest speed but the lowest torque. It is recommended for jobs that require greater resistance to the treatment, for instance, to remove hard tissues from the tooth such as enamel or prosthesis material. Speed of turbine handpiece 350-450 thousand rotation/min.

Micromotors. Micromotors are used for the treatment of semihard dental tissues. This instrument is connected to the hoses of dental equipment with a variable connection system. Different working speeds and torques are also variable, meanwhile wo different types of instruments can be placed onto the micro motor: straight and contra-angle handpieces.

Dental Handpieces

Used for the following:

- Remove dental decay.
- Prepare tooth for restoration.
- Polish.
- Polish and finish dental restorations.
- Cut, finish, and polish dental appliances.
- Trim models and trays.

Parts of the Dental Handpiece

Working end-where the burs, discs, stones, and other rotary instruments and attachments are held (chuck):

- The bur is placed in the chuck on the handpiece.
- Head.
- Shank- the handle portion.
- Connection end-Forward and reverse controls may be located on the connection end.
- The part of the handpiece that attaches to the power source.

Dental Handpieces

- High-speed.
- Low-speed.
- Straight.
- Nose cone.
- Contra-angle.
- Latch-type or friction grip.
- Right angle or prophy angle.
- Electric.

Burs. Are made from various materials (tungsten carbide, diamond and steel). Each has a particular function (cutting, polishing, finishing or caries removal).

Round Burs. Used for the removal or elimination of carious tissue and realization of retentions.

Periform Burs. Mainly used to perforate the dental enamel in order to make the conformation of the cavities.

Cone-inverted Burs. Used to create a flat floor of the cavity, in order that there is a good distribution of masticatory forces.

Cylindrical and frusto-conical Burs. Used to shape the walls of the cavity.

The end of the shank determines which handpiece the attachment will fit into:

- Long straight shank – straight handpiece
- Latch grip – conventional type/slow speed handpiece
- Friction grip shank – air turbine handpiece/high speed handpiece
- Other various attachments such as snap or screw-type attachments

Topic 11: Classification of carious cavities by Black. Methods of preparation of carious cavities. Methods of isolation of the surgical field.

Classification of carious cavities by G. Black.

The carious cavities depending on the group of teeth and affected surface are divided into VI classes:

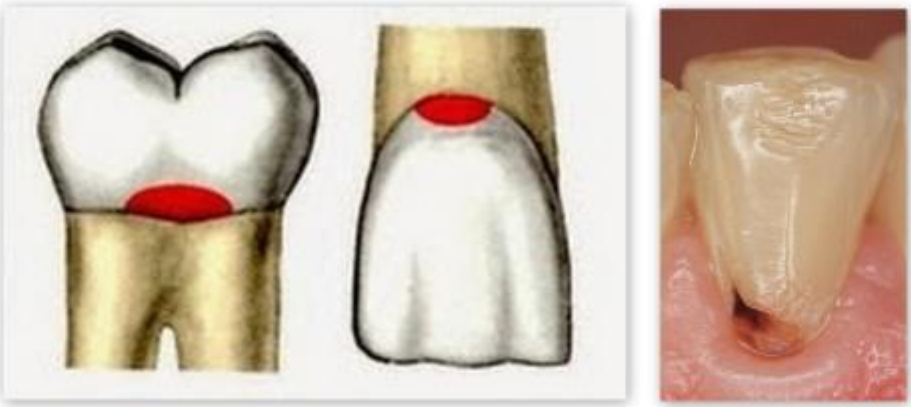
1) I class - carious cavities, which are located in natural recesses of any anatomical tooth groups (on chewing, buccal and lingual surfaces of the molars and premolars and the lingual surface of incisors);
2) II class - carious cavities on the contact surfaces of molars and premolars;
3) III class - carious cavities on the contact surfaces of incisors and canines;
4) IV class - carious cavities of III class, with violation of the integrity of an angle or cutting edge of the tooth crown;
5) V class - cavities on any surface in the cervical areas of all teeth.
6) VI class - involve the incisal edges of all anterior teeth and the cusp tips of all posterior teeth.

Class I Lesions

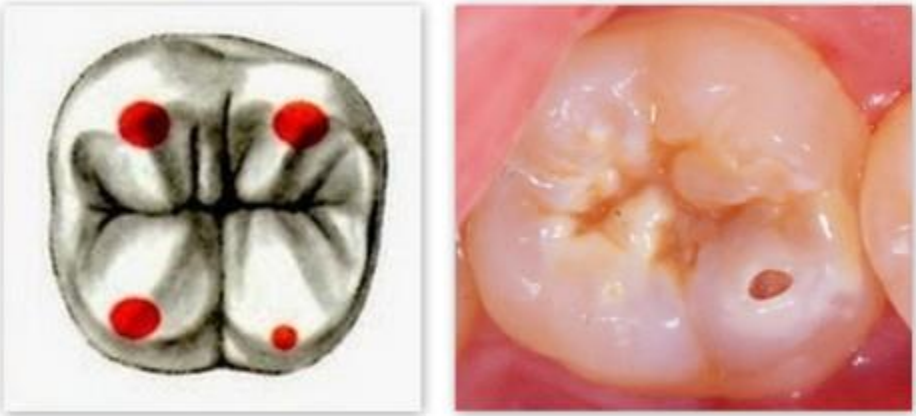
Class II Lesions

Class III Lesions

Class IV Lesions



Class V Lesions



Class VI Lesions

Goals of isolation:

- Moisture control.
- Retraction and access.
- Harm prevention.
- Safe and aseptic operating field.
- Prevent accidental swallowing of restorative materials and instruments.

Methods of isolation:

- **Direct method:**
  - Rubber dam.
  - Cotton rolls & cellulose wafers.
  - Dri-angle.
  - Gauze piece.
  - Suction devices.
  - Gingival retraction cords.
  - Mouth props.

Cotton rolls & cellulose wafers

Rubber dam

Saliva ejector

High volume evacuating equipment

Retraction cords

Retraction cords

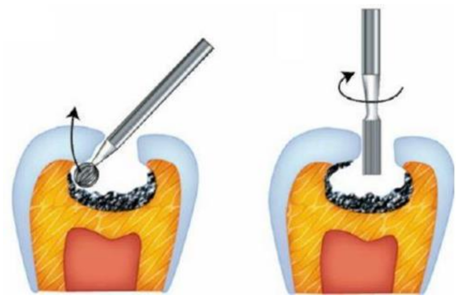
Topic 12. Stages of preparation of carious cavities. Technique of classical preparation of carious cavities of class I and V according to Black.

Regardless of which group the tooth belongs to and on which surface there is a carious cavity, the preparation consists of a number of mandatory and sequential stages:

1) Opening of a carious cavity.
2) Widening of a carious cavity
3) Necrectomy (excision of non-viable tissues).
4) Cavity formation.
5) Shaping of the enamel edges of the carious cavity.

Opening and widening of carious cavity

The size of the carious cavity is much larger than the size of the inlet, especially in acute caries. The opening of the carious cavity involves the removal of overhanging edges of the enamel, providing free access, visual control of the cavity and performing the following stages of preparation. In case of insufficient opening of the cavity, the overhanging edges break off, which can lead to the development of secondary caries, violation of the anatomical shape of the tooth or loss of filling.



Round (spherical) or fissure burs are used to open the carious cavity, they are selected so that the size of the working part was not larger than the inlet of the carious cavity. During the opening of the carious cavity located on the chewing surface, the spherical boron is brought under the overhanging edges of the enamel. Turn on the drill and with careful movements, as if putting a coma, removing boron from the carious cavity, remove the overhanging edges of the enamel.

Necrectomy

This is the final removal from the carious cavity of all non-viable hard tissues (mainly dentin) and their decay products. The amount of necrectomy is determined by the nature of the clinical course of caries, the location and depth of the carious cavity. It is carried out with the help of excavators and ball drills.

Manipulation begins with a sharp excavator, selected according to the size of the carious cavity. In shallow and medium depth cavities, dentin can be excavated, starting from each of the walls of the carious cavity, in turn.

The sharp edge of the working part of the excavator is deepened into the softened dentin and the dentin layer is removed with lever-like movements. In mantle dentin the fibers of the main substance are located radially, so the excavator should be deepened towards the tooth axis, in pulpal dentin the fibers are located tangentially, so the excavator should be deepened in the transverse direction.

Necrectomy, especially of the deep cavity, should be performed carefully so as not to open the tooth cavity and injure the pulp. Removal of infected but denser dentin is continued with a drill using spherical, fissure and conical burs.

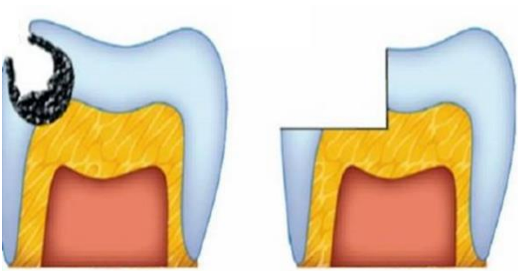
Cavity formation

It is a very important stage of preparation, its purpose is to create a shape of the cavity that would be able to hold the filling material for a long time and keep the seal. To do this, it must meet certain requirements.

The walls and bottom of the prepared carious cavity should be located (one plane relative to the other) at 90 angles, have smooth, not rough, surfaces.

The bottom of the cavity, as a rule, should be flat or repeat the shape of the chewing surface of the tooth.

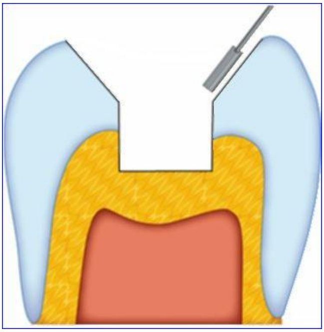
It is necessary that the angles between the walls and the bottom were straight and well defined, because in them filling material will fix.



A rectangle is the most convenient shape for holding a seal, but oval, triangular, cross-shaped, and cylindrical cavities are possible. For better fixation of the seal, it is sometimes recommended to create retention points on the walls of the cavity in the form of grooves, recesses, cuts. Fissure, inverted-conical, cone-shaped and wheel-shaped burs are used to form a carious cavity.

Finishing the enamel edges

Is the last stage of cavity formation. At the same time it is necessary to pay attention that external parts of enamel prisms had good support in the dentin which is contained below. Otherwise, the overhanging edges of the enamel, deprived of nutrition and support, will not be able to withstand the masticatory pressure and will break off. This can lead to the appearance of a retention point, recurrence of caries and destruction or loss of the seal. Therefore, finishes and carborundum heads are carefully (because the enamel is quite fragile and can break off) to process the enamel edge, cutting off overhanging areas. Thus, the enamel edge must be formed in accordance with the direction of the enamel prisms. Depending on the type of filling material to be used in the future, it is necessary to mow the enamel edge at an angle of 45 ° or round it.



To achieve this goal during the preparation of a carious cavity, it is necessary:

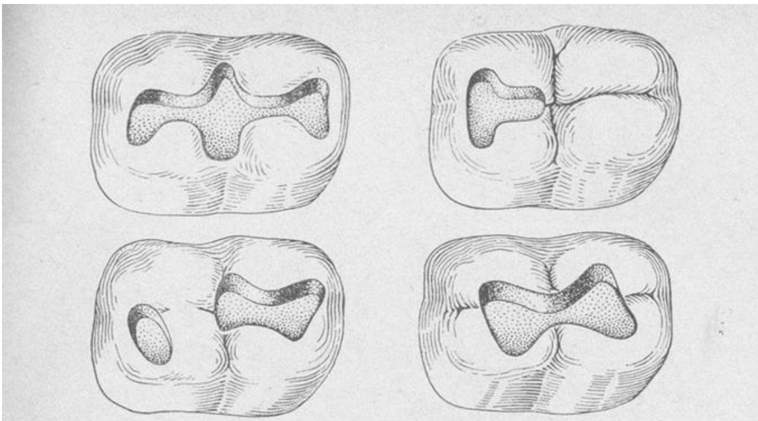
1. In each case, identify the elements of the carious cavity and ensure its reliable visual control.

Consistently perform the main stages of preparation.

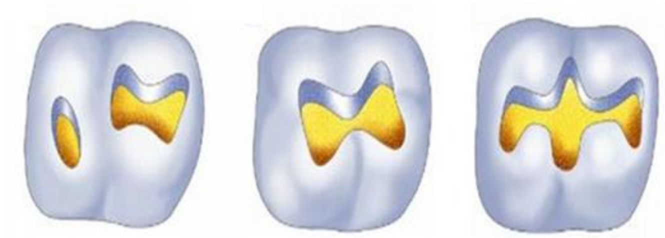
2. Have a clear idea of the possibilities of use and choice of tools (drills of various designs, excavators, etc.) to obtain the desired shape of the carious cavity.

3. Adhere to certain principles of preparation of a carious cavity: biological expediency, taking into account the limits of expansion of cavities and topography of pulp; technical rationality (correct work with tools).

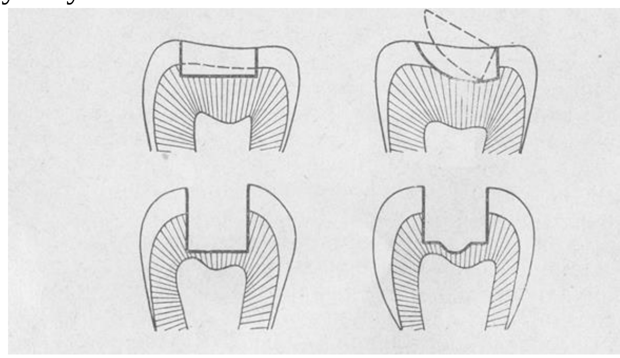
Preparation of carious cavities of class I. Depending on the localization and distribution of the process, the following types of cavities are formed: rectangular, diamond-shaped, cross-shaped, oval, etc. The formed carious cavities of the I class have the most typical box-shaped form with steep walls and a flat bottom. In the case of preparation of deep carious cavities, the formation of a flat bottom may be impossible due to the danger of opening the pulp, especially in the projection of its horns. Therefore, in this case, create the bottom of the cavity, the shape of which repeats the contours of the pulp chamber. The carious cavity located on the masticatory surface of the tooth in the area of the fissures is called the central one.



If there are two (or more) carious cavities located on the masticatory surfaces of premolars and molars, which are separated by sections of healthy tissue, they should be treated and filled separately. If carious cavities are separated by membranes of fabric of doubtful durability, it will be expedient to unite them in one cavity.

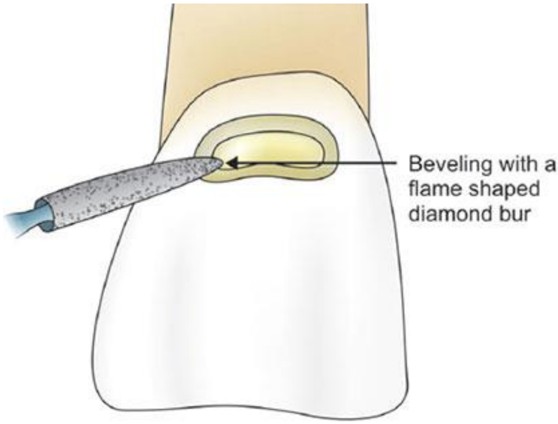


If the cavities are located on the buccal surface of molars above the equator of the crown with a thin layer of intact masticatory surface, the creation of a cavity only on the buccal surface of the tooth will be insufficient. In this case, as in the case of simultaneous damage to the buccal and masticatory surfaces of the tooth, form a cavity with an additional area on the masticatory surface. If the carious cavity on the buccal or lingual surfaces of molars is small and on the masticatory surface a significant layer of unchanged tooth tissue is preserved, forming a cavity only within the buccal surface.

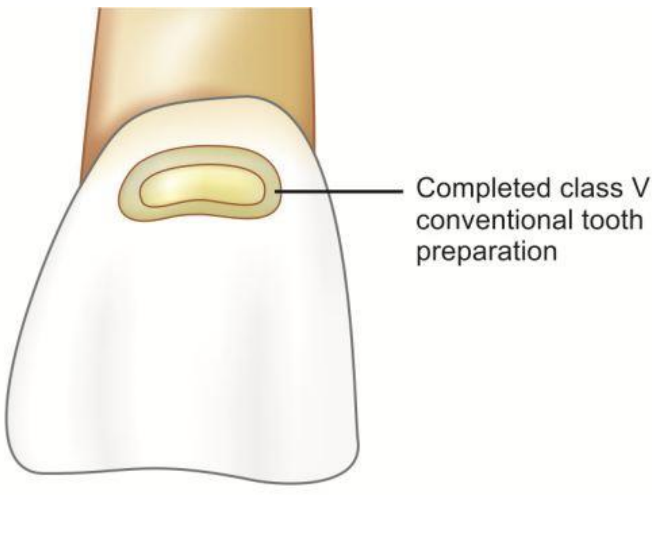


Class 5 preparation carried out almost as well as cavities of the I class. The opening and necrectomy of these cavities do not have pronounced features.

If there are two carious cavities on this surface, separated by a narrow strip of unaffected enamel, then both defects are combined into one cavity. The treated cavity must acquire a horseshoe shape or an elongated oval shape.



When treating a Class V cavity, it is important to keep in mind the possible damage to the pulp, so the depth of the cavity usually does not exceed 1.5 mm. Formed carious cavities of class V are often relatively small. Therefore, for better fixation of the seal, it is necessary that the straight plagues between the walls and bottom were clearly expressed. Sometimes a slight inclination of the walls towards the cavity and the formation of cuts on them by wheel-shaped and inverse conical burs is allowed.

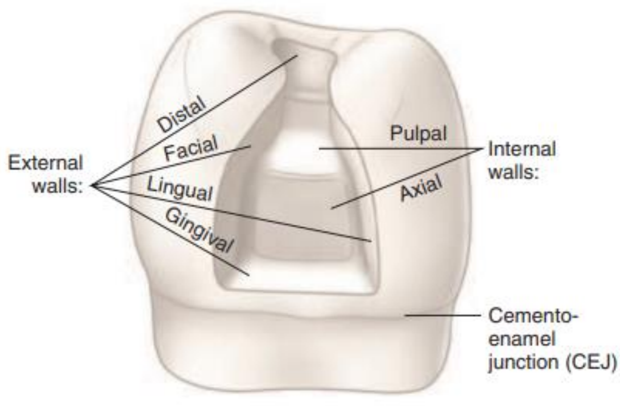


Topic 13. Classical technique of preparation of carious cavities of class II according to Black.

Preparation of carious cavities **of class II (affected contact surfaces of premolars and molars),** in comparison with preparation of carious cavities of class I, is more complicated. This is due to the fact that the carious cavity located on these surfaces, in the presence of adjacent teeth is very difficult to detect and examine. To prepare such a cavity, it is necessary to access it by removing the layer of intact enamel and dentin from the side one of the tooth surfaces. This removal of the carious cavity is most convenient to perform from the masticatory, palatal or lingual surface of the tooth.

If the carious cavity is located on the contact surface above the equator, then after preparation it has a fairly typical box-like shape. In the case of placing a carious cavity on the contact surface below the line of the equator of the tooth, then, fully formed, it must contain two elements: the main cavity and the additional site.

Additional is formed on the chewing surface for better fixation of the seal and more even distribution of chewing pressure.



The disclosure of a class II carious cavity is associated with certain difficulties due to the removal of large masses of enamel and dentin while creating access to it. To do this, a wheel-shaped or cone-shaped boron is cut on the enamel of the masticatory surface in the projection of the carious cavity. You can use trepan, diamond bur, small carborundum heads. Then a small round (spherical) bur penetrate into the carious cavity, expand it, also using fissure burs. Much less often, especially if the carious cavity is located below the equator, it is opened from the lingual (palatal) or parietal surface. To ensure a better approach to the carious cavity, provided that the teeth are closely spaced, separation is used. It is carried out with the help of a special device - a separator or by sawing the contact surfaces of the tooth with a separation disk (the latter is rarely used). Especially carefully prepare the adjacent wall with the help of cone-shaped, conical and fissure burs; it must be placed at right angles to the bottom of the cavity. In the case of a shallow carious cavity on the contact surface, it is slightly expanded and continued on the chewing surface, creating there retention points in the form of a swallow's tail, etc. for better fixation of the seal. In the case of large enough carious cavities, the formation of an additional site or additional cavity is mandatory. The shape of the additional cavity can be varied (triangular, cruciform, in the form of a swallow's tail, etc.), but it must provide a secure fixation of the seal and counteract the force that pushes it out.

In the case of carious lesions of both the medial and distal contact surfaces of large and small canines, an additional area on the masticatory surface is often made common. To prevent chipping of the buccal or lingual (palatal) walls of the cavity, it is necessary, shaping the cavity, to grind the tubercles of the crown.

Topic 14. Classical technique of preparation of carious cavities class III and IV according to Black.

Class III tooth preparations: are located on proximal surfaces of anterior teeth. Conventional Class III Tooth Preparation: The primary indication for this type of Class III preparation is for the restoration of root surfaces, preparation the portion on the root surface that has no enamel.

The outline form on the root surface. Box-like design may be considered, extending the external walls to sound tooth structure while extending pulpally to an initial depth of 0.75 mm. Any remaining infected dentin on the axial wall will be removed during the final tooth-preparation stage. The external walls are prepared perpendicular to the root surface. The cavosurface margins exhibit a 90-degree cavosurface angle and provide butt joints between the tooth and the composite material. Resistance form Extending the external walls pulpally to an initial depth of 0.75 mm thus providing adequate dimension for composite strength, placement of a retention groove (if necessary), and maintenance of strength of the gingival wall and margin. More likely only a portion of a tooth preparation-the portion on the root surface that has no enamel margin-would be prepared in this manner.

Modified or a beveled conventional Class III Tooth Preparation. The beveled conventional tooth preparation for composite restorations is indicated primarily for replacing an existing defective restoration in the crown portion of the tooth. However, it also may be used when restoring a large carious lesion for which the need for increased retention and/or resistance form is anticipated.

Class III beveled conventional tooth preparations are prepared as conventional preparations with the addition of a cavosurface bevel or flare of the enamel rather than a butt joint margin.

The access of Class III: The lingual approach is preferable, unless such an approach would necessitate excessive cutting of tooth structure, such as in instances of irregular alignment of the teeth or facial positioning of the lesion.

Use a round carbide bur (No. 1/2, 1, or 2) or diamond stone, the size depending on the extent of the caries to prepare the outline form. The point of entry is within the incisogingival dimension of the carious

lesion or defective restoration and as close to the adjacent tooth as possible, without contacting it.
Direct the cutting instrument perpendicular to the enamel surface, but at an entry angle that places the neck portion of the bur as far into the embrasure (next to the adjacent tooth) as possible. Incorrect entry overextends the lingual outline.

The advantages of restoring the proximal lesion from the lingual approach include:

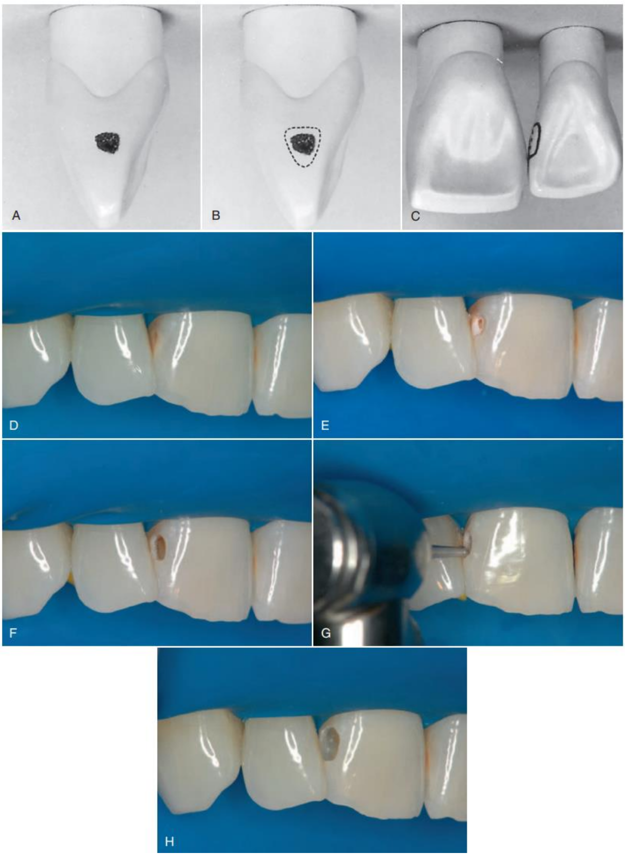
1. The facial enamel is conserved for enhanced esthetics.
2. Some unsupported, but not friable, enamel may be left on the facial wall of a Class III or Class IV preparation.
3. Color matching of the composite is not as critical.
4. Discoloration or deterioration of the restoration is less visible. Prepare the enamel walls perpendicular to the external tooth surface, with the enamel margin beveled.

Extend the external walls to sound tooth structure during preparation of the outline form. The axial wall will be outwardly convex, Following normal external tooth contour and the DEJ, both incisogingivally and faciolingually. Any remaining infected dentin or old, defective restorative material on the axial wall will be removed during the final tooth-preparation stage. The axial wall depth approximately 0.75 to 1.25 mm (0.2 mm inside the dentinoenamel junction (DEJ)).

Usually retention is obtained by bonding to the enamel and dentin and no groove retention is necessary. However, when replacing a large restoration or restoring a large Class III lesion, the operator may decide that retention form should be enhanced by placing groove (at gingival) and/or cove (at incisal) retention features in addition to the bonded tooth structure.

For most Class III using the beveled conventional preparation, the preparation would be complete at this time except for placing an enamel bevel, The cavosurface bevel provides more surface area for end-on etching of the enamel rods. The cavosurface bevel or flare is best prepared with either a flame-shaped or round diamond instrument, resulting in an angle approximately 45 degrees to the external tooth surface all accessible enamel margins usually are beveled, except for the gingival margin. This margin is usually not beveled if little or no enamel is present, or access is difficult for finishing procedures. In addition, bevels may not be recommended on lingual surface margins that are in areas of centric contact or subjected to heavy masticatory forces because composite has less wear resistance than enamel for with standing heavy attritional forces.

Modified Class III tooth Preparation. A modified tooth preparation is the most used type of Class III tooth preparation. It is indicated for small and moderate lesions or faults and is designed to be as conservative as possible. . Thus, the preparation design appears to be "scooped" or concave, the cavosurface margins in a beveled configuration the retention of the material in the tooth will result from the bond created between the composite material and the etched peripheral enamel.



A, Small proximal caries lesion on the mesial surface of a maxillary lateral incisor.
B, Dotted line indicates normal outline form dictated by shape of the caries lesion.
C, Extension (convenience form) required for preparing and restoring preparation from lingual approach when teeth are in normal alignment.
D–H, Clinical case showing conservative Class III preparation, facial approach.
D, Facial view of a caries lesion on the distal surface of the maxillary central incisor.
E and F, Obtaining access to carious dentin.
G, Infected dentin is removed with round bur.
H, Completed caries excavation.

Class IV

Class IV cavity preparation Class IV tooth cavity preparation is indicated for restoring proximal areas that also include the incisal surface of an anterior tooth. The Class IV composite restoration has provided the profession with a conservative treatment to restore fractured, defective, or cariously involved anterior teeth when, previously, a porcelain crown may have been the treatment of choice. The preoperative assessment of the occlusion is even more important for Class IV restorations because it may influence the tooth preparation extension (placing margins in non-contact areas).

Conventional Class IV Tooth preparation. The conventional tooth preparation design (preparation design with 90-degree cavosurface margins) has minimal clinical Class IV application except in those areas that have margins located on root surfaces.

Beveled Conventional Class IV Tooth Preparation. The beveled conventional Class IV tooth preparation is indicated for restoring large Class IV areas.

The outline form. Using an appropriate size round carbide bur or diamond instrument at high speed with air-water coolant. Remove all weakened enamel and establish the 2 initial axial wall depth at 0.5mm into dentin (because groove retention form will likely be utilized). Prepare the walls as much as possible parallel and perpendicular to the long axis of the tooth. Excavate any remaining infected dentin as the first step of final tooth preparation. If necessary, apply a calcium hydroxide liner. Bevel the cavosurface margin of all accessible enamel margins of the preparation. The bevel is prepared at a 45-degree angle to the external tooth surface with a flame-shaped or round diamond instrument. The width of the bevel should be 0.25 to 2 mm, depending on the amount of tooth structure missing and the retention perceived necessary.

Retention and resistance form. (Heavy occlusion and large Class IV require increased retention and resistance form). Thus, may dictate a more conventional tooth preparation form, with more resistance form features: to provide appropriate resistance form, the preparation walls may need to be prepared in such a way as to resist occlusal forces. This often requires proximal facial and lingual preparation walls that form 90-degree cavosurface angles, which are subsequently beveled, and a gingival floor prepared perpendicular to the long axis of the tooth. This boxlike form may provide greater resistance to fracture of the restoration and tooth from masticatory forces.

Retention form features:

1. Etched beveled enamel margin and dentine surface. The bevel could be even wider than enamel margin bevel in class III.

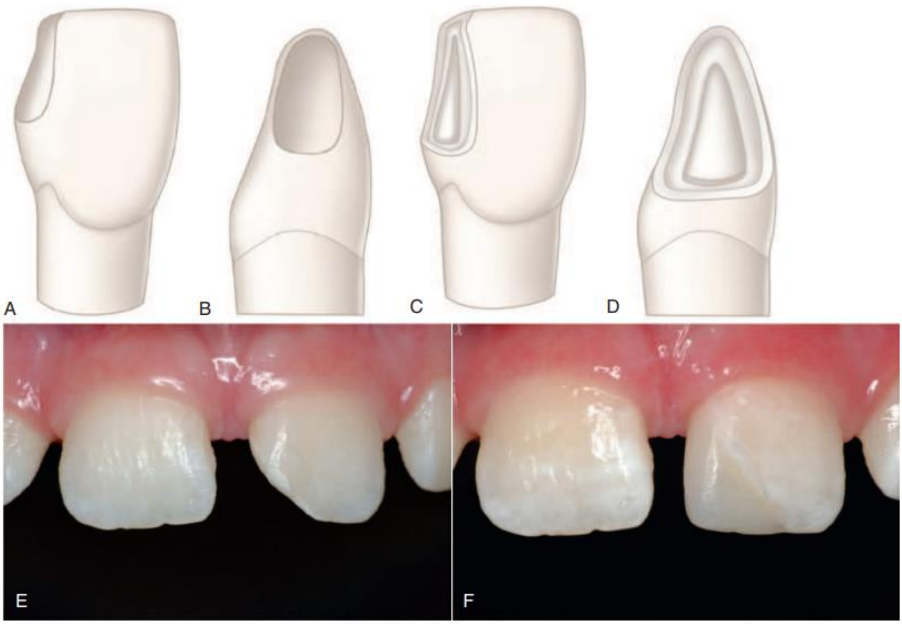
2. Groove or other shaped undercuts placed in the dentin along line angles and into point angles wherever possible, without undermining the enamel. A gingival retention groove prepared using a No. 1/4 round bur. It is prepared 0.2 3 mm inside the DEJ at a depth of 0.25mm (half the diameter of the No. 1/4 bur) and at an angle bisecting the junction of the axial wall and gingival wall.

3. A dovetail extension onto the lingual surface of the tooth may enhance both the restorations strength and retention, but it is less conservative and therefore not used often. Although pin retention is sometimes necessary.

4. Pin placement prepared at 0.2-0.5 mm inside the DEJ.

Modified Class IV Tooth Preparation.

The modified Class IV preparation for composite is indicated for small or moderate Class IV lesions or traumatic defects. The objective of the tooth preparation is to remove as little tooth structure as possible, while removing the fault and providing for appropriate retention and resistance forms. Usually little or no initial tooth preparation is indicated for fractured incisal corners, other than roughening the fractured tooth structure. The cavosurface margins are prepared with a beveled configuration; the axial depth is dependent on the extent of the lesion, previous restoration, or fracture, but initially no deeper than 0.2 mm inside the DEJ. The retention is obtained primarily from the bonding strength of the composite to the enamel and dentin. The treatment of teeth with minor traumatic fractures requires less preparation than the beveled conventional. Example. If the fracture is confined to enamel, adequate retention usually can be attained by simply beveling sharp cavosurface margins in the fractured area with a flame-shaped diamond instrument followed by bonding.



Preparation designs for Class IV (A and B), and larger preparation designs for Class IV (C and D). E and F, Direct composite restoration of a Class IV defect, before (E) and after (F).

Topic 15. Features of the preparation of carious cavities for modern composite materials.

In recent times the term “Minimal Intervention Dentistry” has been used to describe a new approach to the treatment of the disease of caries. It is widely acknowledged that this is a bacterial disease and must be treated as such. The pattern of attack of the carious lesion and its progress through the enamel and dentine has been understood for many years and has tended to dictate the treatment methods used. However, the purely surgical approach to caries control, as taught by GV Black, is now recognised as being far too destructive to be used as the first line of defense. It is highly inefficient because it does not eliminate the cause of the disease and at the same time it leads to a continuing process of replacement dentistry where in the cavity just gets larger, the restoration is subjected to an increasingly heavy load and the tooth gets weaker.

The cavity designs suggested by Black required geometric precision with sharp line angles, flat floors and removal of all signs of demineralised tooth structure. Minimal intervention suggests remineralisation of any enamel margin that is not yet cavitated as well as remineralisation of the lesion floor to avoid irritation of the pulp. Demineralised enamel around the margin of the lesion will be restored during the stabilization phase of treatment aimed at elimination of the disease through the application of fluoride and CPP-ACP. The floor of the lesion will be remineralised through the placement of a glass-ionomer foundation for the restoration and this, at the same time, will seal the margins against microleakage.

Preparation of a cavity may therefore be very conservative indeed. The ultimate aim will be simply to restore the surface of the crown of the tooth to prevent further accumulation of plaque on to or in to any roughness or cavitation that has arisen from the caries process. Access to the lesion should therefore be very conservative and undertaken with care. Open only as far as necessary to allow clear vision in to the lesion. Clean the walls of the lesion sufficient to provide a clean dentine surface around the full periphery so that there can be an ion exchange adhesion between the tooth structure and the glass-ionomer base. Demineralised dentine can remain on the floor providing there is sufficient strength in the glass-ionomer to withstand occlusal load. Both clear vision and a tactile sense are valuable in limiting the depth and extent of the preparation and to thus maintain the maximum strength in the remaining tooth crown.

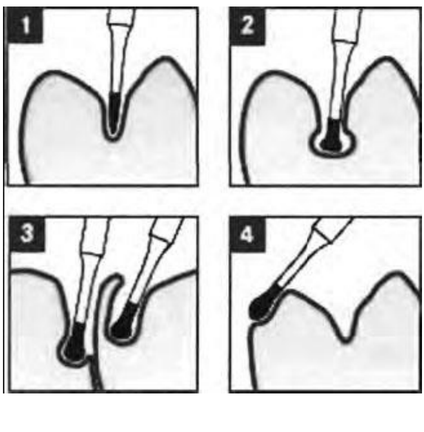
Topic 16. Minimally invasive preparation techniques (tunnel preparation, slot preparation, bate-cave preparation, micro preparation, ART technique).

ART-method.

The technique of treatment is simplified as much as possible. The carious cavity is cleaned by an excavator, without preparation by means of a drill. Then it is dried and sealed with glass ionomer cement - a material that is easy to use and has anti-carious effect. It was found that if the filling is carried out in the early stages of caries, it allows you to stop the progression of the process of destruction of the hard tissues of the tooth, even if the walls of the cavity was left pigmented dentin.

Treatment by the method of minimal preparation is carried out by analogy with the ART-technique, but for the preparation of the cavity are used not only hand tools but also a drill. When opening the cavity with drills or enamel knives cut only demineralized enamel, leaving a small entrance. Then a spherical boron or excavator is inserted into the cavity and all softened dentin is carefully removed. The result is a pear-shaped cavity with a small inlet.

The effectiveness of the method of minimal preparation is due to the fact that, despite advances in the creation of new filling materials, tooth enamel is still the most stable and durable substance that can be stored for decades in an aggressive environment of the oral cavity. Healthy enamel cannot yet be effectively replaced by any restoration material.



The process of filling, according to this concept, is aimed not only at restoring the tooth, but also at preventing its re-caries. This has been made possible by the emergence of new filling materials that meet the requirements of the minimally invasive treatment program.

Constant control and active detection of initial carious lesions allows treatment in the early stages of carious process, and the adhesive features of modern filling materials make it possible to abandon the formation of extensive cavities, limited to the removal of infected tissues. The cavity can be very small.

Modern materials and their adhesive systems not only provide a reliable edge fit of the seal, prevent bacterial invasion and the development of recurrent caries. Many of them, primarily glass ionomer cements, have biological activity - saturating the hard tissues of the tooth with fluoride ions, they are able to restore their mineral composition and protect against further damage. It is expected that future generations of bioactive filling materials will be able to fill other apatite-forming substances: ions of calcium, phosphorus, strontium, etc.

The appearance of new remineralizing compositions allows to effectively treat carious lesions in the form of white spots without the use of invasive treatments. It should be noted that clear principles of micropreparation have not yet been developed. Usually, if the cavity is within the enamel, it is made cone-shaped, if the carious process captures the dentin, the cavity is made pear-shaped with a narrow inlet.

In general, the doctor chooses the design of the cavity individually in each case. Only complete excision of the affected non-viable dentin and provision of conditions for high-quality filling of the defect is mandatory.

Chemical-mechanical - the use of systems that destroy the affected tissues of the carious process, which are then removed with hand tools. An example of a system for chemical-mechanical preparation of the cavity is "Carisolv". Carisolv gel is made on the basis of 0.95% sodium hypochlorite and a mixture of amino acids (leucine, lysine, glutamic acid). The gel is introduced into the carious cavity, then the cavity is cleaned with special hand tools and sealed.

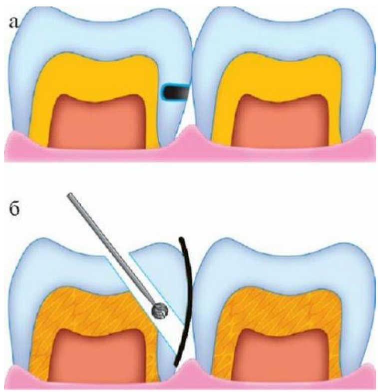
Ultrasonic - the use of ultrasonic tips and special attachments to them with a diamond coating of the working part. The tip of the nozzle during operation performs microscopic vibrating movements along an oval trajectory, processing the walls of the cavity;

Kinetic, or air-abrasive method implements in dentistry the method of sandblasting hard surfaces. This method consists in a directed supply to the tissues that prepare the tooth through special tips of a jet of aerosol containing water and abrasive. The active component of the aerosol used for preparation of hard tissues of the tooth is an abrasive powder consisting of particles of alumina of high abrasiveness.

CAVITY DESIGNS FOR MINIMAL INTERVENTION

- Tunnel Preparation
- Slot Cavity Preparation
- "Minibox" Approximal Cavity Preparations
- "Full Box" Approximal Cavity Preparation

Tunnel Preparation. It could be used when the lesion is more than 2.5 mm below the crest of the marginal ridge and the contact area may remain sound and the marginal ridge may be quite strong. (Wilson and Mc Lean, 1988). Access to the lesion through the occlusal surfaces should be limited to the extent required to achieve visibility and should be undertaken from an area that is not under direct occlusal load (Knight, 1984). Access may be gained through the occlusal surface with No. 2 bur about 2.0 mm from the marginal ridge. Resin-modified glass ionomer cement is the current material of choice for this restoration. They are radiopaque and have been shown to prevent microleakage.



"Slot cavity preparations". It could be used when the lesion is less than 2.5 mm below the crest of the marginal ridge. The basic principles of cavity design remain the same, with the objective of removing only that tooth structure that has broken beyond the possibility of remineralization

"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 need not to be developed.

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 restoration differs from the design for a porcelain or gold inlay.

Topic 17: Filling materials. Classification. Requirements for them. Temporary filling materials: composition, properties.

Depending on what they are used for, modern filling materials are divided into materials:

1) for dressings and temporary fillings;
2) for pulp caps;
3) for insulating liners;
4) for permanent filling;
5) for root canal filling.

Depending to which group the tooth belongs, filling materials are distinguished:

1. For front group of teeth (filling materials should correspond to high esthetic requirements);
2. For molars and premolars (filling materials should stand high occlusion press).

According to the material from what restorative materials are produced, they are divided into:

1. Metals: amalgam, alloys, pure metals (gold).
2. Non metals: cements, resins, composite materials.

According to the purpose, filling materials are divided for:

1. Temporary fillings.
2. Permanent fillings.
3. Treatment(therapeutic) linings.
4. Isolative(insulating) linings.
5. Fillings for the root canal.

Temporary filling materials

1) Zinc-sulfate cements(dentin-powder, dentin-paste).
3) Zinc-eugenol cements.
5) Poly-carboxylate cements.
6) Zinc-phosphate cements.
7) Glass-ionomer cements.

Filling materials for linings

Isolative linings:

1) Zinc-phosphate cements.
2) Glass-ionomer cements.
3) Poly-carboxylate cements.

Treatment (therapeutic) linings:
1) Materials based on calcium hydroxide.
2) Zinc-eugenol cements.
3) Combined therapeutic pastes (not setting, are prepared ex tempore).

The filling materials of this group have to meet the next requirements:
- provide the hermetic sealing of the tooth cavity;
- be resistant enough to compression;
- be indifferent to the pulp, dental tissue, and medical substances;
- be easily introduced and removed from the cavity;
- do not dissolve in the oral fluid and saliva;
- do not contain ingredients that disrupt the processes of adhesion and hardening of permanent filling materials.

Medical bandages are imposed for a period of 1 - 14 days. Artificial dentin, dentin paste, zinc oxide-eugenol cements, vinoxole, and gutta-percha are used as dental bandages.

Temporary fillings are designed to be used for several months (usually up to six months). Most often zinc- eugenole, zinc phosphate, sometimes - polycarboxylate or glass ionomer cements are used for this purpose.

Permanent filling (restorative) materials are intended for restoration of the anatomical form function and appearance of the tooth preventing further development of caries. Since none of the currently available materials fully corresponds to all the requirements, the search and development in this direction continue. Today, the dental market is full of many various filling (restorative) materials of different chemical composition and properties.

Classification of regular restorative materials:

A. Hardening

1. Cements:

1.1. Mineral cements based on phosphoric acid:
a zinc phosphate;
b) silicate;
c) silico-phosphate.
1.2. Polymer cements (based on polyacrylic or other organic acids):
a) polycarboxylate;

b) glass ionomer.

2. Polymer filling materials (plastics):

2.1. Untilled:

a) based on acrylic resins;

b) based on epoxy resins.

2.2. Filled (composite).

3. Compomers are composition ionomer systems.

4. Metal filling materials:

4.1. Amalgam:

a) silver;

b) copper.

Gallium alloys.

4.3. Pure gold for direct tilling.

B. Primary solid

1. Inlays;

a) metal (cast);

b) porcelain;

c) plastic (including composite);

d) combined (metal + porcelain).

2. Veneers - adhesive crowns.

3. Retention devices:

a) parapulpar pins;

b) intrapulpar posts.

Topic 18. Therapeutic linings: groups, composition, properties, indications for use, methods of application.

Most modern permanent filling materials have an unfavorable effect on the dental pulp. That is why a liner should be placed between the permanent filling and the bottom of the carious cavity (especially it the cavity is within the dentin).

This liner must correspond to certain requirements:

- provide long-term dentin and dental pulp protection from chemical, thermal and galvanic action;
- prevent hypersensitivity alter preparation and filing;
- withstand mechanical load associated with redistribution of chewing pressure; improve fixation of permanent filling;
- be easily introduced into the cavity;
- quickly harden and get bound with the tooth tissues stronger than a regular filling material, so that in case of shrinkage of the latter the liner does not detach from the bottom of the cavity;
- have an anti-carious and remineralization effect on the dentin, not to be toxic for the pulp, not to affect the properties of permanent restoration material;
- the liner should not collapse under the influence of gingival and dentinal fluids, and in case of micro- leakage under the influence of oral fluid.

On the basis of the functions and features of material application certain kinds of insulating liners are singled out.

A. Basic liners - a thick (more than 1 mm) layer of liner material. Its purpose is to protect the pulp from thermal irritation (e.g. amalgam filings) and chemical irritants (while filling with cement and polymer materials), to create or preserve the optimal geometry of the carious cavity with preservation of retention properties, to reduce the volume (quantity) of permanent filing material (to reduce polymerization shrinkage of the filling and create under the filling a "cushion" of compensating forces that arise during mastication, to preserve the expensive composite, etc.).

B. Thin-layer liners are intended to isolate the pulp from chemical irritants; create strong binding between the cavity walls and permanent restoration material. It should be noted that thin liners do not protect the pulp from thermal stimuli. The materials for insulating liners are characterized by a great diversity. Today there are many domestic and imported materials of different purposes and properties.

Therapeutic (Treatment) linings

In the case of deep dental caries partial necrectomy is allowed, when the bottom of the cavity is very thin and there is a danger of the pulp horn disclosure, necrectomy is conducted with excavator. In this case is permitted to leave on the bottom of the cavity a layer of dense pigmented dentin, but in the course of acute deep caries – it is allowed to leave a small layer of softened dentin with the next remineralizing influence on it. In such cases it is recommended to use calcium hydroxide paste (“Life” KERR) as a treatment lining, it is placed for 14 days, with the subsequent filling of carious cavity with permanent filling material.

Indications for use:

For deeper cavities where there is less than 2 mm of remaining dentine, an insulating liner should be placed in the deepest aspects of the preparation. It is usual to place a small increment of hard-setting calcium hydroxide cement in the deepest aspects (but only if a pulp exposure is evident or a micro-exposure suspected).

Direct pulp coating - involves the application of drugs to the open surface of the pulp.

Indirect pulp coating. Two-stage gradual caries treatment, or targeted coating of the pulp dentin after complete removal of carious dentin from the tooth cavity in case of deep caries.

The thickness of calcium hydroxide lining is should be no more than 0,3 mm.

Objectives of pulp protection are as follows:

■ Therapeutic:

1. Stimulate odontoblasts to lay down reparative dentine.
2. Encourage remineralisation of dentine.
3. Act against any remaining bacteria.

■ Protect from chemicals. These may come from the oral cavity, bacteria or from the restorative material.

■ Protect from temperature. Metal restorative materials, such as amalgam and gold, will transmit changes in temperature from the oral cavity and, in the absence of a suitable layer of dentine in deep cavities, additional protection must be provided.
■ Seal the dentinal tubules. This will prevent fluids containing bacteria, molecules and ions entering the dentinal tubules, and as a result prevent pain and possible further caries.

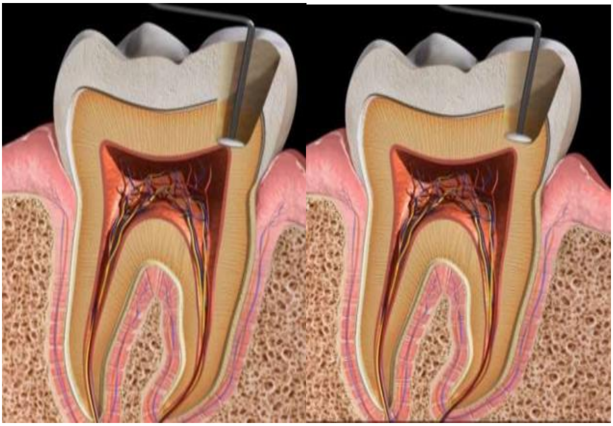
Methods of pulp protection with insulating lining.

This method depends upon the type of cavity.
The modern concept of insulating lining usage is as follows:
■ Minimal cavities: either a dental adhesive is used to seal the dentinal tubules or no pulp protection + filling material.
■ Moderately deep cavities: a layer of a resin-modified glass ionomer is used to give thermal and chemical protection + filling material.
■ Deep cavities: a thin layer of setting calcium hydroxide as a therapeutic lining is applied, followed by a layer of resin-modified glass ionomers + filling material.

Techniques for placement:

A small ball-ended instrument is used to place the setting calcium hydroxide material. The calcium hydroxide should be placed in a thin layer on the deepest part of the cavity. For the glass ionomer, a flat plastic or ball-ended plastic is used and the material is applied to the pulpal floor and/or pulpal wall, depending on the cavity shape. The lining material should not extend to the cavity margins.

Calcium hydroxide cements. Some calcium hydroxide preparations consist simply of a suspension of calcium hydroxide in water. This is applied to the base of the cavity and dries out to give a layer of calcium hydroxide. These materials are both difficult to manipulate and form a very friable cavity lining which is easily fractured. A solution of methyl cellulose in water or of a synthetic polymer in a volatile organic solvent can be used instead of water. These additives produce more cohesive cement but the compressive strength remains very low at about 8 MPa. This is well below the value of strength required to withstand amalgam condensation and when this filling material is to be used the calcium hydroxide preparation must be overlaid with a layer of stronger cement. Most calcium hydroxide products in current use are supplied in the form of two components, normally pastes, which set following mixing to form a more substantial cavity lining.



Direct pulp capping ***Indirect pulp capping***

Topic 19. Dental cements, their classification. Zinc-phosphate, silicate and silicophosphate cements: composition, positive and negative qualities, indications and rules for use. Isolation of pulp: concept, types. Application of insulating pads in carious cavities of I-V classes according to Black.

The international classification of cements:

1. Zinc-phosphate cement;
2. Bactericidal cement;
3. Silicate cement;
4. Silico-phosphate cement;
5. Zinc-oxide eugenol cement;
6. Carboxylate cement;
7. Glassionomer cement;
8. Polymeric cement.

Zinc phosphate cement (ZPC, phosphate cement) is a strong and dense material, which is slightly irritatative for the pulp. This is a powder- liquid system. The powder is mainly zinc oxide and the liquid - is water solution of phosphoric acid. Despite the emergence of modern liner materials, practitioners are still highly interested in ZPCs.

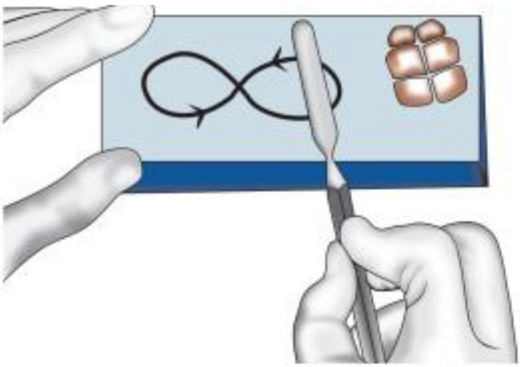
The use of ZPC liners in deep carious cavities is contraindicated. This is due to their irritant action on the pulp because of free phosphoric acid and release of heat during hardening. Even in case of average caries many authors recommend reducing the harmful effects of phosphate cement by covering the dentin with insulating varnish before overlaying the liner. On the dental market we can find both domestic and imported ZPCs: Phosphate Cement, Silver-Enriched Phosphate Cement, Unifas (JSC Medpolimer), Adhesor (Dental Spota), Bayer Phosphatzement (Heraeus/Kulzer), DeTrey Zinc (Delrey/ Dentsply), Harvard Cement (Harvard), Phosphacap, Tenet (Vivadent), Poscal (Voco). To improve mechanical properties and to add antibactericidal effect phosphate cements are enriched with metals or their salts. This group includes silver-containing cements: Argil (Dental Spofa) and Silver-Containing Phosphate Cement, Bactericidal Phoszyn (Raduga-R); copper phosphate-containing cements: Harvard

Kupierzement (Harvard) and Rron Fix N (Merz); and bismuth oxide-containing cements: Visphat-cement, Dioxy-visphat (SC Medpolimer).

Sometimes practitioners add some thymol to make phosphate cement antibacterial. Despite the fact that these materials have antibacterial properties, their use as curing liners in deep caries is not recommended because of their irritative effect on the pulp.

Hydrophosphate cement. It is prepared with distilled water, besides about 35 % of phosphate anhydride is introduced into the powder. After mixing the powder with water there forms phosphoric acid, which causes the hardening reaction. The mechanical properties of the cement are slightly worse than those of common ZPCs. For this reason hydrophosphate cements were not widely used.

Zinc phosphate cement should be mixed on large area of glass slab to dissipate the exothermic heat of reaction



Silicate cement

Silicate cements differ from zinc-phosphate mainly by the composition of the powder, which is the thin crushed glass and consist of silicium dioxide (up to 47%) and aluminium oxide (up to 35%), calcium, fluorides (to 15 %). Liquid – ortophosphoric acid similar applied in phosphate cement.

These cements are rarely used because of bad adhesion and pulp irritating effect.

Application:

- for filling caries cavities of 3 and 5 classes by Black;

- for filling caries cavities of 1 class by Black.

Zinc silicophosphate cements:

Zinc silicophosphate cements (ZSPC) consist of a mixture of silicate glass and zincphosphate cement.

Composition

- Powder contains an acid soluble silicate, zinc and magnesium oxides.
- Liquid consists of phosphoric acid.

Properties of zinc silicophosphate cements

- Translucent and more esthetic than zinc phosphate cement.
- Anticariogenic because of fluoride release from this cement.
- Has sufficient strength.

Zinc-oxide eugenol cements.

Zinc-oxide eugenol cement (ZOE)
cement have been used extensively in dentistry since 1890s. They are cements of low strength. Also they are the least irritating of all dental cements and are known to have an obtundant effect on exposed dentin.

Classification:

- Type I – for temporal cementation;
- Type II – for permanent cementation;
- Type III – for temporary filling and thermal base;
- Type IV – as cavity liners.

ZOE cement is available as powder and liquid or two – paste system. The set cement consists of particles of zinc oxide embedded in a matrix of zinceugenolate.

Positive properties:

- Antiseptic action.
- Low heat conductivity.

Negative properties:

- Bad adjoins to cavity walls.
- Bad physio-mechanical and handling properties.
- Break polymerization of composites.
- Paint a tooth crown.
- Can irritate the pulp and periodontium.

Topic 20. Glass ionomer cements: classification, composition, properties, positive and negative qualities, indications for use. Dental accessories for its restoration. Grinding and polishing of fillings: tools, products, techniques. The concept of post-bonding.

Glass ionomer cements (GICs) combine low toxicity, high strength, satisfactory aesthetic characteristics, and anticarious activity.
The interest in this group of filling materials has grown recently. GICs can be used to apply both basic and thin-layer liners, insulating liners, permanent filling, to tix orthopaedic prostheses.

Modern GIC Classification

Nowadays, the most common classification of glass ionomer cements is based on J. McLean's classification (1988):

Type 1 - fixation GIC.

Type 2 - recovery GIC for permanent fillings:

a) esthetic;

b) improved;

c) condensed.

Type 3 - quickly hardening GIC.

a) tor liners;

b) fissure sealants.

Type 4 - GiC used for root canal filling.

Indications for clinical use of GIC:

- fixation of orthopedic constructions;
- application of basic liners under metal and composite fillings;
- hermetization o fissures; filling of carious cavities in temporary and permanent teeth, including root caries,
- filling of carious lesions of the teeth;
- ART method of caries treatment;
- restoration of tooth stump.

"Classical" glass ionomer cement is a powder-liquid system. The powder Is calcium alumosilicate glass with the addition of fluoride (23 %); the liquid is a solution of polycarbonate acids: polyacrylic and polymaleic. During the process of cement hardening there takes place cross-linking of polymer molecule acids, calcium and aluminium ions, which are extracted from the glass.

The main positive features of GIC:

1. Chemical adhesion to the tooth tissues. Chemical bonds of GIC with enamel and dentin is formed by the chelate compounds of carboxylate groups of the polymer molecule of the acid with calcium of the hard dental tissues. Acid etching and absolute dryness of the tooth surface are not necessary. In addition, at the final stage of hardening there is a slight increase in glass ionomer weight that provides more precise regional bonding. It should be remembered that the strength of GIC adhesion to the enamel and dentin is relatively low (2.7 MPa), so chemical bonding of the hard tissues is important not so much for connection strength, as for ensuring tightness along the line of contact of the filling material with the hard tooth structures (N. V. Bidenko, 1999). GIC should be preferred in non-carious lesions of the hard dental tissues, because this pathology is characterized by the structural change of the enamel, so dentin composites and adhesive systems of composites, which are designed for the normal structure of these tissues, are ineffective. From the practical point of view an important fact is that due to chelate and hydrogen bonds GIC form chemical adhesion to the composites, stainless steel, alloys of gold, platinum, and also eugenol-containing materials.

2. The anti-carious activity is provided by prolonged emission of fluorine from the cement mass in the oral environment. This process begins immediately after filling and continues for at least one year. The diffusion of fluoride to the surrounding tissues increases their mineralization, formation of fluorapatite in the enamel and dentin that is adjacent to the filling. This improves acid strength and reduces dentin permeability, deteriorates the living conditions of microorganisms, and prevents recurrent caries.

3. Sufficient mechanical strength and elasticity. GCs have a high compressive strength and low elasticity coefficient.

The satisfactory esthetic properties make glass ionomer cements a material of choice in the clinical situations where composite cannot be used for different reasons:

- high biological compatibility, non-toxic, the absence of irritating effect on the dental pulp.;
- ease of use. This factor is important in treatment of children, the elderly and the senile, and in other situations where the patient can not sit still for a long time.

- a relatively low cost (compared to composites) for a fully satisfactory quality of the filling makes GIC the basic material for provision of free dental care to low-in-come people, in case of filling teeth with a doubtful prognosis (e.g. in severe periodontitis), during filling of temporary teeth, etc.

Classification of glass ionomer cements based on the curing mechanisms.

- "Classic" two-component chemical-cure GICs (system powder - liquid).
- Two-component aqua chemical- cure cements (system powder water).
- Hybrid dual-cure GICs.
- Hybrid triple-cure GICs.
- The polymer of unicomponent photopolymeric materials with a glass iono-mer filler.

Manipulation

The prepared cavity should first be conditioned with a dentine conditioner, the most common one being 10% polyacrylic acid. The conditioner removes the smear layer and debris from the prepared cavity walls, allowing a clean surface to bond to, but leaves smear plugs intact so as to prevent contamination of the cleaned dentine surface with dentinal tubular fluid. The acids used for the bonding of resin composite should not be used for conditioning prior to glass ionomer placement, as the low molecular weight of these acids would demineralize the dentine, leaving less calcium available for the ion-exchange bonding mechanism. The polyacrylic acid conditioning agent should only be applied for a short time, about 10 seconds, and should be washed off thoroughly before drying, without dehydrating the dentine. Care must be taken when handling this class of materials since they are quite technique-sensitive and errors could lead to a potentially compromised clinical outcome. Manufacturers of these cements recommend that the powder and liquid are dispensed in defined ratios and then mixed rapidly with a spatula within 30–45 seconds. The general rule is to first incorporate half the amount of the powder into the liquid and then mix in the other half. The stainless steel cement spatula is most often used, although in some practices a plastic spatula is preferred to avoid potential discoloration. As with all powder–liquid formulations care must be taken to dispense the powder and liquid accurately so as to prevent operational variability. The working and set times are dependent on the powder/liquid ratio. The cement should be used immediately after mixing because the working time is only a few minutes at room temperature. If the ambient temperature is high, working time is even further decreased. If a skin forms over the cement, the mix should be discarded – otherwise adhesion will be compromised. The manipulation is easier for encapsulated versions although it is important to follow the manufacturers' recommended speed and times for trituration of the capsules. Conventional glass ionomers are quite susceptible to moisture contamination. After initial set and removal of excess cement, it is often advisable to coat the cement margins with a sealing agent supplied by the manufacturer.

Finishing and Polishing

Surface of glass ionomers is sensitive to both moisture contamination and desiccation. During initial phase of cement setting, it is always preferred to delay finishing and polishing of glass ionomer cements. It is delayed for at least 24 hours after the cement placement because by then, the surface of restoration attains ionic equilibrium in the environment. But in case of resin modified glass ionomer cements, finishing is started after their placement.

After placing the restoration, gross finishing is done following the matrix removal. Before starting the finishing procedure, the surface of restoration is coated with protective agent. A sharp knife is used to remove the extra cement. For this, rotary or hand-cutting instruments can also be used though it is believed that hand-cutting instruments can tear or pull the restoration margins leading to marginal breakdown. Final finishing of restoration is done with the help of superfine diamond points, soflex disk and abrasive strips in moist condition.

After final finishing and polishing is done, surface of restoration is protected using petroleum jelly, varnish or bonding agent. Surface Protection Since glass ionomers show sensitivity to both moisture contamination and surface desiccation, the newly placed restoration should always be protected immediately after matrix removal so as to prevent water exchange.

It can be done with the help of resin bonding agent, cocoa butter, petroleum jelly or varnish. Among these, resin bonding agents provide the best surface protection as they fill the microporosities of the surface and stay for longer time in comparison to other agents.

Topic 21. Silver and copper amalgam: composition, properties, positive and negative qualities, indications and rules of use. Features of grinding and polishing of the filling.

Dental amalgam is an alloy of mercury with silver, tin, and varying amounts of copper, zinc and other minor constituents. Dental amalgam alloys are silver tin alloys with varying amounts of copper, zinc and other metals.

Advantages

• Ease of manipulation. Amalgam is easier to manipulate and less technique sensitive. It can be completed in one dental visit.

• Self-sealing ability. Corrosion products formed at interface of amalgam restoration and tooth seal the amalgam against microleakage. Amalgam also shows satisfactory marginal adaptation.

• High compressive strength. Physical characteristics of amalgam are comparable to enamel and dentin.

• Biocompatible. Amalgam is a biocompatible material.

• Good wear resistance. Because of good wear resistance amalgam can be used in patients with moderate to heavy occlusal loads.

• Economical. Cost of amalgam is much less than composites, ceramics and cast restorations.

• Can be bonded to tooth structure. Bonded amalgam restorations can bond to tooth structure. This results in better bonding and strengthening of the remaining tooth structure.

• Favorable long-term clinical results. Amalgam has shown long history of successful use.

Disadvantages

• Less esthetic. Silver grey color of amalgam makes it unesthetic.

• Need extensive tooth preparation. Since amalgam does not bond to the tooth structure, an extensive preparation is required to hold an amalgam filling.

• Corrosion. Amalgam fillings can corrode or tarnish overtime, causing discoloration.

• Noninsulating. Being metallic restoration, it transmits thermal sensation to the pulp making it noninsulating.

• Marginal degradation. Marginal degradation is seen in low copper alloys.

• Lack of reinforcement of weakened tooth structure. Amalgam is not strong enough to reinforce the weakened tooth structure.
• Brittle material. Poor tensile strength making amalgam a brittle material.
• Galvanism. Results in galvanic current in association with gold restoration or even in same restoration with nonuniform condensation.
• Oral lichen planus. It is also seen with amalgam restoration.

Classification

• *Based on shape of particles*
– Irregular. In this, shape of particles is irregular, may be in the shape of spindles or shavings.
– Spherical. In this, shape of particle is spherical with smooth surface.
– Spheroidal. In this, shape of particle is spheroidal with irregular surface.
• *Based on copper content*
– Low copper alloy. Copper is in range of 2 to 6%.
– High copper alloy. Copper is in the range of 6 to 30%.
• Based on zinc content
– Zinc containing alloys. Zinc is in range of 0.01–1%.
– Zinc free alloys. Zinc is in the range of < 0.01%.
• *Based on the presence of alloyed metals*
– Binary alloys. Contains two metals, i.e. silver and tin.
– Ternary alloys. Contain three metals, i.e. silver, tin and copper.
– Quaternary alloys. Contain four metals, i.e. silver, tin, copper and zinc. Out of these, quaternary alloys are most acceptable.
• *Based on whether alloy is unmixed or admixed*
– Single composition or unicompositional. Each particle of alloy has same chemical composition
– Admixed alloys. These are physical blend of lathe cut and spherical particles.
• *Based on presence or absence of noble metals*
– Noble metal alloys. Contain small amount of gold or platinum
– Non-noble metal alloys. Don’t contain noble metals.

Composition

Amalgam consists of amalgam alloy and mercury. Amalgam alloy is composed of silver-tin alloy with varying amounts of copper, zinc, indium and palladium. Dental amalgam alloys are mainly of two types, low copper and high copper alloys. Low copper alloys contain copper up to 6% by weight and high copper alloys contain copper between 6 to 30%.

Effects of Constituent Metals on Properties of Amalgam

Silver:

It has the following effects on the properties of amalgam.

• Increases strength.
• Increases setting expansion.
• Reduces setting time.
• Resists tarnish and corrosion.
• Decreases flow.

Tin: Tin helps in formation of a silver/tin compound (AgSn). This is the gamma phase which readily undergoes an amalgamation reaction with mercury.

Tin causes following effects:

• Increases setting time.
• Retards the reaction.
• Reduces strength, hardness, and setting expansion.

Copper: It has the following effects on the properties of amalgam.

• Reduces corrosion.
• Reduces creep.
• Strengthening effect on the set amalgam.
• Helps in uniform comminution of the alloy.

Zinc: Its presence is not essential. It may vary from 0 to 2 percent by weight. It has the following effects on the properties of amalgam:

• Scavengers the available oxygen to impede oxidization of Ag, Sn or Cu during alloy ingot manufacturer.
• If zinc containing alloys are contaminated with moisture, Zn gives rise to delayed or secondary expansion.

Palladium (0 to 1% by weight): Improves the corrosion resistance and the mechanical properties.

Types

Lathe-cut is made by cutting fillings of alloy from a prehomogenized ingot which was heat treated at 420°C for many hours. Fillings are then reheated at 100°C for 1 hour for aging of the alloy.

Spherical (spheroidal) alloy is formed when molten alloy is sprayed into a column filled with inert gas, this molten metal solidifies as fine droplets of alloy.
Admixed alloy is that when different size or shape of amalgam powder is mixed together to increase filling efficiency.
Single composition is that alloy in which every particle of alloy is having same shape, size and composition.
Dispersion modified, high copper alloys is that in which high copper alloy is mixed with conventional alloy.

Generations of Dental Amalgam

Class–I Silver and tin in ratio (8:1).
Class–II Silver, tin, copper (4%), zinc.
Class–III Silver eutectic alloy added to original alloy.
Class–IV Copper content increased to 29%.
Class–V Indium added to mixture of silver, tin and copper.
Class–VI Noble metals added such as palladium/

Setting reactions

The reaction which takes place when alloy powder and mercury are mixed is complex. Mercury diffuses into the alloy particles; very small particles may become totally dissolved in mercury. The alloy structure of the surface layers is broken down and the constituent metals undergo amalgamation with mercury. The reaction products crystallize to give new phases in the set amalgam. A considerable quantity of the initial alloy remains unreacted at the completion of setting.

Indications

Clinical Indications for Direct Amalgam Restorations

Because of the factors already presented, amalgam is considered most appropriate for the following indications:

1. Moderate to large Class I and II restorations (especially restorations that involve heavy occlusion, cannot be isolated well, or extend onto the root surface).
2. Class V restorations (including restorations that are not esthetically critical, cannot be well isolated, or are located entirely on the root surface).

3. Temporary caries-control restorations (including teeth that are badly broken and require a subsequent assessment of pulpal health before a definitive restoration).
4. Foundations (including for badly broken teeth that require increased retention and resistance forms in anticipation of the subsequent placement of a crown or metallic onlay).

Contraindications

Esthetics

- Use of amalgam is avoided in esthetic areas of oral cavity. So, preparations class III, IV, V usually are not indicated except in certain cases.

Small to Moderate Class I and Class II Preparations

- These cases should be restored with composite rather than amalgam as former results in more conservative tooth preparation.

Grossly Decayed Teeth

- In grossly decayed teeth, amalgam is not indicated because it does not reinforce the remaining tooth structure. These teeth should be restored using cast restorations.

Finishing and Polishing

At placement, contouring of the amalgam is carried out using various instruments, according to the clinician's preference and the specific circumstances. Carving should always be across margins on to adjacent tooth tissue to optimise marginal adaptation. The surface of the carved amalgam should be lightly compacted and smoothed with a burnisher hand instrument. This technique, sometimes referred to as resurfacing, aims to homogenize the amalgam forming the surface of the restoration and to readapt the material to cavity margins – in particular, where it may have been carved away.

The surface of the amalgam may be given a uniform luster with a damp cotton wool pellet held in tweezers. This procedure aids refinements at a subsequent visit and improves marginal integrity. Excessive manipulation of the surface of a newly placed amalgam should be avoided to prevent gouging or damage to the structure.

At the next appointment, the surface of the amalgam can be refined, if required, using steel finishing burs, with water coolant to avoid overheating and to reduce the amount of mercury vapour released. Steel finishing burs are available in a range of sizes and shapes to aid access to all aspects of the restoration.

An exception to the normal protocol is high-copper amalgams with high early strength. Restorations of these amalgams may be polished 8–10 minutes after the start of trituration, to avoid the need for the patient to attend for a second appointment.

Polishing is a procedure that makes amalgam restorations look their best, but it makes little difference to clinical performance. Polishing can be carried out in a number of different ways. The traditional method entails polishing with flours of pumice, mixed with water, followed by zinc oxide powder in an alcohol slurry, applied using a prophylaxis cup in a low-speed handpiece. This is a low-cost option for polishing, but it has the disadvantage of splatter from the rotating cup, which can be very messy and unpleasant for the patient. These procedures produce a mirror-like surface finish on an amalgam.

Amalgam restorations may also be polished using rubber cups impregnated with abrasive particles or aluminium oxide discs. These devices should be used with water coolant to avoid excessive heat generation in the restored tooth.

Topic 22. Composite materials: classification, composition. Materials of chemical and photopolymer curing methods: positive and negative qualities, indications for use, methods of application. Photopolymerizers: purpose, types, physical and technical characteristics. Safety precautions for working with them. Modes of light exposure.

The modern classification of composite filling (restorative) materials was developed considering a number of factors:

1. The amount of the filler:
a) macrofilled (particle size 8- - 45 um);
b) microfilled (0.04 -0.4 m);
c) mini-filled composites with small particles (particle size of 1 - 5 pm);
d) hybrid (a mixture of particles of different size from 0.04 to 5 m), including microhybrid (hybrid composites with the particle size of 0.04 to 1 m, average particle size of 0.5 - 0.6 m).

2. The method of curing:
a) chemical curing - type I;
b) heat curing - type lA;
c) light curing - type I;
d) dual curing:
light + chemical;
light + heat.

3. Consistency:
a) "classical" composites of normal consistency;
b) liquid (fluid) composites;
c) condensed composites.

4. Purpose:
a) filling of the masticatory teeth;
b) filling of the front teeth;
c) universal composites.

Macrofilled composites

The macrofiled composites contain particles of an inorganic filler of large size (8 - 45 mm, sometimes about 100 um).

The advantages of macrofilled composites:

- sufficient strength;
- acceptable optical properties;
- radioopacity.

However, over the long term of clinical use some disadvantages of this group of composites have been found:

- polishing difficulties;
- high roughness of the surface;
- accumulation of dental plaque;
- bad colour stability.

The indications for the use of macrofilled composites:

- filling of the I class cavities;
- filling of the V class cavities in the masticatory teeth;
- filling of the front teeth cavities it the aesthetic effect is not a priority (for example, carious cavity localization on the tongue surface);
- restoration of badly damaged crowns of the front teeth with subsequent restoration of the vestibular surface with microfilled materials;
- filling the II class cavities in the premolars in the molars they are a material of choice);
- modelling tooth stumps to be used under crowns (Coradent (Vivadent), Rebilda (Voco)).

Microfilled composites

The high aesthetic requirements for filling materials led to creation of microfilled composites. As fillers there are used very small particles with a size of 0.04 - 0.4 um, typically silicon dioxide. The advantages of microfilled composites:

- good grindability;
- stability of glossy surface;
- high colour stability;
- satisfactory aesthetic quality;

At the same time, microfilled composites have such drawbacks:

- insufficient mechanical strength;
- a high coefficient of thermal expansion.

The indications for the use of microfilled composites:

- filling of the Ill class cavities;
- filling of the V class cavities;
- filling of the defects in non-carious teeth lesions (enamel erosion, hypoplasia, wedge-shaped defects etc.);

- aesthetic filling of the IV class cavities and traumatic injury of the crown (in combination with hybrid or macrofilled composites and pulp pins).

Minifilled composites

The filler particles usually have a size of 15 um. They occupy an intermediate position between the micro- and macrofilled composites. These materials have satisfactory aesthetic and physic- mechanical properties; they are used for the restoration of the masticatory (small cavities) and front teeth. However, due to the lack of durability and colour stability they are not very common in dental practice.

Hybrid composite

Resins Hybrid composites are named so because they are made up of polymer groups (organic phase) reinforced by an inorganic phase. Hybrid composites are composed of glasses of different compositions and sizes, with particle size diameter of less than 2 µm and containing 0.04 µm sized fumed silica. Filler content in these composites is 75 to 80% by weight. This mixture of fillers is responsible for their physical properties similar to those of conventional composites with the advantage of smooth surface texture.

Advantages

• Availability in various colors.
• Different degrees of opaqueness and translucency in different tones and fluorescence.
• Excellent polishing and texturing properties.
• Good abrasion and wear resistance.
• Similar coefficient of thermal expansion.
• Ability to imitate the tooth structure.
• Decreased polymerization shrinkage.
• Less water absorption.

Disadvantages

• Not appropriate for heavy stress bearing areas
• Not highly polishable as microfilled because of presence of larger filler particles in between smaller ones
• Loss of gloss occurs when exposed to toothbrushing with abrasive toothpaste.

Two new generations of hybrid composite resins are:

1. Nanofill and nanohybrids
2. Microhybrids.

Flowable Composite

Filler content is 60% by weight with particle size ranging from 0.02 to 0.05 μm. Low filler loading is responsible for decreased viscosity of composites, which allows them to be injected into small preparations, this makes them a good choice for pit and fissure restorations. But incorporation of lower filler content results in poor mechanical properties of these composites than conventional composites.

Indications

• Preventive resin restorations.
• Small pit and fissure sealants.
• Small, angular Class V lesions.
• For repairing ditched amalgam margins.
• Repair of small porcelain fractures.
• Inner layer for Class II posterior composite resin placement for sealing the gingival margin.
• Resurfacing of worn composite or glass ionomer cement restorations.
• For repair of enamel defects.
• For repair of crown margins.
• Repair of composite resin margins.
• For luting porcelain and composite resin veneers.
• Class I restorations.
• Small Class III restorations.
• As base or liner.
• Tunnel restorations.

Contraindications

- High stress areas like class I and II cavities because of low strength and more wear.

Condensable (Packable) Composites

Condensable/packable composites have improved mechanical properties and handling characteristics. Main basis of packable composites is Polymer Rigid Inorganic Matrix Material (PRIMM). Here components are resin and ceramic inorganic fillers which are incorporated in silanated network of ceramic fibers. These fibers are composed of alumina and silicon dioxide which are fused to each other at specific sites to form a continuous network of small compartments. Filler content in packable composites ranges from 48 to 65% by volume with average particle size ranging from 0.7 to 20 µm.

Properties of packable composites:

- Packable composites posses improved mechanical properties because of presence of ceramic fibers.
- Improved handling properties because of presence of higher percentage of irregular or porous filler, fibrous filler and resin matrix.
- Consistency of condensable composites is like freshly triturated amalgam, so it can be pushed into posterior tooth preparation and has greater control over proximal contour of Class II preparations.
- High depth of cure due to light conducting properties of ceramic fibers. Each increment of composite can be condensed like amalgam and cured to a depth of over 4 mm.
- Low polymerization shrinkage.

Indications

- Indicated for stress-bearing areas.
- In Class II restorations as they allow easier establishment of physiological contact points.

Compomers (Polyacid Modified Composite Resins)

Compomers provide combined advantages of composites (term ‘Comp’ in their name) and glass ionomer (‘Omers’ in their name). They are available in single paste, light enable material in syringe or compules.

Light curing of resin composites is initiated by light in the wavelength range 450–500 nm. This blue light can damage the eyes so an orange filter should be used when the light is in use. The tip of the light source should be placed as close as possible to the surface of the restoration and each increment of composite should be cured for 40–60 seconds. Under-cured composites will readily absorb stain and will rapidly degenerate.

Polymerisation shrinkage of the resin during curing (in the order of 2–3%) still occurs and may contribute to marginal defects, cuspal distortion and crack formation in the enamel or dentine, and may therefore contribute to postoperative pain or sensitivity for the patient. There are, however, a number of clinical techniques available to overcome these problems and the longevity of restorations using the newer resin composites is much improved over that of the original materials.

Reducing the effect of polymerisation shrinkage may be achieved by incremental packing of the composite. Each increment should touch as few walls of the cavity as possible. The stress induced by polymerization shrinkage is highest in cavities with more bonded than unbonded surfaces: the occlusal cavity has the potential for the most stress.

Setting mechanisms of resin composite

Types of setting mechanisms:

• Chemical cure (self-cure / dark cure)
• Light cure
• Dual cure (setting both chemically and by light)
• Chemically cured resin composite is a two-paste system (base and catalyst) which starts to set when the base and the catalyst are mixed together.
• Light cured resin composites contains a photo-initiator (e.g. camphorquinone) and an accelerator. The activator present in light

activated composite is diethyl-amino-ethyl-methacrylate (amine) or diketone. They interact when exposed to light at wave length of 400-500 nm, i.e, blue region of the visible light spectrum. The composite sets when it is exposed to light energy at a set wave length of light. Light cured resin composites are also sensitive to ambient light, and therefore, polymerisation can begin before use of the curing light.

• Dual cured resin composite contains both photo-initiators and chemical accelerators, allowing the material to set even where there is insufficient light exposure for light curing.

• Chemical polymerisation inhibitors (e.g. monomethyl ether of hydroquinone) are added to the resin composite to prevent polymerisation of the material during storage, increasing its shelf life.

Curing Lamps Different types of lights used in curing are:

• Tungsten-quartz halogen (TQH) curing unit.
• Plasma arc curing (PAC) unit.
• Light emitting diode (LED) unit.
• Argon laser curing unit.

Topic 23. Adhesion: concept, types. Adhesive systems: composition, principle of interaction with tooth tissues, application technique. Acid etching, conditioning: purpose, technique, errors and complications. Standard technique for working with composite materials of chemical and light curing methods.

Bonding and adhesion comprise a complex set of physical, chemical and mechanical mechanisms that allow the attachment and binding of one substance to another.

Enamel consists of 95% mineralized inorganic and 4% organic substance. Buonocore, in 1955, was the first to reveal the adhesion of acrylic resin to acid etched enamel. He used 85% phosphoric acid for etching, later Silverstone revealed that the optimum concentration of phosphoric acid should range between 30 to 40% to get a satisfactory adhesion to the enamel.

Standard treatment protocol for etching is use of 37% phosphoric acid for 60 seconds. But now studies have shown that enamel should not be etched for more than 15 to 20 seconds

Etching. It is the process of increasing the surface reactivity by demineralizing the superficial calcium layer and thus creating the enamel tags. These tags are responsible for micromechanical bonding between tooth and restorative resin.

Effects of Etching

- Cleanses debris from enamel.
- Produces a complex three-dimensional microtopography at the enamel surface.
- Increases the enamel surface area available for bonding.
- Produces micropores into which there is mechanical interlocking of the resin.
- Exposes more reactive surface layer, thus increasing its wettability.

Enamel Bonding

Bonding to enamel requires two clinical steps;

1) Acid etching.

2) The application of the adhesive resin to the etched surface.

Usually 37% phosphoric acid is used for 15 to 30 seconds.

The goals of enamel etching are:

1) to clean enamel surface from debris,

2) to increase the enamel surface area available for bonding, and

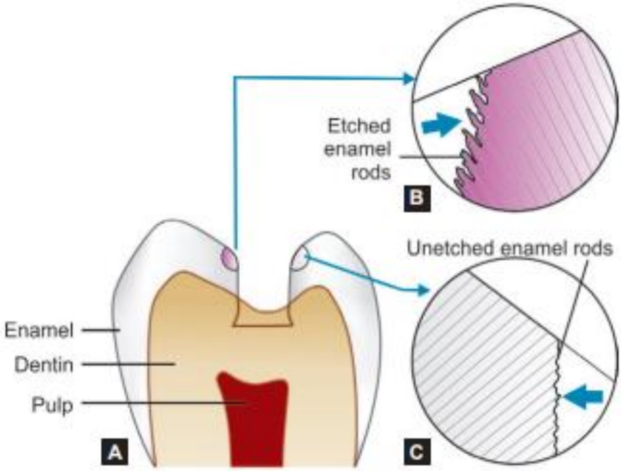
3) to partially dissolve the mineral crystallites to create retentive microporosities into which the resinous bonding agent can infiltrate and form retentive resin tags (micromechanical retention).
4) In addition, acid etching increases the surface energy and lowers the contact angle of resins to enamel.

Procedure

Apply acid etchant in the form of liquid or gel for 15 to 30 seconds.
• Wash the etchant continuously with water for 10 to 15 seconds.
• Note the appearance of a properly etched surface. It should give a frosty white appearance on drying.
• If any sort of contamination occurs, repeat the procedure.
• Now apply bonding agent and low viscosity monomers over the etched enamel surface.

Generally, enamel bonding agents contain Bis-GMA or UDMA with TEGDMA added to lower the viscosity of the bonding agent. The bonding agents due to their low viscosity, rapidly wet and penetrate the clean, dried, conditioned enamel into the microspaces forming resin tags. The resin tags which form between enamel prisms are known as Macrotags.
• Finer network of numerous small tags is formed across the end of each rod where individual hydroxyapatite crystals were dissolved and are known as microtags. These microtags are more important due to their larger number and greater surface area of contact. Micro and macrotags within the enamel surface constitute the fundamental mechanism of enamel-resin adhesion.

Difference in appearance of etched and unetched enamel rods



DENTIN BONDING

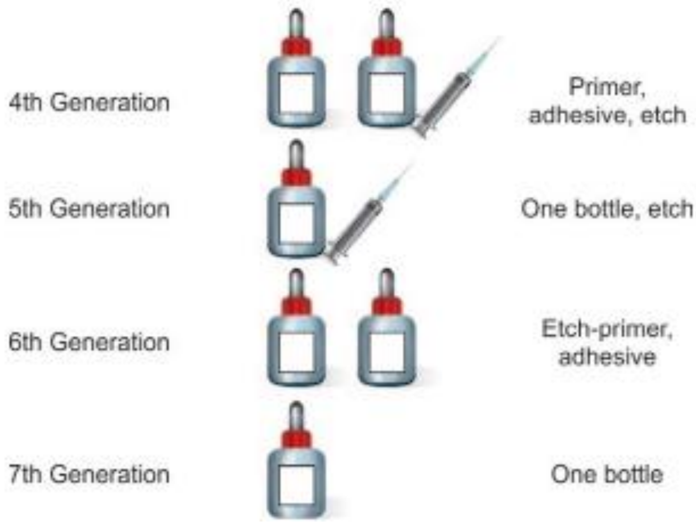
Bonding to dentin has been proven more difficult and less reliable and predictable than enamel. This is because of difference in morphologic, histologic and compositional differences between the two.

Problems Encountered during Dentin Bonding

- In enamel, it is 95 percent inorganic hydroxyapatite by volume, in dentin it is 50 percent. Dentin contains more water than does enamel.
- Hydroxyapatite crystals have a regular pattern in enamel whereas in dentin, hydroxyapatite crystals are randomly arranged in an organic matrix.
- Presence of smear layer makes wetting of the dentin by the adhesive more difficult.
- Dentin contains dentinal tubules which contain vital processes of the pulp, odontoblasts. This makes the dentin a sensitive structure.
- Dentin is a dynamic tissue which shows changes due to aging, caries or operative procedures.
- Fluid present in dentinal tubules constantly flows outwards which reduces the adhesion of the composite resin.

Ideal Requirement of Dentin Bonding Agent Ideal requirements of dentin bonding agent are:

• Provide optimal bond strength similar to bond strength of composite to resin.
• Biocompatibility.
• Long-term stability.
• Attain high bond strength early.
• Be easy to apply and not be technique sensitive.



Classification of Modern Adhesives Based on Generations

• First generation bonding agent.
• Second generation bonding agent.
• Third generation bonding agent.
• Fourth generation bonding agent.
• Fifth generation bonding agent.
• Sixth generation bonding agent.
• Seventh generation bonding agent.

Based on Smear Layer Treatment

• Smear layer modifying agents.

- Smear layer removing agents.
- Smear layer dissolving agents.

Generation	*No. of steps*	*Steps description*
First	2	Etch enamel + Apply adhesive
Second	2	Etch enamel + Apply adhesive
Third	3	Etch enamel + Apply primer + Apply bonding agent
Fourth	3	Total etch + Apply primer + Apply bonding agent
Fifth	2	Total etch + Apply bonding agent
Sixth	1	Apply self-etch adhesive
Seventh	1	Apply self-etch adhesive

Topic 24. Endodontics - its tasks and goals. Endodontic instruments: classification, variety, purpose, rules of application. ISO standards. Optical systems for endodontic manipulations.

Endodontics it's the science that study anatomy, pathology and treatment of tooth cavity and root canals.

The goal of endodontic therapy is to relieve pain, control infection, and preserve the tooth so that it may function normally during mastication. Endodontic treatment is normally preferred to extraction.

Classifications of Endodontic Instruments:

1-ISO classification (according to method of use):

- Group I: manually operated instruments. E.g. K- and H-file.
- Group II: low-speed instruments with latch-type attachment. E.g. gates glidden drills and peeso reamers.
- Group III: engine-driven rotary Ni-Ti files. E.g. Ni-Ti ProTaper rotary files. (continuous rotation)
- Group IV: engine-driven instruments that adjust themselves to shape of root canal. Self Adjusting file (SAF).
- Group V: engine driven reciprocating instruments. E.g. Wave-one and reciprocating rotary Ni-Ti files.
- Group VI: ultrasonic instruments.

2-grossman classification (according to function).

- Exploring instruments: such as endodontic explorer & smooth broach.
- Extirpating instruments: for removal of pulp tissue such as barbed broach & k-file.
- Shaping instruments: for cleaning & shaping of root canal such as files & reamers.
- Obturating instruments: such as spreader, plugger to fill root canal with filling material.

Classification of endodontic armamentarium according to sequence of use:

- Diagnostic instruments.
- Isolating instruments.
- Access cavity instruments.

- Extirpating instruments.
- Devices for tooth length determination.
- Root canal enlarging instruments.
- Obturation materials, instruments, and devices.

According to material of construction:

1- Carbon steel: it is a solid solution of carbon in iron with higher carbon content, they have high mechanical properties but with low flexibility and corrosion resistance due to carbon precipitation at the grain boundaries which inhibit dislocation movement .
2- Stainless steel: it is also an interstitial primary solid solution of carbon in iron. Stainless stands for corrosion resistance thanks to their high content of chromium which form a skinny cohesive protective layer of chromium oxide on surface of steel, but Stainless steel is more flexible than carbon steel, so Stainless steel is widely used for both hand files and endodontic burs.
3- Nickel-titanium: " Endodontic therapy from 1990 to the present has utilized super elastic nickel-titanium (NiTi) instrumentation. This material has enhanced the armamentarium, and NiTi is now the material of choice for engine-driven endodontic instruments".
4- Diamonds: used with sonics and ultrasonics, very effective in managing canal obstructions, separated instruments, post, and heavily mineralized root canal system moreover as retro cavity preparation in microsurgical endodontics.

According to manufacturing process:

1-Counter-clockwise twisting: it's the oldest method of producing file and reamer. A wire that's ground into triangular or square cross section is rotated during a counterclockwise direction to form a file or reamer. Counterclockwise twisting may be a matter of plastic deformation which debate why instrument are more prone to separation if rotated during a counterclockwise direction at half number of cycles. E.g. K-reamer, K-file.
2- Machine grinding: grinding helical flutes into circular or tapered rods to make a file with one or more cutting surfaces. this method of producing creates more flexible files thanks to absence of plastic

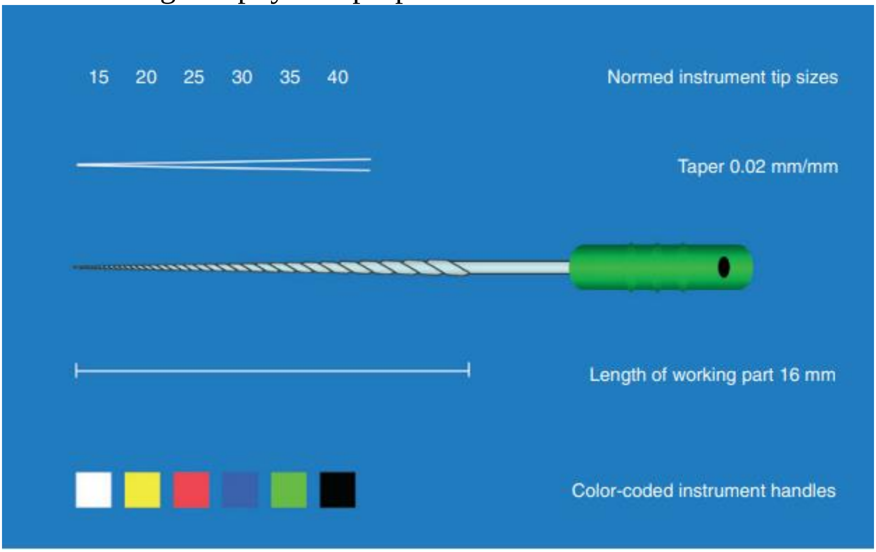
deformation from twisting. E.g. all Ni-Ti files except twisted files and K3XF files, H-files, Flex-R-file.

According to energy supply or power source:

1- Hand-driven or manually-operated: basic or hybrid instrument.
2- Engine-driven: rotary or vibratory instruments.

ISO STANDARDIZATION OF BASIC ENDODONTIC INSTRUMENTS :

Instruments are manufactured to a size and type advised by the International Standards Organisation (ISO). The terminology, dimensions, physical properties, measuring systems and quality control of endodontic instruments and materials are defined by these standards. As a result, endodontic hand instruments, i.e. files, reamers and barbed broaches, are standardized in relation to size, colour coding and physical properties.



Schematic drawing of an ISO-normed hand instrument size #35. Instrument tip sizing, taper, and handle colors are regulated by the ISO/ANSI/ADA norm.

Landmarks of standardized instruments are:

Length of instrument. The position where the cutting edges begin on the instrument is called Do . The flutes extend along the shaft for at least 16mm to stop at position D 16 . The rest of shaft has no flutes. The whole length of instrument from tip to handle is either 25mm, 21mm, or 31mm. The length of blade with flutes is 16mm regardless of total instrument length.

Size of instruments. In small sizes instruments from number 10 up to 60, there's an incremental increase at handle 0.05mm or 50 microns. In large sizes instruments from number 60 up to 140, there's an incremental increase at handle 0.1mm or 100 microns. For sizes from 6 up to 10, the incremental increase at Do is 0.02mm or 20 microns. a complete of 21 instruments with the subsequent sequence 6,8,10,15,20, 25,30,35,40,45,50,55,60,70,80,90,100,110,120,130,140. Special sizes: (6,8,10) these are used for initial preparation inside narrow canals or calcified canals. Sizes from (15-80) for cleaning &shaping .Sizes from (90-140) used in special conditions such as in child has immature tooth with large canal.

Color coding of different instruments: instrument handles are color coded for easer recognition. White (15), yellow (20), red (25), blue (30), green (35), and black (40). This color coding is repeated up to instrument number 140 such instrument number 45 and 90 are white. File 6 is pink, 8 is grey, and 10 is purple. File number 6 not preferred to be used because it’s very weak. Files from white to black are used in sequence for cleaning and shaping the root canal system. File number 25 is red for warning for curved canals because the flexibility of this file decrease due to increasing of size so can’t use this file in curved canal as it’snot able to be bent. Colour coding originally gives the size, but now represents a sequence of sizes.

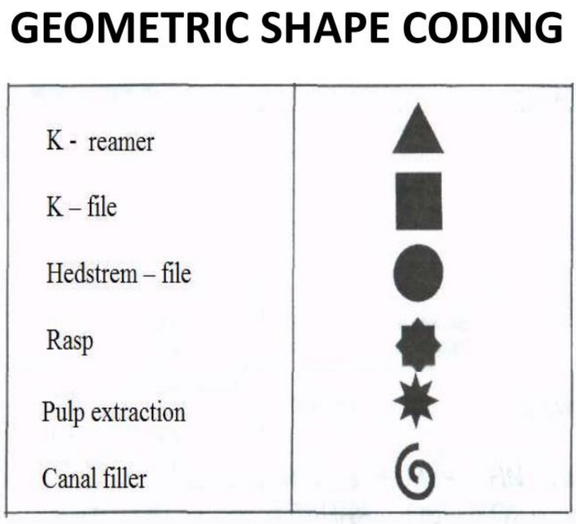
Standardization of taper of instrument: (increase in diameter/mm along its working length). The taper of standardized instrument is that the same no matter its tip diameter or size of instrument. Iso taper is ready at 0.02 mm increase/mm i, e, the instrument at D16 is 0.32 mm thicker than Do. this is often calculated by multiplying length of working a part of instrument 16mm by 0.02= 0.32mm.

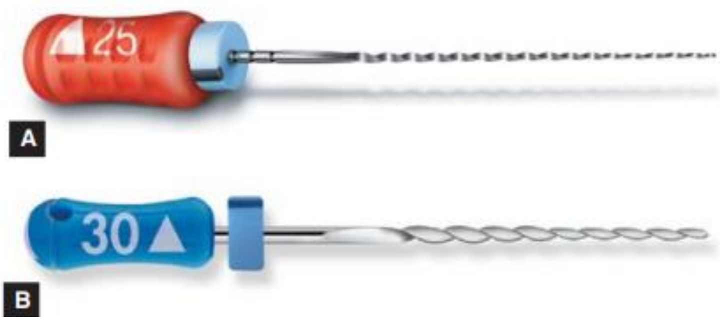
Standardization of tip angle. Iso standardization of all instruments is sharp cutting tip. The angle between the instrument tip and the long axis of the instrument shaft is standardized to be 75o ±15o. It has some advantages such as providing cutting efficiency without an excessively sharp transition angle and facilitate penetration of root canal, on the other hand, has some disadvantages such as ledge formation in curved canals.

Basic intracanal instruments: (k-file, h-file, k reamer)

Reamers

1. Reamers are K-type instruments (manufactured by Kerr company), which are used to ream the canals. They cut by inserting into the canal, twisting clockwise one quarter to half turn and then withdrawing, i.e. penetration, rotation and retraction.
2. Reamers have triangular blank and lesser number of flutes than files. Numbers of flutes in reamer are ½- 1/mm, while in files the flutes are 1½-2½/mm
3. Though reamer has fewer numbers of flutes than file, cutting efficiency is same as that of files because more space between flutes causes better removal of debris. 4. Reamer tends to remain self centered in the canal resulting in less chances of canal transportation.





A and B: Reamers

Files

Files are the instruments used during cleaning and shaping of the root canals for machining of the dentin. Since Kerr manufacturing company was first to produce them, the files were also called K-files. Files are predominantly used with filing or rasping action in which there is little or no rotation in the root canals. It is placed in root canal and pressure is exerted against the canal wall and instrument is withdrawn while maintaining the pressure.

K-file

Hedstrom Files (H-files)

• Hedstrom files have flutes which resemble successively triangles set one on another.
• They are made by cutting the spiral grooves into round, tapered steel wire in the same manner as wood screws are made. This results in formation of a sharp edge which cuts on removing strokes only.
• Hedstrom files cut only when instrument is withdrawn because its edges face the handle of the instrument.

• When used in torquing motion, their edges can engage in the dentin of root canal wall and causing H - files to fracture.
• Rake angle and distance between the flutes are two main features which determine working of the file.
• H-files have positive rake angle, i.e. its cutting edge is turned in the same direction in which the force is applied which makes it dig into the dentin making it more aggressive in cutting.
• Hedstrom files should be used to machine straight canals because they are strong and aggressive cutters. Since they lack the flexibility and are fragile in nature, the H-files tend to fracture when used in torquing action.

A and B: Hedstrom file

Modified k-instruments

K-flex file. The Kerr Manufacturing Company in 1982 introduced a new instrument design that they termed the K-Flex File. The cross-section of the K-Flex is rhombus or diamond shaped. This new cross-section presents significant changes in instrument flexibility and cutting characteristics.

Flex-r file (milled k-file). They are made by removing the sharp cutting edges from the tip of the instrument and the tip is rounded. The flutes are sharper and has less negative rake angle than a traditional twisted K-file.

C-file (mallifer). These are made of specially treated stainless steel for stiffness and strength. The result is easier access to challenging, calcified canals.
•Heat-tempered steel for stiff performance.
•Twisted file design for greater strength.
•Eases penetration of calcified canals.

•Available in 21 mm & 25 mm.

Modified H-style files

McSpadden was the first to modify the traditional Hedstroem file. Marketed as the Unifile and Dynatrak, these files were designed with two spirals for cutting blades, a double-helix design. In cross-section, the blades presented an “S” shape rather than the single-helix teardrop cross-sectional shape of the true Hedstroem file.

The “S” File (J-S Dental). This instrument can be used with any hand motion (filing or reaming) thus this file can also be classified as hybrid design.

Low-speed rotary instruments

Gates – glidden drill. This has a long, thin shaft ending in a flame-shaped head with a non-cutting safe tip to guard against perforation. It is made of hardened carbon steel. The flame shaped head cuts laterally and is used with a gentle, apically directed pressure. It has a modified safe tip i.e. non-cutting tip. These instruments come in sizes 1 to 6.

Uses of Gates-Glidden Drills

1. For coronal flaring during root canal preparation.
2. During retreatment cases or post space preparation for removal of gutta-percha.
3. During instrument removal, if used incorrectly for example using at high rpm, incorrect angle of insertion, forceful drilling, the use of Gates-Glidden can result in procedural accidents like perforations, instrument separation, etc.

Peeso- reamer

• It has long sharp flutes with a safe tip connected to a thick shaft.

• It is most often used in preparing the coronal part of the root canal for a post and core.

Protaper

Profile

• Used to clean and shape the canals.
• Used with endodontic handpiece and motor.
• NiTi is flexible and instruments follow the canal outline very well.
• Several varieties of systems with different sequences of instruments are used.
• Instruments that reduce creation of blocks, ledges, transportations and perforations by remaining centered within the natural path of the canal; useful for curved canals but have increased risk of fracture;
• Important to follow the manufacturer's recommended speeds and instructions for use.

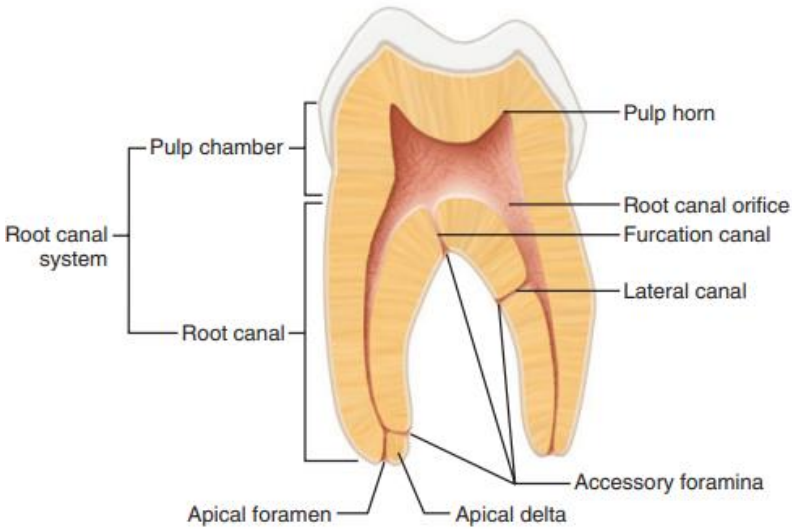
Lentulo spiral filler/rotary paste filler

• Small flexible instrument used to place materials into the canal.
• Fits into the conventional handpiece.

• Use with caution as it can be easily broken.
• Different sizes available.

Electric endomotor with speed and torque control handpiece

Topic 25. Clinical features of the structure of the tooth cavity and root canals of incisors, canines, premolars and molars.



Guidelines for Access Cavity Preparation.

1. Before starting the access cavity preparation one should check the depth of preparation by aligning the bur and handpiece against the radiograph. This is done so as to note the position and depth of the pulp chamber

2. Place a safe-ended bur in handpiece to complete the outline form. The bur is penetrated into the crown until the roof of pulp chamber is penetrated. Commonly recommended access opening bur is round bur, that is to penetrate the pulp chamber. It prevents the overpreparation. Once the “drop in” into the pulp chamber is obtained, round bur is replaced by tapered fissured bur.

Shape of pulp chamber is determined by:

Size of pulp chamber: Access preparation in young patients is broader than the older patients, in which pulp cavity is shrunken.

Shape of pulp chamber: The final outline form should reflect the shape of pulp chamber. It is triangular in anteriors, ovoid buccolingually in premolars and trapezoidal or triangular in molars.

Number, position and curvature of the canal: It can lead to modified access preparation, like Shamrock preparation in maxillary molar because of presence of distally curved mesial root.

Maxillary Central Incisor

Average Tooth Length The average length of the maxillary central incisor is 22.5 mm. The average pulp volume of this tooth is 12.4 mm3.

Pulp Chamber

• It is located in the center of the crown, equal distance from the dentinal walls.

• Mesiodistally, pulp chamber follows the outline of the crown and it is ovoid in shape.

• Buccopalatally the pulp chamber is narrow as it transforms into the root canal with a constriction just apical to the cervix.

• In young patients, central incisors usually have three pulp horns that correspond to enamel mamelons on the incisal edge.

Root Canal

• Usually central incisor has one root with one root canal.

• Coronally, the root canal is wider buccopalatally.

• Coronally or cervically, the canal shape is ovoid in cross-section but in apical region, the canal is round.

• The root canal differs greatly in outline in mesiodistal and labiopalatal view.

a. Mesiodistal view shows a fine straight canal.

b. In labiopalatal view the canal is very much wider and often shows a constriction just apical to the cervix.

• Usually lateral canals are found in apical third.

• Most of the time, the root of central incisor is found to be straight.

Maxillary Lateral Incisor

Average Length. The average length of maxillary lateral incisor is 21 mm with average pulp volume of 11.4 mm3.

Pulp Chamber

The shape of pulp chamber of maxillary lateral incisor is similar to that of maxillary central incisor but there are few differences.

I. The incisal outline of the pulp chamber tends to be more rounded.

II. Lateral incisors usually have two pulp horns, corresponding to the development mammelons.

Root Canal

• Root canal has finer diameter than that of central incisor though shape is similar to that.

• Labiopalatally, the canal is wider and usually shows constriction just apical to the cervix.

• Canal is ovoid labiopalatally in cervical third, ovoid in middle third and round in apical third.

• Apical region of the canal is usually curved in a palatal direction.

Maxillary Canine

Average Tooth Length. It is the longest tooth with an average length of 26.5 mm with average pulp space volume of 14.7 mm3.

Pulp Chamber

• Labiopalatally, the pulp chamber is almost triangular shape with apex pointed incisally.

• Mesiodistally it is narrow, sometimes resembling a flame. At cervix, there can be constrictions sometimes.

• In cross-section it is ovoid in shape with larger diameter labiopalatally.

• Usually one pulp horn is present corresponding to one cusp.

Root Canal

• Normally there is single root canal which is wider labiopalatally than in mesiodistal aspect.

• Cross-section at cervical and middle third show its oval shape, at apex it becomes circular.

• Canal is usually straight but may show a distal apical curvature.

Maxillary First Premolar

Average Tooth Length. This tooth has generally two roots with two canals and average length of 21 mm. The pulp space volume of maxillary first premolar is 18.2 mm3.

Pulp Chamber

• Pulp chamber is wider buccopalatally with two pulp horns, corresponding to buccal and palatal cusps.

• Roof of pulp chamber is coronal to the cervical line.

• Floor is convex generally with two canal orifices.

Root Canal

• Maxillary first premolar has two roots in most (>60%) of the cases but cases with single root or three roots have also been reported.

• Buccal canal is directly under the buccal cusp and palatal canal is directly under the palatal cusp. Cross-section of root canals shows ovoid shape in cervical third with larger dimensions buccopalatally. At middle and apical third, they show circular shape in cross-section.

• The root canals are usually straight and divergent.

Access cavity for a maxillary first premolar. Schematic representation of a three-canal access preparation

Maxillary Second Premolar

Average length of maxillary second premolar is 21.5 mm. Average pulp volume is 16.5 mm3.

Pulp Chamber

• Maxillary second premolar usually has one root with a single canal, but shape of canal system is variable.

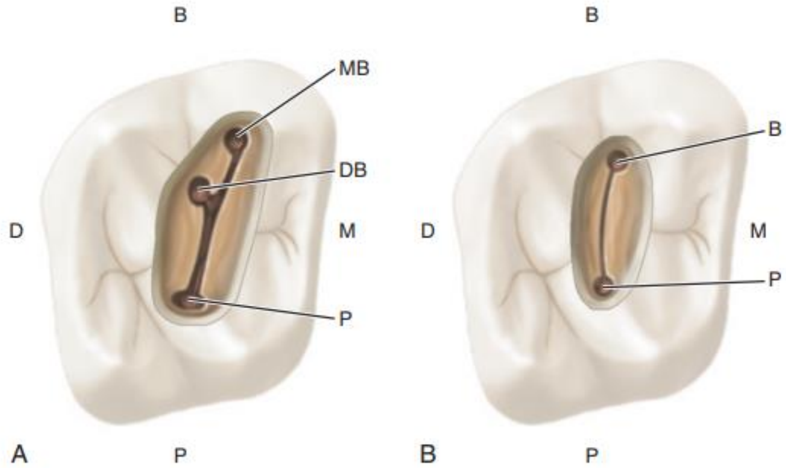
• Pulp chamber is wider buccopalatally and narrower in mesiodistal direction.

Root Canals Internal Anatomy

• In more than 60 percent of cases single root with single canal is found. There may be a single canal along the entire length of the root.

• If there are two canals, they may be separated or distinct along the entire length of the root or they may merge to form a single canal as they approach apically.

• Canal is wider buccopalatally forming a ribbon like shape.
• At cervix, cross-section shows ovoid and narrow shape, at middle third it is ovoid which becomes circular in apical third.
• In cross-section, pulp chamber has narrow and ovoid shape.



A, Three canal orifices in a maxillary second molar. B, Two canal orifices in a maxillary second molar. B, Buccal; P, palatal; D, distal, DB, distobuccal; M, medial; MB, mesiobuccal

Maxillary First Molar

Average Tooth Length. The average tooth length of this tooth is 21 mm and average pulpal volume is 68.2 mm3.

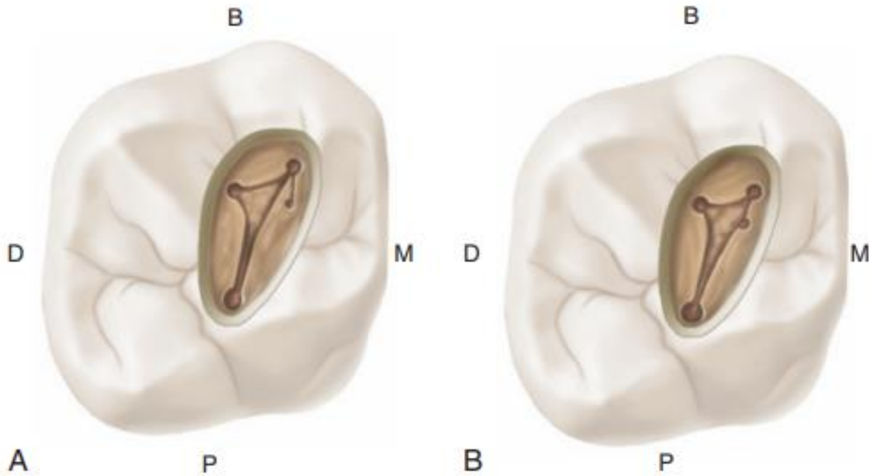
Pulp Chamber

• Maxillary first molar has the largest pulp chamber with four pulp horns, viz. mesiobuccal, mesiopalatal, distobuccal and distopalatal.
• Bulk of pulp chamber lies mesial to the oblique ridge across the surface of the tooth.
• The four pulp horns are arranged in such a fashion which gives it rhomboidal shape in the cross-section. The four walls forming roof converge towards the floor, where palatal wall almost disappears making a triangular form in cross section.
• Orifices of root canals are located in the three angles of the floor; Palatal orifice is largest and easiest to locate and appears funnel like in the floor of pulp chamber.

• Distobuccal canal orifice is located more palatally than mesiobuccal canal orifice.
• More than 60 percent of maxillary first molars have shown the presence of two canals in mesiobuccal root. The minor mesiobuccal canal (MB2) is located on a line between palatal canal orifice and the main mesiobuccal canal orifice.

Root Canals

• Maxillary is generally three rooted with three or four canals.
• Two canals in mesiobuccal root are usually closely interconnected and sometimes merge into one canal.
• Mesiobuccal canal is the narrowest of the three canals, flattened in mesiodistal direction at cervix but becomes round as it reaches apically.
• Distobuccal canal is narrow, tapering canal, sometimes flattened in mesiodistal direction but generally it is round in cross-section.
• The palatal root canal has largest diameter which has rounded triangular cross-section coronally and becomes round apically.
• Palatal canal can curve buccally in the apically one-third.
• Lateral canals are found in 40 percent of three canals at apical third and at trifurcation area.



The two locations of the second mesiobuccal (MB2) canal orifices in a maxillary first molar. B, Buccal; D, distal; M, mesial; P, palatal.

Maxillary Second Molar

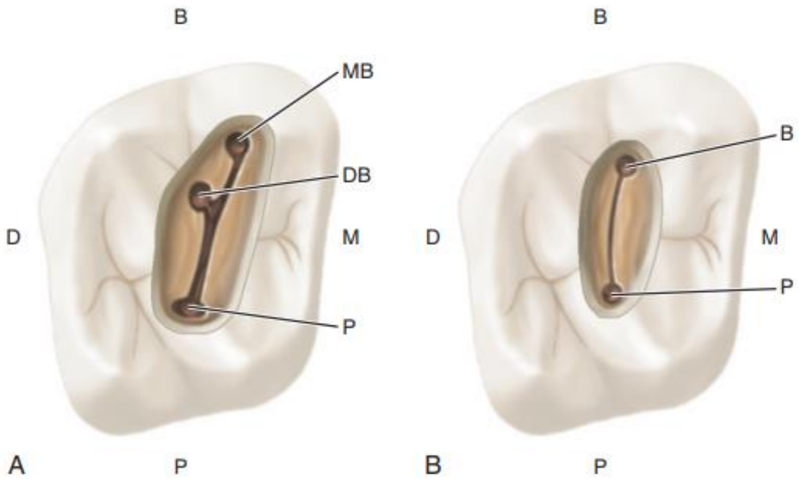
Average Tooth Length. The average tooth length of this tooth is 20 mm and average pulp volume is 44.3 mm3 .

Pulp Chamber

- It is similar to maxillary first molar except that it is narrower mesiodistally.
- Roof of pulp chamber is more rhomboidal in cross-section and floor is an obtuse triangle.
- Mesiobuccal and distobuccal canal orifices lie very close to each other.

Root Canals

- Similar to first molar except that in maxillary second molar roots tend to be less divergent and may be fused.
- Fewer lateral canals are present in roots and furcation area than in first molar.



A, Three canal orifices in a maxillary second molar. B, Two canal orifices in a maxillary second molar. B, Buccal; P, palatal; D, distal, DB, distobuccal; M, medial; MB, mesiobuccal.

Maxillary Third Molar

Average length of tooth is 16.5 mm.

Pulp Chamber and Root Canal. It is similar to second molar but displays great variations in shape, size, and form of both pulp chamber as well as root canal. There may be presence of one, two, three or more canals sometimes.

Mandibular Teeth Central Incisor

Average length of this tooth is 21 mm. Average pulp volume is 6.1 mm3.

Pulp Chamber. Mandibular central incisor is the smallest tooth in the arch.

• Pulp chamber is similar to maxillary central incisor being wider labiolingually pointed incisally with three pulp horns.

• Cross-section of pulp chamber shows its ovoid shape.

Root Canals

• Various root canal formations have been seen in mandibular incisors. There can be a single canal from orifice to apex or a single canal by bifurcate into two canals or sometimes two separate canals are also found. Incidence of two canals can be as high as 41 percent.

• Cross-section of root canals show wider dimension in labiolingual direction making it ovoid shape whereas round in the apical third.

• Since canal is flat and narrow mesiodistally and wide buccopalatally, ribbon shaped configuration is formed.

Mandibular Lateral Incisor

Average length of mandibular lateral incisor is 21 mm. Average pulp volume is 7.1 mm3 .

Pulp Chamber. The configuration of pulp chamber is similar to that of mandibular central incisor except that it has larger dimensions.

Root Canal

• It has features similar to those of mandibular central incisor.

• Usually the roots are straight or curved distally or labially, but distal curve is sharper than those of mandibular central incisors.

Mandibular Canine

Average length of the tooth is 22.5 mm. Average pulp volume is 14.2 mm3 .

Pulp Chamber

• On viewing labiolingually, the pulp chamber tapers to a point in the incisal third of the crown.

• In cervical third of tooth, it is wider in dimensions and ovoid in cross-section at this level.

• Pulp chamber appears to narrower mesiodistally.
• Cervical constriction is also present.

Root Canals

• Mandibular canine usually has one root and one canal but can occasionally have two (14% cases).
• Coronally, the root canal is oval in cross-section, becomes round in the apical region.
• Lateral canals are present in 30 percent of cases.

Mandibular First Premolar

Average length of the tooth is 21.5 mm and average mature pulp volume is 14.9 mm3.

Pulp Chamber

• Mesiodistally, the pulp chamber is narrow in dimension.
• Pulp chamber has two pulp horns, the buccal horn being most prominent.
• Buccolingually, the pulp chamber is wide and ovoid in cross section.

Root Canal

• Mandibular first premolars usually have one root and one canal. Sometimes teeth have shown presence of second canal.
• Mesiodistally, the canal is narrower in dimension.
• Buccolingually, root canal cross-sections tend to be oval until the most apical extents, where they become round.
• Lateral canals are present in 44 percent of the cases.

Mandibular Second Premolar

The average length of this tooth is 22.5 mm and average mature pulp volume is 14.9 mm3.

Pulp Chamber

• It is similar to that of mandibular first premolar except that lingual pulp horn is more prominent.
• Cross-section of pulp chamber shows oval shape with greatest dimensions buccolingually.

Root Canal

• Usually has one root and one canal and in 11 percent of the teeth, has a second canal.
• Buccolingually, it is wider than that of mandibular first premolar.
• Root canal cross-sections tend to be oval coronally and round apically.

Mandibular First Molar

The average length of this tooth is 21 mm and an average pulp volume is 52.4 mm3.

Pulp Chamber

• It is quadrilateral in cross-section at the level of the pulp floor and is wider mesially than distally.

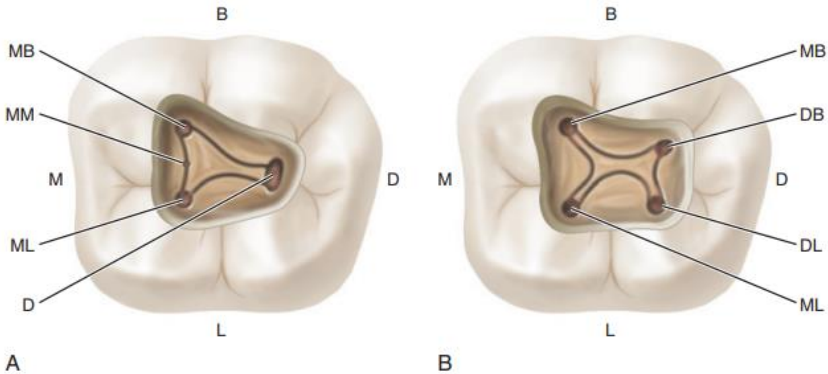
• The roof of the pulp chamber is rectangular in shape with straight mesial wall and rounded distal wall.

• There may be presence of four or five pulp horns.

• Mesiobuccal orifice is present under the mesiobuccal cusp.

• The mesiolingual orifice is located in a depression formed by mesial and the lingual walls. Usually a connecting groove is present between mesiobuccal and mesiolingual orifices.

• Distal orifice is the widest of all three canals. It is oval in shape with greater diameter in buccolingual direction.



Access cavities for the mandibular first molar. A, Three mesial canal orifices and one distal canal orifice. B, Two mesial and two distal canal orifices. B, Buccal; D, distal, distal orifice; DB, distobuccal orifice; DL, distolingual orifice; L, labial; M, mesial; MB, mesiobuccal orifice; ML, mesiolingual orifice; MM, middle mesial orifice

Root Canals. Mandibular first molar usually has two roots with three canals. But teeth with three roots and four or five canals have also been reported.

• Mesial root has two canals, viz. mesiobuccal and mesiolingual which may exit in two foramina (>41% cases), exit in single foramen (30%) and may also exit in different pattern.

• Mesiobuccal canal is usually curved and often exit in pulp chamber in a mesial direction.

• Distal root generally has one canal (> 70% cases). But two canals are also seen in some cases. A single distal canal is ribbon shaped and has largest diameter buccolingually. But when two canals are present in distal root, they tend to be round in the cross-section.

Mandibular Second Molar

The average tooth length of this tooth is 20 mm and average pulp volume is 32.9 mm3 .

Pulp Chamber

• It is similar to that of mandibular first molar except that it is smaller in size.

• Root canal orifices are smaller and closer together.

Root Canals

• Usually it contains two roots with three canals but variation in their presence (one or three roots, 2 canals) is also seen.

• C-shaped canals are also seen, i.e. mesial and distal canals Internal Anatomy become fused into a fin.

Mandibular Third Molar

Average length of this tooth is 17.5 mm. **Pulp Chamber and Root Canals**. It resembles to that of mandibular first and second molar but with enormous variations, i.e. there may be presence of one, two or three canals. Anomalous configurations such as “C-shaped” root canal orifices are also seen commonly.

Topic 26. Stages of endodontic treatment of the tooth: opening (trepanation) of tooth cavities of different groups, application of devitalizing substances. Amputation, pulp extraction: instruments, technique, possible complications. Drug treatment of root canals: types (irrigation, application, temporary obturation), groups and mechanism of action of drugs. Concepts hermetic, semi-hermetic, loose dressing.

Access cavity preparation is defined as endodontic coronal preparation which enables unobstructed access to the canal orifices, a straight line access to apical foramen, complete control over instrumentation and to accommodate obturation technique.

It is a well established fact that success of endodontic therapy depends on the main three factors:

a. Cleaning and shaping.

b. Disinfection.

c. Three-dimensional obturation of the root canal system.

Guidelines for Access Cavity Preparation

1. Before starting the access cavity preparation one should check the depth of preparation by aligning the bur and handpiece against the radiograph. This is done so as to note the position and depth of the pulp chamber.

2. Place a safe-ended bur in handpiece to complete the outline form. The bur is penetrated into the crown until the roof of pulp chamber is penetrated. Commonly recommended access opening bur is round bur, that is to penetrate the pulp chamber. It prevents the overpreparation. Once the "drop in" into the pulp chamber is obtained, round bur is replaced by tapered fissured bur.

Round-ended carbide burs are used for access opening into cast restorations because they have distinct tactile sense when dropping into the pulp chamber. Access finishing is best carried out by using burs with safe non-cutting ends. Advantage of using these burs is that they are less likely to damage or perforate the pulp chamber floor. Disadvantages of using these burs are that they can cut laterally and they cannot drop into small orifices to funnel the point of transition between the access cavity and walls.

3. When locating the canal orifices is difficult, one should not apply rubber dam until correct location has been confirmed.

4. Remove all the unsupported tooth structure to prevent tooth fracture during treatment.

5. Remove the chamber roof completely as this will allow the removal of all the pulp tissue, calcifications, caries or any residuals of previous fillings. If pulp chamber is not completely deroofed, it can result in:

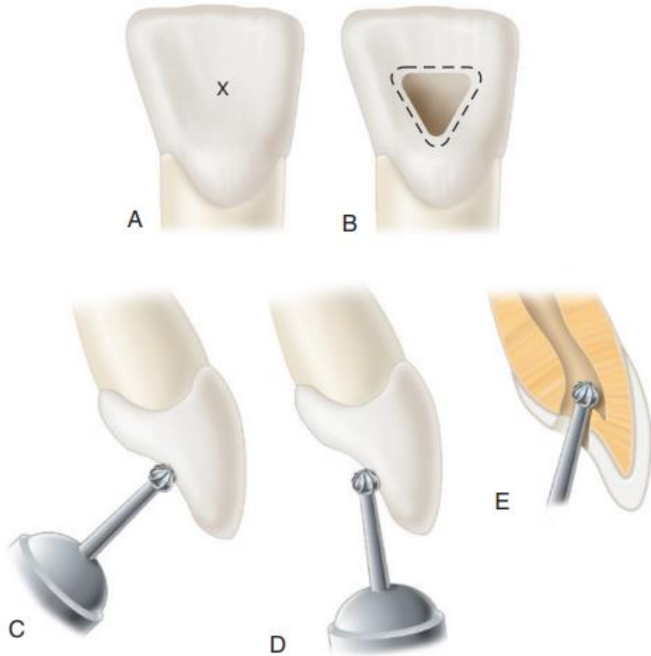
a. Contamination of the pulp space.

b. Discoloration of endodontically treated tooth.

6. The walls of pulp chamber are flared and tapered to form a gentle funnel shape with larger diameter towards occlusal surface.

7. Endodontic access cavity is prepared through the occlusal or lingual surface, never through proximal or gingival surface. If access cavity is made through wrong entry, it will cause inadequate canal instrumentation resulting in iatrogenic errors.

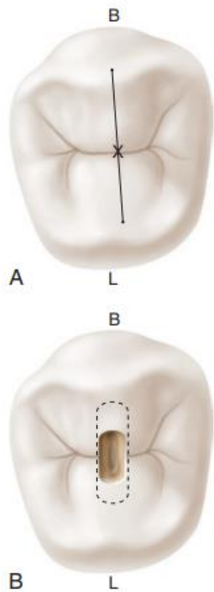
8. Inspect the pulp chamber for determining the location of canals, curvatures, calcifications using well magnification and illumination.



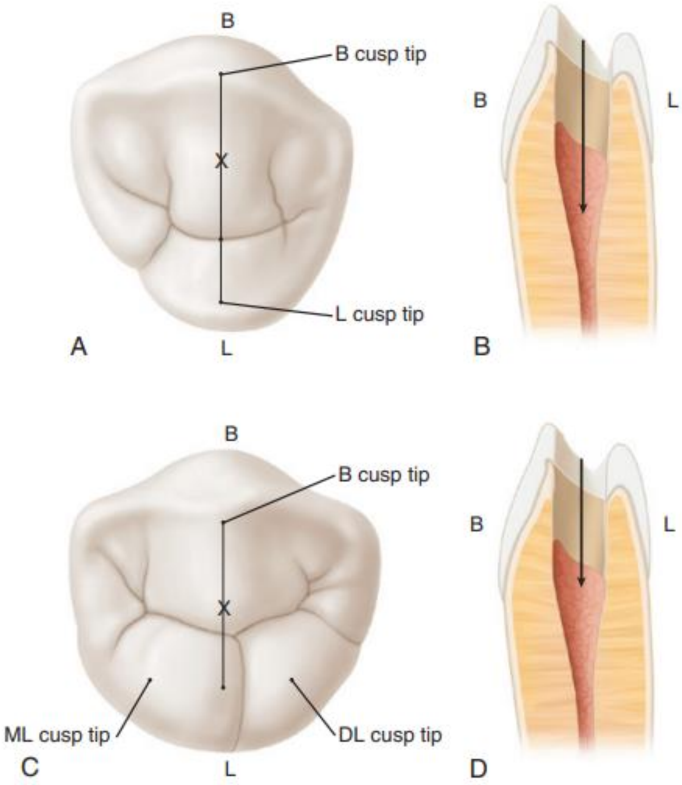
A, In anterior teeth the starting location for the access cavity is the center of the anatomic crown on the lingual surface (X). B, Preliminary outline form for anterior teeth. The shape should mimic the expected final outline form, and the size should be half to three-fourths the size of the final outline form. C, The angle of penetration for the preliminary outline form is perpendicular to the lingual surface. D, The angle of penetration for initial entry into the pulp chamber is nearly parallel to the long axis of the root. E, Completion of removal of the pulp chamber roof; a round carbide bur is used to engage the pulp horn, cutting on a lingual withdrawal stroke.

Pulp capping (lining placing). Treatment procedure aimed at preserving a dental pulp that has been exposed to the oral environment.
Partial pulpotomy. Treatment procedure by which the most (often inflamed) superficial portion (1–2 mm) of the coronal pulp is surgically removed with the aim of preserving the remaining tissue.
Pulpotomy (amputation). Treatment procedure by which the coronal pulp tissue is surgically removed with the aim of preserving the

remaining tissue. The term pulpotomy is also used to describe a pain-relieving procedure in an emergency treatment of symptomatic pulpitis.
Pulpectomy (extirpation). Treatment procedure by which entire pulp tissue (often inflamed) is surgically removed and replaced with a root filling.
(RCT) Root canal treatment. Treatment of teeth with necrotic pulps where root canals are often infected.
Non-surgical retreatment. Treatment of root filled teeth with clinical and/or radiographic signs of root canal infection, where root fillings are removed, canals disinfected and refilled. May also be carried out to improve the technical quality of previous root fillings.
Surgical retreatment. Treatment procedure by which the root apex of a tooth is surgically accessed to manage a root canal infection that has not been successfully treated by RCT. Retrograde endodontics or surgical endodontics are other terms for this procedure.



A, Starting location for access to the maxillary premolar (X). B, Initial outline form (dark area) and projected final outline form (dashed line). B, Buccal; L, lingual.



A, Mandibular first premolar and access starting location (X) (occlusal view). B, Mandibular first premolar and starting location (proximal view). C, Mandibular second premolar and access starting location (X) (occlusal view). D, Mandibular second premolar and starting location (proximal view). B, Buccal; DL, distolingual; L, lingual; ML, mesiolingual.

Devital extirpation and amputation

Method of devital extirpation (pulpectomy) involves removal of the entire pulp after its necrotization (devitalization). Mechanism of arsenic paste action. Arsenic trioxide or arsenous acid (As, Oz) is one of the strongest poisons - protoplasmatic poison under which action oxidase loses its specific functions as the enzyme of oxidation. Blocking SH-groups (thiol enzymes that function as coenzymes of breathing) in pulp tissues, poison negatively affects respiration. This results in the inhibition of oxidation-reduction processes in the connective tissue, redistribution of amino acids, nucleic acids, RNA, DNA that on the background of the overall oxygen deficiency ultimately leads to the irreversible effects of hypoxia. Vessels are overfilled with formed elements of blood and rupture, causing bleeding that leads to necrotization of tissue structures. Swelling leads to compression of pulp tissue. Nerve fibers undergo fatty degeneration.

Changes in all groups of cellular elements of the pulp lead to phenomena of karyorrhexis and death of cells, particularly odontoblasts. The depth of the pulp lesion directly depends on the action and dose arsenous acid. In the site of its application, all the elements of the coronal pulp are killed. Prolonged exposure can cause toxic changes in periodontium and necrosis of adjacent tissues. Arsenous acid (anhydride) is used in the form of paste.

The arsenous paste composition includes the following components:

- antiseptics (thymol, eugenol);
- anesthetic substances (cocaine, benzocaine, etc.);
- arsenous acid;
- astringents (Y.M. Hofung proposed to introduce them for slowing down a diffusion of arsenic beyond the apex).

Cleaning –refer to the debridement of the root canal space and shaping as the step to prepare the canal for obturation. All clinically accepted endodontic instruments and instrumentation techniques attempt to perform both processes simultaneously.

Debridement of the root canal space includes removal of vital and necrotic tissue, bacteria, bacterial byproducts, and dentinal debris created during the cleaning and shaping process. Irrigation and disinfection are integral parts of debridement.

Sodium hypochlorite (NaOCl) is the most important irrigant in root canal treatment. It is the only presently used solution that can dissolve organic matter in the canal. Hypochlorite is used in concentrations between 0.5-6%. The normal concentration is 5.25% available chlorine. Chelating agents which soften dentine by their demineralizing action are particularly helpful when trying to negotiate sclerosed or blocked canals.

Chlorhexidine. The antibacterial mechanism of chlorhexidine is related to its cationic bisbiguanide molecular structure. The cationic molecule is absorbed to the negatively charged inner cell membrane and causes leakage of intracellular components.

At low concentration, it acts as a bacteriostatic, whereas at higher concentrations; it causes coagulation and precipitation of cytoplasm and therefore acts as bactericidal. In addition, chlorhexidine has the property of substantivity (residual effect).

Both 2 and 0.2 percent chlorhexidine can cause residual antimicrobial activity for 72 hours, if used as an endodontic irrigant.

Needle with side venting helps to move the irrigant sidways in whole canal

Chelating agents. After canals are instrumented, an organic layer remains which covers the dentinal tubules. Controversies still exist whether to keep or to remove smear layer as it relates to permeability of dentin. However most of studies have recommended removal of smear layer because it is the source of microorganisms and also the closest possible adaptation of endodontic filling is possible only after its removal. Though sodium hypochlorite is thought to be almost ideal irrigating solution but it does not possess chelating properties. EDTA and other chelating agents like citric acid, polyacrylic acids are used for this purpose.

Chelating agent is defined as a chemical which combines with a metal to form chelate. EDTA is most commonly used chelating agent. It was introduced in dentistry by Nygaard Ostby for cleaning and shaping of the canals. It contains four acetic acid groups attached to ethylenediamine. EDTA is relatively nontoxic and slightly irritating in weak solutions.

The effect of EDTA on dentin depends on the concentration of EDTA solution and length of time it is in contact with dentin. Serper and Calt in their study observed that EDTA was more effective at a neutral pH than at a pH 9.0. They showed that for optimal cleaning and shaping of canals EDTA should be used at neutral pH and with lower concentrations.

Functions of EDTA

- Lubrication
- Emulsification
- Holding debris in suspension
- Smear layer removal

Citric Acid. Other commonly used chelating agent for removal of smear layer as irrigating solution is citric acid. It can be used alone or in combination with other irrigants but EDTA or citric acid should never be mixed with sodium hypochlorite because EDTA and citric acid strongly interact with sodium hypochlorite. This immediately reduces the available chlorine in solution and thus making it ineffective against bacteria.

Polyacrylic Acid. Another chelating agent suggested as irrigant is polyacrylic acid, commercially available as Durelon and Fuji II liquid

Properties of an ideal intracanal medicament

- It should be an effective antimicrobial agent.
- It should be nonirritating to the periradicular tissues.
- It should remain stable in solution.
- It should have a prolonged antimicrobial effect.
- It should be active in the presence of blood, serum, and protein derivatives of tissues.
- It should have low surface tension.
- It should not interfere with the repair of periradicular tissues.
- It should not stain tooth structure.

- It should not induce a cell-mediated immune response.

Indications of intracanal medicaments

- To dry persistently wet or the so-called weeping canals.
- To eliminate any remaining microbes in the pulp space.
- To render root canal contents inert.
- To neutralize tissue debris.
- To act as a barrier against leakage from an interappointment dressing in symptomatic cases.

Classification of intracanal medicament:

1. Phenolic compounds. Phenol or carbolic acid is a potent antimicrobial agent capable of destroying tissue cells by binding to cell membrane lipids and proteins. Most common phenolic compounds that are used as intracanal medicament are aqueous parachlorophenicol, camphorated monochlorophenicol, cresatin and creosote. Of these camphorated monophenicol (CMCP) was the most commonly used intracanal medicament in early years, currently its use has been decreased over 9 the years. The antimicrobial action of CMCP is dependent on the volatility of the medicament by the diffusion of its vapors to spread the material throughout the root canal system and bring it into contact with microorganisms remaining in the canal. This makes it not reliable.

2. Essential oils. Clove oil (eugenol) has some antibacterial effect but is considered as severe periapical irritant.

3. Aldehydes. Formalaldehyde, paraformalaldehyde and glutaraldehyde are commonly used intracanal medicaments in endodontic therapy. They are water soluble protein denaturating agents and are considered as one of the best disinfectant agents. Formocresol is considered as one of the most commonly used intracanal medicament. However it should be used with caution because it is mutagenic and cytotoxic agent.

4. Halogens. Chlorine which is the active ingredient of sodium hypochlorite is used as antiseptic agent in endodontic therapy. Iodine which is found in iodine-potassium iodine is another agent that has minimal toxicity and has bactericidal effect.

5. Quaternary ammonium compounds. They are mild antiseptic irrigants and intracanal medicament.

6. Antibiotics and corticosteroids. Antibiotics are avoided nowadays due to fear of bacterial resistance development. Antibiotic mixtures such as ciprofloxacin-metronidazoleminocycline have been used topical root canal antibiotic agent. Topical corticosteroids have also been used as anti-inflammatory agents for several decades. There are several combinations of antibiotics and corticosteroids such as septomixine, pulpomixine and ledermix paste. These mixtures should be used with caution because of the risk of bacterial resistance, drug's hypersenstization and the potential to mask certain etiological factors limit their benefits.

Topic 27. Instrumental treatment of root canals: the concept of reaming and filing. Methods determination of the working length of the root canal, electrometric methods of measurement. Methods of instrumental root canal treatment: "Step-back" and "Crown-down" techniques, etc. Canal treatment using rotary instruments. Medications for chemical expansion of root canals. Preparation of canals for filling.

Endodontic treatment mainly consists of three steps:
1. Cleaning and shaping of the root canal system.
2. Disinfection.
3. Obturation.

Cleaning and shaping is one of the most important step in the root canal therapy for obtaining success in the root canal treatment

Step back technique

Step back technique is also known as Telescopic canal preparation or serial root canal preparation. Step back technique emphasizes keeping the apical preparation small, in its original position and producing a gradual taper coronally. This technique was first described in 1960 by Mullaney.

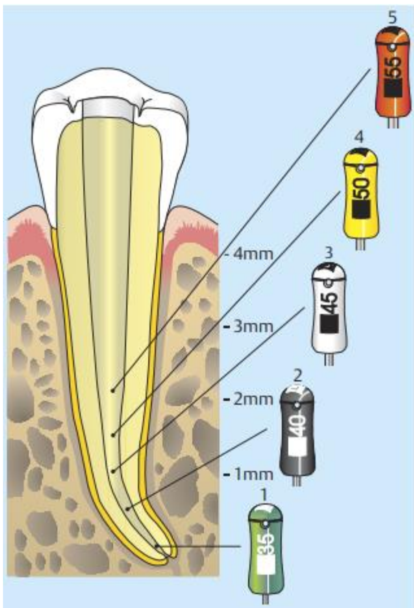
"Step-back" technique.

Stage 1 - passage of the root canal and determination of its working length with K-reamers. After passing through the canal to the apex opening, the working length is determined using a sighting Rh-gram with the instrument inserted into the root canal. The set working length is fixed with a stopper.

Stage 2 - formation of the apical stop. The purpose of this stage is to create an apical stop for the subsequent gutta-percha post and endo-sealant to prevent the apical hole from extending beyond the periodontal tissue.

We begin this stage by treating the root canal with the K-file of the same number that was used to reach the apical foramen and with which we felt a jam in the apex area. The instrument is inserted into the root canal and processed with up and down sawing movements. After that, the canal is rinsed with an antiseptic solution. Next, the next numbered instrument with the same length set by the stopper is used. Repeat mechanical and medical treatment of the root canal. Use instruments 3-

4 numbers more than the initial one (but not less than No. 25 - for adequate preparation and rinsing of the canal).
The last instrument is called Master file. After these manipulations, the root canal acquires a conical shape, which corresponds to the cone shape of the instruments and standard gutta-percha pins.
Stage 3 - treatment of the apical third of the root canal Continue processing the canal with the next instrument, but reduce the length by 1 mm. The next instrument will be 2 mm smaller, then 3 mm smaller, and so on. Between instruments, we return to the Master file each time to smooth out the stairs in the apical third. Perform antiseptic treatment of the canal between all instruments.
Stage 4 - formation of the middle and upper thirds of the root canal. The goal is to create a funnel-shaped canal mouth for further adequate antiseptic rinsing and filling. It is recommended to use Gates Glidden sequentially from 1 to 3 numbers and work in the straight part of the canal. This stage is completed by passing the Master file along the entire length of the canal.
Stage 5 - final alignment of the channel walls. To give the final conical shape to the channel, we pass and smooth its walls with the Master file.



Crown down technique

In the crown down technique, the dentist prepares the canal from crown of the tooth, shaping the canal as he/she moves towards the apical portion of the canal.

Crown Down technique (from the crown down).

Stage 1 - insertion of K-file No. 35 to a depth of 16 mm. If there are difficulties, the reasons may be curvature of the root canal or its narrowing.

If the cause is curvature, then we process a part of the root canal until the point of curvature. If the cause is narrowing, we take a smaller file and try to go 16 mm. The goal is free passage of the K-file No. 35 to a length of 16 mm.

Stage 2 - determining the "temporary" working length. On the Rh-gram, we determine the intermediate working length with the canal instrument not brought to the apex by 3 mm.

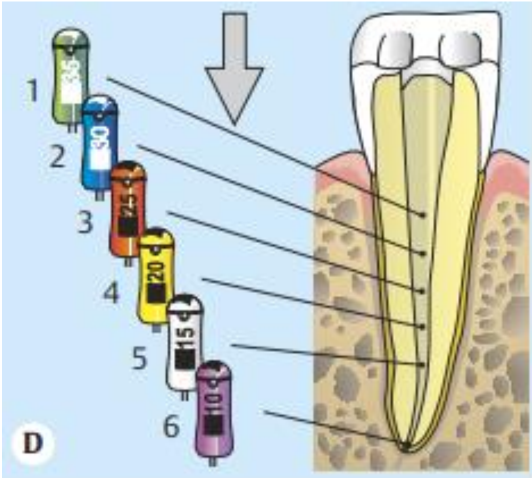
Stage 3 - processing the canal to the "temporary" working length. We start by entering and scrolling through K-file No. 35. Then file No. 30, No. 25, etc. until the working length is reached.

Stage 4 - determining the final working length. As in stage 2, the working length is determined with the help of an X-ray with the instrument inserted into the root canal.

Stage 5 - root canal expansion.

The canal is first expanded with a K-file No. 40, then No. 35, etc. until the working length is reached. The instrument is inserted into the root canal, scrolled clockwise for two turns without pressure and withdrawn. With each subsequent instrument, they try to move deeper by scrolling it clockwise.

After that, the cycle is repeated again, but starting with file #45. The next cycle is from file No 50. Continue until the apical third is expanded to the desired size, but not less than file No. 25.



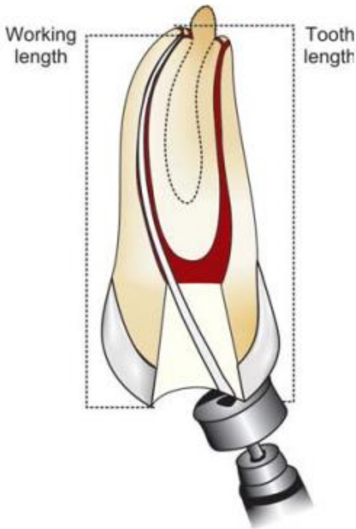
Balanced force technique

This technique involves the use of instrument with noncutting tip. Since the K-type files have pyramidal tips with cutting angles which can be quite aggressive with clockwise rotation. For this technique, use of triangular cross sectioned instruments should be done. The decreased mass of the instrument and deeper cutting flutes improves the flexibility of instrument and decrease the restoring force of the instrument when placed in curved canals. Use of Flex-R files is recommended for this technique. This file has "safe tip design" with a guiding land area behind the tip which allows the file to follow the canal curvature without binding in the outside wall of the curved canal.

According to endodontic glossary working length is defined as "the distance from a coronal reference point to a point at which canal preparation and obturation should terminate".

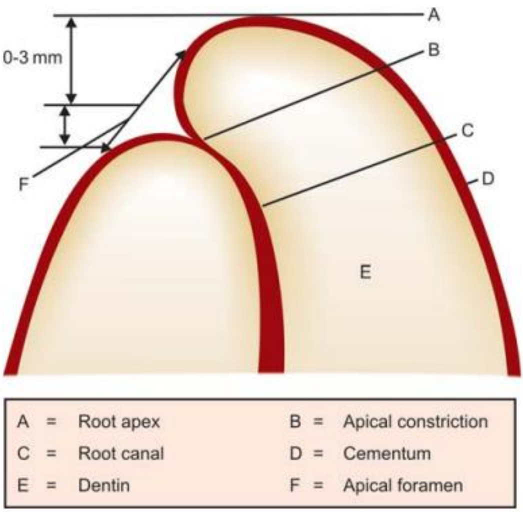
Step back vs. crown down technique

Step back technique	*Crown down technique*
1. Apico-coronal technique	1. Corono-apical technique
2. Has been used for past many year	2. Introduced recently an gaining popularity.
3. Starts with smallest instruments	3. Starts with largest instruments.
4. Shapes apical 1/3rd initially	4. Shapes coronal 1/3rd initially.
5. Commonly uses hand files	5. Commonly uses rotary files.



Working length distance is defined as the distance from coronal referencer point to a point where canal preparation and obturation should terminate.

Anatomy of root apex



Significance of working length

• Working length determines how far into canal, instruments can be placed and worked.
• It affects degree of pain and discomfort which patient will experience following appointment by virtue of over and under instrumentation.
• If placed within correct limits, it plays an important role in determining the success of treatment.
• Before determining a definite working length, there should be straight line access for the canal orifice for unobstructed penetration of instrument into apical constriction.
• Once apical stop is calculated, monitor the working length periodically because working length may change as curved canal is straightened.
• Failure to accurately determine and maintain working length may result in length being over than normal which will lead to postoperative pain, prolonged healing time and lower success rate because of incomplete regeneration of cementum, periodontal ligament and alveolar bone.
• When working length is made short of apical constriction it may cause persistent discomfort because of incomplete cleaning and underfilling. Apical leakage may occur into uncleaned and unfilled space short of apical constriction. It may support continued existence of viable bacteria and contributes to the periradicular lesion and thus poor success rate.

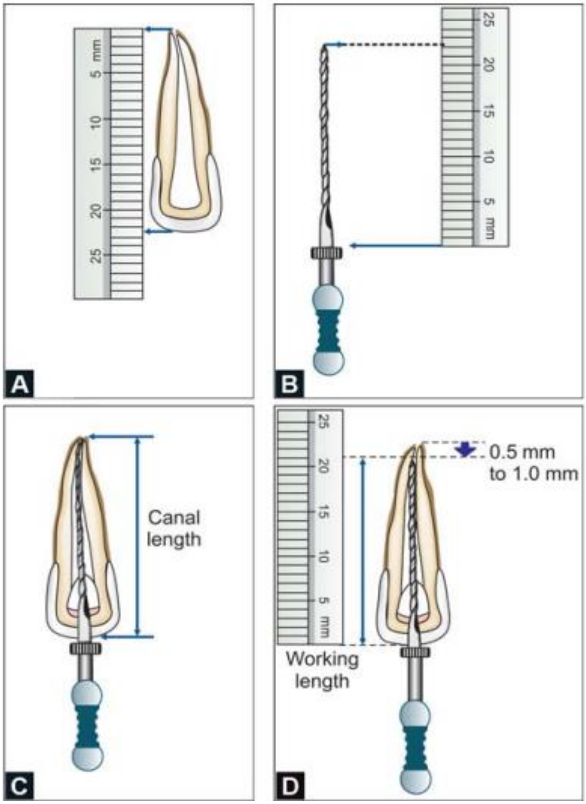
Different methods of working length determination

Various methods for determining working length include using average root lengths from anatomic studies, preoperative radiographs, tactile sensation, etc.

Other common methods include use of paper point, working length radiograph, electronic apex locators or any combination of the above. In this era of improved illumination and magnification, working length determination should be to the nearest 1.5 mm.

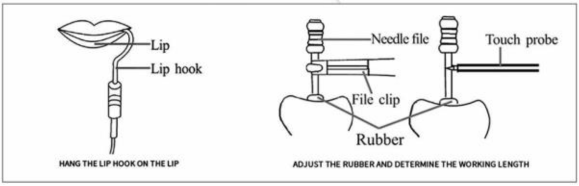
So to achieve the highest degree of accuracy a combination of several methods should be used.

A to D: Radiographic method of working length determination



Electronic apex locator. Radiographs are often misinterpreted because of difficulty in distinguishing the radicular anatomy and pathosis from normal structures.

Electronic apex locators (EAL) are used for determining working length as an adjunct to radiography. They are basically used to locate the apical constriction or cementodentinal junction or the apical foramen, and not the radiographic apex. Hence the term apex locator is a misnomer one.



Components of Electronic Apex Locators

- Lip clip.
- File clip.
- Electronic device.
- Cord which connects above three parts.

Advantages of Apex Locators

- Provide objective information with high degree of accuracy.
- Accurate in reading (90-98% accuracy).
- Some apex locators are also available in combination with pulp tester, so can be used to test pulp vitality.

Disadvantages

a. Can provide inaccurate readings in following cases: presence of pulp tissue in canal, too wet or too dry canal, use of narrow file, blockage of canal, incomplete circuit, low battery.
b. Chances of over estimation.
c. May pose problem in teeth with immature apex.

Topic 28. Materials for root canal filling. Silers and fillers:concepts, classification. Plastic non-hardening pastes: groups, composition, properties, indications for application, methods of temporary root canal filling.

Root canal filling materials may be divided into three types:

- cones;
- sealers;
- combinations of the two.

Sealing (filling, obturation) of the root canal can be temporary and permanent.

Temporary filling is an intermediate stage of endodontic treatment, which is the filling of the root canal with medical pastes.

Permanent filling - the final stage of endodontic treatment - hermetic obturation of the root canal with permanent filling materials.

Characteristics of an ideal root canal filling material

1. Easily introduced in the canal.
2. Seal canal laterally and apically.
3. Dimensionally stable after being inserted.
4. Impervious to moisture.
5. Bacteriostatic or at least should not encourage bacterial growth.
6. Radiopaque.
7. Non staining to tooth structure.
8. Non irritating.
9. Sterile/easily sterilized.
10. Removed easily from canal if required

Different forms of gutta-percha

<u>Alpha form</u>

• Pliable and tacky at 56°-64°.
• Available in form of bars or pellets.
• Used in thermoplasticized obturation technique.

<u>Beta form</u>

• Rigid and solid 42°-44°.
• Used for manufacturing gutta-percha points and sticks.

<u>Amorphous form</u>

• Exists in molten stage

Temporary root obturation

Temporary filling (obturation) of the root canal is intermediate

stage of endodontic treatment, which aims to:
• active continuous and long-term release of drugs;
• elimination or blocking of microorganisms and their endotoxins in the systems macro- and microchannels;
• suppression of inflammation in the periapical tissues;
• stimulation of reparative processes in the periodontium;
• filling the canal if it is impossible to complete endodontic treatment in one session due to lack of time and inability to dry root canal due to bleeding or exudation;
• filling of the difficult root canal;
• apexification - the formation of an unformed apex in the area permanent barrier tooth made of dense cement-like tissue.

The following are used for temporary filling of root canals groups of non-hardening pastes:
• pastes based on calcium hydroxide;
• pastes based on metronidazole;
• pastes based on long-acting antiseptics;
• combined pastes:
- based on antibiotics and corticosteroids;
- pastes based on a combination of calcium hydroxide and iodoform.

Calcium hydroxide. This is considered separately because it has a wide range of applications in endodontics due to its antibacterial properties and an ability to promote the formation of a calcific barrier. The former is thought to be due to a high pH and also to the absorption of carbon dioxide, upon which the metabolic activities of many root-canal pathogens depend. It is also proteolytic

Indications for the use of calcium hydroxide include:
• To promote apical closure in immature teeth.
• In the management of perforations.
• In the treatment of resorption.
• As a temporary dressing for canals where filling has to be delayed. In the management of recurrent infections during RCT.

Pastes based on metronidazole

• Metronidazole effectively inhibits the anaerobic root microflora, stops the catabolic destruction of tissues, indirectly blocking inflammatory phenomena at the biochemical level.

• Designed to temporarily fill severely infected roots canals of teeth, especially with the predominance of anaerobic microflora (with gangrenous pulpitis, acute and acute chronic periodontitis).

Pastes based on long-acting antiseptics

• Contain strong antiseptics: thymol, cresol, iodoform, camphor, menthol, etc.

• Designed for temporary canal filling in adults at treatment of pulpitis and periodontitis, endodontic treatment deciduous teeth, including those with resorbable roots (in this in this case, the paste acts as a permanent filling material).

Pastes based on antibiotics and corticosteroids

• Contain 2-3 antibiotics with a wide range of antibacterial and antifungal action, corticosteroid, X-ray contrast agent.

• Designed to suppress the acute inflammatory process.

• Have a strong but short-lived effect, they are left in the channel for a while from 1 to 7 days.

Pastes based on a combination of calcium hydroxide and iodoform

• Designed to temporarily fill the canals during treatment chronic periodontitis, cystogranulomas and radicular cysts, as well as for filling root canals of temporary teeth. Calcium hydroxide provides an osteotropic effect, and iodoform - long-lasting antiseptic action.

Topic 29. Plastic hardening materials for root canal filling (silers): groups, composition, properties, indications for use. Techniques of root canal filling: central pin, lateral condensation, etc.

Gutta percha is the preferred choice as a solid, core filling material for canal obturation. It demonstrates minimal toxicity, minimal tissue irritability, and is the least allergenic material available when retained within the canal system

Different types of gutta percha availability

- Gutta percha points. They have size and shape similar to ISO standardization.
- Greater taper gutta percha. They have taper other than 2%. They are available in 4%, 6%, 8% and 10 % sizes.
- Auxiliary points. They are non-standardized gutta cones. They perceive the shape of root canal.
- Precoated gutta percha. Metallic carriers are coated with gutta percha. Carriers used are stainless steel, titanium, or plastic materials. Eg: Thermafill.
- Gutta flow. In these powdered gutta percha is incorporated in resin based sealer.
- Syringe system. Here low viscocity gutta percha is used. Eg: Successfil
- Gutta percha pellets/bars. Available in small pellets and are used for thermoplasticized gutta percha obturation. Eg: Obtura system.
- Gutta percha sealers. Gutta percha is dissolved in chloroform or eucalyptol to be used in the canal.
- Medicated gutta percha: calcium hydroxide, iodoform or chlorhexidine containing gutta percha points.

Advantages of gutta-percha

- Compatibility: adaptation to canal walls
- Inertness: makes it non-reactive material
- Dimensionally stable
- Tissue tolerance
- Radiopacity: easily recognizable on radiograph
- Plasticity: becomes plastic when heated
- Dissolve in some solvents like chloroform, eucalyptus oil, etc.

Root canal sealers

The purpose of sealing root canals is to prevent periapical exudates from diffusing into the unfilled part of the canal, to avoid reentry and colonization of bacteria and to check residual bacteria from reaching the periapical tissues. Therefore, to accomplish a fluid tight seal, a root canal sealer is needed. The sealer performs several functions during the obturation of a root canal system with gutta-percha; it lubricates and aids the seating of the master gutta-percha cone, acts as a binding agent between the gutta-percha and the canal wall and fills anatomical spaces where the primary filling material fails to reach. Root canal sealers, although used only as adjunctive materials in the obturation of root canal systems, have been shown to influence the outcome of root canal treatment.

Functions of Root Canal Sealers Root canal sealers are used in conjunction with filling materials for the following purposes:

1. Antimicrobial agent. All the popularly used sealers contain some antibacterial agent, and so a germicidal quality is excreted in the period of time immediately after its placement.
2. Sealers are needed to fill in the discrepancies between the filling material and the dentin walls.
3. Binding agent. Sealers act as binding agent between the filling material and the dentin walls.
4. As lubricant. With the use of semisolid materials, the most important function for the sealer to perform is its action of lubrication.
5. Radiopacity. All sealers display some degree of radiopacity; thus they can be detected on a radiograph. This property can disclose the presence of auxiliary canals, resorptive areas, root fractures, and the shape of apical foramen.
6. Certain techniques dictate the use of particular sealer.

Commonly used sealers can be divided into six groups based on their constituents:

- Zinc oxide-eugenol (ZOE) sealers: e.g. Tubli-Seal and Pulp Canal Sealer (Kerr Endodontics, Brea, CA, USA) and Roth's Sealer (Roth International, Chicago, IL, USA).
- Calcium hydroxide sealers: e.g. Sealapex (Kerr Endodontics) and Apexit and Apexit Plus (Ivoclar Vivadent, Liechtenstein, Germany).

- Glass ionomer sealers: e.g. Ketac Endo (3M ESPE, Seefeld, Germany).
- Resin sealers: e.g. AH 26, AH Plus (Dentsply De Trey GmbH, Konstanz, Germany), SimpliSeal (Kerr Endodontics), 2Seal (VDW GmbH, Munich, Germany), and Obturys (Itena, Paris, France).
- Silicone-based sealers: e.g. Roekoseal (Coltène/Whaledent, Langenau, Germany).
- HCSC sealers: e.g. BioRoot RCS (Septodont, Saint-Maur-des Fosses, France), EndoSequence BC Sealer (Brasseler, Savannah, GA, USA), and Totalfill BC sealer (FKG Dentaire, La Chaux-de-Fonds, Switzerland).

Fillers divided on:

Solid materials. Silver cones met many of the criteria for filling materials but suffered from several deficiencies. The rigidity that made them easy to introduce into the canal also made them impossible to adapt to the inevitably irregular canal preparation, encouraging leakage. When leakage occurred and the points contacted tissue fluids, they corroded, further increasing leakage.

Semisolid materials.

Gutta-percha, a semisolid material, is the most widely used and accepted obturating material. Gutta-percha is a natural product that consists of the purified coagulated exudate of mazer wood trees (Isonandra percha) from the Malay archipelago or from South America. Gutta-percha does not adhere to the canal walls, regardless of the filling technique applied, resulting in the potential for marked leakage. Therefore, it is generally recommended that gutta-percha (used cold or heated) is used together with a sealer. For an optimal seal the sealer layer should generally be as thin as possible.

Obturation techniques

1. Use of cold gutta-percha
• Lateral compaction technique
2. Use of chemically softened gutta-percha
• Chloroform
• Halothane
• Eucalyptol
3. Use of heat softened gutta-percha
• Vertical compaction technique
• System B continuous wave condensation technique
• Lateral/vertical compaction
• Sectional compaction technique
• McSpadden compaction of gutta-percha
• Thermoplasticized gutta-percha technique including – Obtura II – Ultrasonic plasticizing – Ultrafil system
• Solid core obturation technique including – Thermafil system – Silver point obturation

Single cone

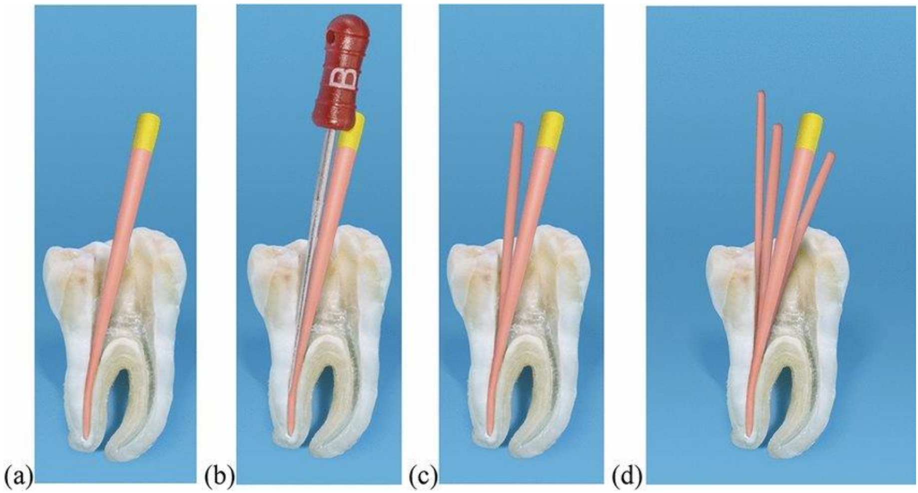
The single-cone technique consists of matching a cone to the prepared canal. For this technique a type of canal preparation is advocated so that the size of the cone and the shape of the preparation are closely matched. When a gutta-percha cone fits the apical portion of the canal snugly, it is cemented in place with a root canal sealer. Although the technique is simple, it has several disadvantages and cannot be considered as one that seals canals completely. After preparation, root canals are seldom round throughout their length, except possibly for the apical 2 or 3 mm. Therefore, the single-cone technique, at best, only seals this portion.

Cold lateral condensation

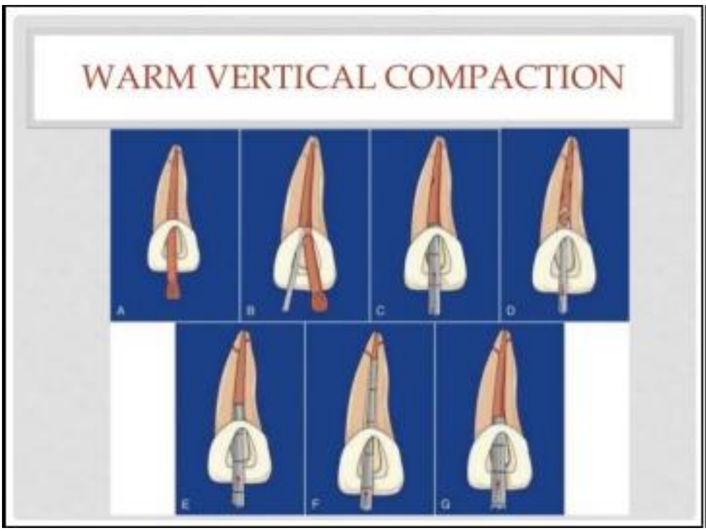
This is a commonly taught method of obturation and is the gold standard by which others are judged. The technique involves placement of a master point chosen to fit the apical section of the canal. Obturation of the remainder is achieved by condensation of smaller accessory points. The steps involved are:

1. Select a GP master point to correspond with the master apical file instrument. This should fit the apical region snugly at the working length so that on removal a degree of resistance or 'tug-back' is felt. If there is no tug-back select a larger point or cut 1 mm at a time off the tip of the point until a good fit is obtained. The point should be notched at the correct working length to guide its placement to the apical constriction.
2. Take a radiograph to confirm that the point is in correct position if you are in any doubt.
3. Coat walls of canal with sealer using a small file.
4. Insert the master point, covered in cement.
5. Condense the GP laterally with a finger spreader to provide space into which accessory points can be inserted until the canal is full.
6. Excess GP is cut off with a hot instrument and the remainder packed vertically into the canal with a cold plugger.

Clinical steps of cold lateral compaction technique using master and accessory GP points and finger spreader



Warm lateral condensation. Lateral compaction provides length control whereas vertical compaction provides dense obturation. So advantages of both these techniques are provided newer devices Endotech II. It comes with battery which provides energy to heat the attached plugger and spreader.



Vertical condensation.

The ‘classic’ warm vertical compaction technique.

a. A master GP point is selected and fit 0.5–2.0 mm short of the WL.

b. Heat is applied, and coronal part of master GP point is removed using plugger.

c. A cold plugger is used to compact the softened GP apically.

d. Down-pack or apical compaction is completed.

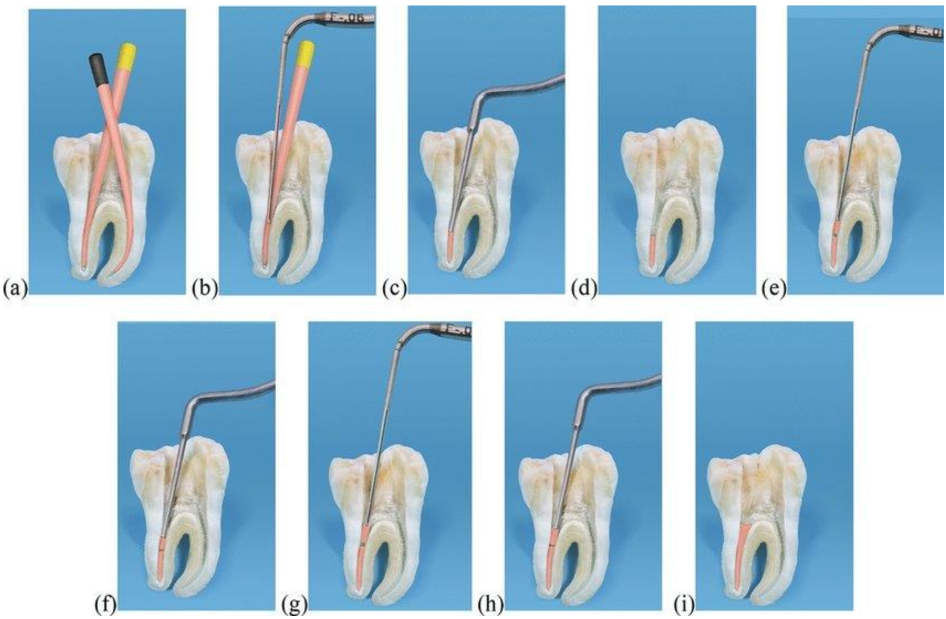
e. A GP pellet is placed in the canal, and heat is applied.

f The heated pellet is condensed apically with a cold plugger.

g. The procedure is repeated in the middle and coronal thirds of the canal by delivering and heating pellets of GP.

h. A cold plugger is used to compact the softened GP.

i. Completely obturated root canal



Thermomechanical compaction. This involves a reverse turning (e.g. McSpadden compactor or GP condenser) instrument which, like a reverse Hedstroem file, softens the GP, forcing it ahead of, and lateral to the compactor shaft. This is a very effective technique, particularly if used in conjunction with lateral condensation in the apical region, but requires much practice to perfect.

Thermoplasticized injectable GP (e.g. Obtura, Ultrafil) These commercial machines extrude heated GP (70-160°C) into the canal. It is difficult to control the apical extent of the root filling, and some contraction of the GP occurs on cooling. Useful for irregular canal defects, e.g. following internal root resorption.

Coated carriers (e.g. Thermafil). These are cores of metal or plastic coated with GP. They are heated in an oven and then simply pushed into the root canal to the correct length. The core is then severed with a bur. A dense filling results, but again apical control is poor and extrusions common. They are expensive and difficult to remove.

Once the filling is in place the tooth will need to be permanently restored, provided the follow-up radiograph is satisfactory. Fillings that appear inadequate radiographically may be reviewed regularly, or replaced, depending upon the clinical circumstances.


INNOTHERM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Topic 30. Features of endodontic intervention in complicated anatomical conditions. Mummification and impregnation. Tasks and goals. Substances for their implementation. Mistakes and complications. Features of preparation and filling of destroyed crowns of vital and depulpated teeth, atypical carious cavities. Types of pin structures.

Goldschmidt (1935) proposed the use of 2.5% alcoholic solution of silver nitrate, and for his recovery - 4% solution pirohalic acid. YS Pekker (1950) proposed to apply 30% aqueous solution of silver nitrate, as well as reductant - 4% hydroquinone solution.

Method of silver impregnation.

Clean root canal by alcohol or isotonic sodium chloride solution. With tweezers or pipette put 2 - 3 drops of silver nitrate, pushing its along the canal, the procedure is repeated to fill the channel, after add 1-2 drops of 4% solution of hydroquinone or pirohalic acid. After 3-4 min ball of cotton sucking the remains and after close the cavity with filling. The disadvantage of this method is staining tooth in the dark, which greatly limits its use, especially in front teeth. This disadvantage can be reduced if before plating wall cavity and the tooth solution of glycerine or petroleum, which prevent diffusion of silver. The method is very common in pediatric dentistry and periodontal treatment in the case of elderly patients with sclerotic altered and distorted channels.

Mummification by resorcine-formaline liquid that is prepared ex tempore. Impregnation technique: on the glass plate consistently mix 5-6 drops 40% solution of formaldehyde (formalin), 2 parts of saturated solution of resorcinol and 1 part of sodium hydroxide or antyformin.
The finished mixture is pinkish-red color. Supervisory in the mouth prepared root canal small portion we gradually pushed along the channel. Above the channel leave the ball of cotton moistened with resorcine-formaline solution, and then dry ball and a tooth covering the tight bandage on 2 -3 days. To prevent tooth coloring in pink, the liquid should not fall on the wall cavity.

Depophoresis is a method of sterilization and treatment of dental canals under the influence of copper and calcium hydroxide, which is exposed to a small electric current.

The depophoresis process is performed under anesthesia. Negatively charged electrode in the form of a needle is inserted into the tooth canal. The electrode is installed at a depth of 5-8 mm. The positively charged electrode is attached behind the patient's cheek and should not touch his teeth. The device is activated for a few minutes. Thus, an electric current of 1-2 mA is directed into the dental canal. Simultaneously with the current, copper-calcium hydroxide is supplied, which sterilizes the root canal.

Depophoresis session lasts only 5-10 minutes. A separate procedure is required for each channel. At the end of the process, all the canals of the teeth that were treated are washed with purified water.

The depophoresis method must be carried out at least 3 times in an interval of 8-10 days.

Errors and complications in endodontic treatment

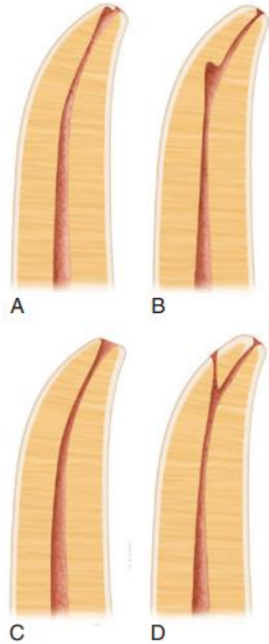
Errors in access:

- Inadequate Preparation.

Errors in access preparations are varied. A common error is inadequate preparation, which has several significant consequences. Direct effects are decreased access and visibility, which prevents locating the canals. The ability to remove the coronal pulp tissue and subsequent obturation materials is limited, and straight-line access cannot be achieved. Inadequate straight-line access can indirectly lead to errors during the cleaning and shaping.

When files are deflected by coronal interferences, procedural errors, such as loss of working length, apical transportation, ledging, and apical perforation, are likely in curved canals. A No. 25 file or above has a straightening force that overcomes the confining resistance of the dentin wall.

The file cuts on the outer surface apical to the curvature and the inner wall coronal to the curve. Adequate straight-line access decreases the canal curvature and reduces the coronal interferences, allowing the instrument to work more freely in the canal.



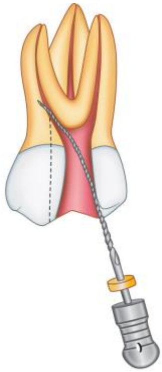
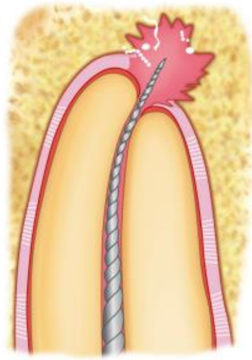
Schematic diagrams showing the most common preparation errors. A, Apical zip. B, Ledge. C, Apical zip with perforation. D, Ledge with perforation.

■ Excessive Removal of Tooth Structure

The excessive removal of tooth structure has direct consequences and unlike inadequate preparation is irreversible and cannot be corrected. A minimum consequence is weakening the tooth and subsequent coronal fracture.

Evidence indicates that appropriate access and strategic removal of tooth structure that does not involve the marginal ridges will not significantly weaken the remaining coronal structure.

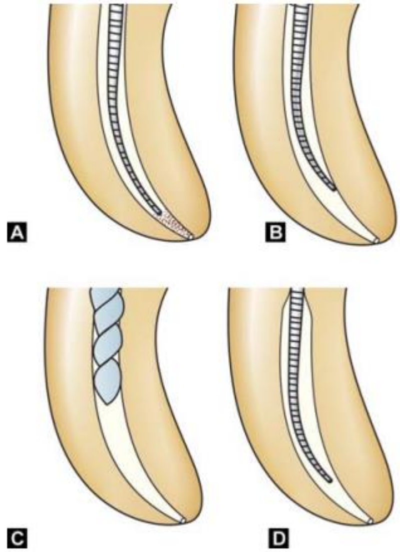
The marginal ridges provide the faciolingual strength to the crown; access openings do not require removal of tooth structure in this area. The ultimate result of removing excessive tooth structure is perforation. Perforations in single-rooted teeth are located on the lateral surface. In multirooted teeth, perforations may be lateral or furcal.

■ Incomplete debridement: short working length, missed canals.
■ Lateral perforation: often occurs as a result of poor access.
■ Apical perforation: makes filling difficult.
■ Ledge formation: can be very difficult to bypass.
■ Apical transportation (zipping) A file will tend to straighten out when used in a curved canal and straightening can transport the apical part of the preparation away from the curvature. The use of flexible files reduces the likelihood of this happening.

Apical transportation and zipping occur when the restoring force of the file exceeds the threshold for cutting dentin in a cylindrical nontapering curved canal. When this apical transportation continues with larger and larger files, a "teardrop" shape develops and apical perforation can occur on the lateral root surface. Transportation in curved canals begins with a No. 25 file. Enlargement of curved canals at the corrected working length beyond a No. 25 file can be done only when an adequate coronal flare is developed.

■ Elbow formation. When apical zipping happens, a narrowing often occurs coronal to this in the canal such that the canal is hourglass in shape. This narrowing is termed an elbow.
■ Strip perforation. A perforation occurring in the inner or furcal wall of a curved root canal, usually towards the coronal end.
■ Instrument separation.



Reasons why file does not reach to full working length (A) Dentin chips (B) Wrong angulation of instrument (C) Larger instrument than canal diameter (D) Restriction to instrument making it short of apex

Planning postendodontic restoration procedure

Various studies of unsuccessful endodontic procedures have shown that failures due to inadequate restoration of the teeth. Restorative treatment of tooth depends upon amount of remaining tooth structure, its functional need and need for the tooth as abutment. After caries is removed and access cavity is prepared, the postendodontic restoration can be planned following the complete visualization of the tooth.

The restoration plan depends on:

• Amount of remaining tooth structure

• Functional needs of the patient

• Position/location of tooth in the arch

• Morphology/anatomy of the root canal. As the remaining tooth structure decreases, and the functional need increases, greater restorative control is needed. Teeth with only little remaining tooth structure have increased risk of fracture, so great care is needed for restorative planning.

For Anterior Teeth. Not all endodontically treated teeth require posts.

1. Most teeth with healthy remaining tooth can be restored by direct closure of the access cavity, with usually tooth composite resins or glass ionomer cements.
2. For devitalized, discolored anterior teeth, where more than half of the coronal structure is intact, the preferred treatment should be bleaching and/or composite or porcelain laminate veneers rather than the full coverage crowns or post and core.
3. But if there is doubt regarding the adequacy of resistance form of the coronal portion of the tooth for any restoration, then in such cases post and core is indicated.

For Posterior Teeth. Since posterior teeth are subjected to greater loading than anterior teeth, these should be treated differently. Also the morphology of posterior teeth is such that the cusps can be wedged apart, which make them more susceptible to fracture.

1. If there are no proximal fillings, caries or unsupported cusps or strong facets, the access cavity of posterior teeth can be easily restored with amalgam or high strength posterior composites
2. If there is moderate damage of posterior teeth having at least minimum of one sound cusp, the choice of restoration can be:

• Amalgam. Coronal-radicular core (Nayyers Technique) which is finally restored with cast restoration.
• Pin retained restorations.
• Onlay.
• Prosthetic crown.

3. In case there is presence of severely damaged clinical crown with no remaining cusps, the root canal is used as a space for intraradicular retention. Generally all the endodontically treated teeth should be restored using the crown. A post is indicated in the tooth when it is severely damaged, or it is to serve as an abutment for a removable partial denture. In such cases, the forces which act on teeth are not physiologic, thus a coronal reinforcement is indicated. Post is usually given in palatal canal of maxillary molars and distal canal of mandibular molars

Classification of posts

A. Posts can be classified as:

I. Prefabricated.
II. Custom made.
I. Prefabricated post.
1. Metal prefabricated posts are made up of:
• Gold alloy.
• High platinum alloys.
• Co-Cr-Mo alloys.
• Stainless steel.
• Titanium and titanium alloys.
2. Carbon fiber post.
3. Quartz fiber post.
4. Zirconia posts.
5. Glass fiber post.
6. Plastic posts.
II. Custom made posts. They can be cast from a direct pattern fabricated in patient’s month or indirect pattern fabricated in the lab. These can be of two types:
a. Custom cast metal post and core are usually made up of:
• Gold alloys.
• Platinum-palladium alloys.
• Base metal alloys.
• Co-Cr-Mo alloys.
• Ni-Cr alloys.
b. Ceramic custom made posts are made up of all ceramic.
B. Posts can also be classified as:
1. Active post. Active posts mechanically engage the canal walls. They are retentive in nature but can generate stresses during their placement and functional loading.
2. Passive or cemented posts: Passive posts do not engage the canal walls. They are less retentive but also produce low stresses while placement and functional loading.
C. According to post design They can be:
• Smooth.
• Serrated .
• Parallel sided.
• Tapered.
• Combination of above.

CONCLUSIONS

Complementing the training at the dental faculty by analyzing and studying the information array of this textbook, each student will be able to achieve the goal of studying the discipline "Propaedeutics of Therapeutic Dentistry", namely to be ready to work in a dental clinic, to determine the belonging of teeth to a particular group, side, maxilla or mandible, taking into account their clinical and anatomical features, signs; know use of instruments to determine the presence of a carious cavity; determine carious cavities of I-VI classes according to Black, use dental instruments, according to the purpose; determine the belonging of carious cavities to a certain Black class; to prepare carious cavities of Black's classes I - VI in various ways, observing the mode and stages of preparation by classical and minimally and minimally invasive techniques; to fill carious cavities of Black's classes I - V with materials of different groups.

The textbook contains information that will help to determine the approach, plan, type and principle of dental disease's treatment by making an informed decision based on existing algorithms and standard schemes.

LIST OF TEST TASKS AND QUESTIONS FOR SELF-CONTROL

1. Histological microslide of tooth development has shown collagen fibers in the intercellular substance of a tissue pierced through with canaliculi. The fibers are arranged in radial and tangential directions. It is characteristic of the histogenesis of:
A. Dentin
B. Cement
C. Dense connective tissue
D. Enamel
E. Pulp
2. During an exam a student is analyzing a histological slide of decalcified carious tooth. The student has noted dilated dark blue dentinal tubules with thickenings that merge into cavities (caverns) and transversal fissures in the dentin. Such morphological changes are the characteristic of the following zone of the carious dentin:
A. Softened dentin
B. Tertiary dentin
C. Transparent dentin
D. Replacement dentin
E. Secondary dentin
3. A 35-year-old patient undergoes treatment of chronic fibrous pulpitis of tooth 25. The canal is to be filled using the warm gutta-percha vertical condensation technique. What instrument is needed for gutta-percha condensation?
A. Plugger
B. Spreader
C. Endodontic probe
D. Root needle
E. K-file
4. A 30-year-old man complains of lost dental filling on his upper right jaw. Objectively in tooth 16 there is a deep carious cavity filled with dense pigmented dentin. What dentin layer forms as the result of tooth irritation in the course of caries process?
A. Tertiary
B. Secondary

C. Primary
D. Hybrid
E. Predentin
5. A patient needs endodontic treatment of tooth 21. The canal is being processed with manually operated endodontic instruments. Name one such instrument made by means of conical spiral threading (turning) of a steel wire with round cross-section (milling):
A. H-file
B. K-file
C. K-reamer
D. Spreader
E. Plugger
6. What is the purpose of using of isolative liners?
A. To provide a barrier against chemical irritation
B. To provide a barrier against chemical irritation, provide thermal insulation C. To restore the form of the tooth
D. To resist forces applied during condensation of the restorative material
E. For the root canal filling
7. What is the purpose of using of the base materials?
A. To provide a barrier against chemical irritation, provide thermal insulation B. To provide a barrier against chemical irritation, provide thermal insulation and resist forces applied during condensation of the restorative material
C. To restore the form of the tooth
D. To resist forces applied during condensation of the restorative material
E. To provide a barrier against chemical irritation
8. The caries cavities located on the contact surfaces of the molars and premolars refer to?
A. IV class according to Black
B. I class according to Black.
C. III class according to Black
D. V class according to Black
E. Class II according to Black
9. What the third stage of the carious cavity preparation?
A. Widening of a carious cavity

B. Opening of a carious cavity.
C. Necrectomy (excision of non-viable tissues).
D. Cavity formation.
E. Shaping of the enamel edges of the carious cavity.
10. Glass-ionomer cements concern to the following group of filling materials:
A. Adhesive systems
B. Polymeric cements
C. Mineral cements
D. Materials for medical linings
E. All answers are true
11. The basic components of glass-ionomeric cement are:
A. Aluminum oxide and polycarbonicis acid
B. Zinc oxide and polycarbonicis acid
C. Fluoridalumosilicate glass and polycarbonicis acid
D. Fluoridalumosilicate glass and a phosphoric acid
E. Oxide aluminum, silicium and a phosphoric acid
12. A patronage nurse visited a newborn baby. Examination revealed the shortened lower part of the face, the backward-sloping chin, missing teeth, the retroposed lower jaw. What is the number of dental follicles in each jaw of a newborn baby?
A. 18
B. 16
C. 14
D. 12
E. 10
13. A dentist performs endodontic treatment of the 31 tooth of a 62-year-old patient. The root canal is narrow, extremely calcificated. Choose the optimal tool to pass through the root canal in this case:
A. Pathfinder
B. Gates-glidden drill
C. K-Reamer
D. K-File Nitiflex
E. H-File
14. For a 30-year-old patient a composite inlay for the 37 tooth is being made. Objectively: there is a carious cavity of medium size (Black's

classification I class) on the masticatory surface of the 37 tooth. What specifics are required for the tooth preparation in this case?
A. Creating a flat floor
B. Creating an auxiliary ledge
C. Creating an incline
D. Widening of the cavity floor
E. Creating an auxiliary cavity
15. A 22-year-old patient is diagnosed with chronic granulomatous periodontitis of the 46 tooth. During the first appointment the patient was prescribed a temporary filling made of antibacterial mateterial that stimulates osteo-, dentino- and cement genesis. Specify the material that satisfies this requirements:
A. Calcium hydroxide
B. Iodoform
C. Dexamethasone
D. Thymol
E. Camphor
16. The most commonly used restorative material for Class II cavity is:
A. Composite resin
B. Glass-ionomer cement
C. Cements
D. Amalgam
17. Composite resin is used for Class II cavity restoration in teeth with:
A. Small cavity
B. Bruxism
C. Big cavity
D. Allergic reaction to amalgam
18. To make proximal surface of Class II cavity it is needed to use:
A. All this things
B. Wedge
C. Metal matrix
D. Burnisher
19. What restoration material does belong to Glassionomer?
A. Cariosan
B. Photac fil
C. Lumikolor
D. Calxyd

20. Angle of stairs between the main and additional cavity must be:
A. 60°
B. 90°
C. 100°
D. 45°
21. The bottom of the Class II cavity has to be:
A. Lower than enamel-dentin junction
B. Hire than enamel-dentin junction
C. On the level of enamel
D. On the level of parapulpar dentin
22. 7. The concentration of phosphoric acid in enamel etching gel is:
A. 37%
B. 42%
C. 47%
D. 35%
23. Dual bonding technic is used for:
A. Glass-ionomer cements
B. Zink oxide-eugenol cement
C. Polycarboxylate cements
D. Amalgam
24. Application time of enamel etching of the permanent teeth is:
A. 20 seconds
B. 25 seconds
C. 30 seconds
D. 15 seconds
25. Direct routs of disease transmision (choose the correct answer):
A. Through contact with an open woud or sore
B. By swallowing organisms as a result of placing contaminated hands in or around the oral cavity
C. Use of contaminated instruments and devises
D. Through contact with the eyes either by splatter of blood or saliva or by rubbing the eyes with contaminated hands
E. Through tiny cuts or cracks in the skin while working in the oral cavity
26. Indirect routs of disease transmision (choose the correct answers):
A. Cuts from contaminated instruments and needle sticks from contaminated anesthetic needles

B. Use of contaminated instruments and devises
C. Through contact with the eyes either by splatter of blood or saliva or by rubbing the eyes with contaminated hands
D. Through contact with an open wound or sore
E. Through tiny cuts or cracks in the skin while working in the oral cavity
27. Infection control includes the following elements (choose the incorrect answer):
A. Protecting the operating team
B. Any correct answer
C. Decontaminating instruments, dental equipment, and work surfaces
D. Maintaning an aseptic microorganism - free technique
E. Reviewing the patient's health status
28. Protection of the operating team includes the following elements (choose the incorrect answer):
A. Barrier techniques
B. Any correct answer
C. All mention above
D. Immunisation of the dental personnal
29. The barrier techniques includes the following elements (choose the correct answer):
A. Face masks
B. Rubber gloves
C. Clinic attire
D. All mention above
E. Protective eyewear
30. Cleaning is (follow the correct definition):
A. the chemical destruction of most forms of microorganisms
B. is the process of destroying all living microorganisms, including viruses and bacterial spores
C. the process of removing debris and some organisms from instruments, devices, and work surfaces
31. Disinfection is (follow the correct definition):
A. the process of removing debris and some organisms from instruments, devices, and work surfaces
B. is the process of destroying all living microorganisms, including viruses and bacterial spores

C. the chemical destruction of most forms of microorganisms
32. Sterilization is (follow the correct definition): .
A. is the process of destroying all living microorganisms, including viruses and bacterial spores
B. the chemical destruction of most forms of microorganisms
C. the process of removing debris and some organisms from instruments, devices, and work surfaces
33. Three major methods of the heat sterilization:
A. Salt sterilization
B. Dry-heat sterilization
C. Chemical vapor sterilization
D. Autoclaving (moist-heat)
34. An auxiliary method of sterilizing endodontic files and reamers is
A. Chemical vapor sterilization
B. Dry-heat sterilization
C. Autoclaving (moist-heat)
D. Salt sterilization
35. Autoclaving:
A. is a combination of heat and chemical vapor
B. is a popular method of sterilization that is essentially a process of "baking" instruments in an oven at temperatures greater than 160 C for 1 hour
C. is an efficient method of sterilization, or moist-heat sterilization.
36. Dry-heat sterilization:
A. is a popular method of sterilization that is essentially a process of "baking" instruments in an oven at temperatures greater than 160 C for 1 hour
B. is an efficient method of sterilization, or moist-heat sterilization
C. is a combination of heat and chemical vapor
37. Chemical vapor sterilization:
A. is a combination of heat and chemical vapor
B. is a popular method of sterilization that is essentially a process of "baking" instruments in an oven at temperatures greater than 160 C for 1 hour
C. is an efficient method of sterilization, or moist-heat sterilization E.
38. Salt sterilization:
A. is an efficient method of sterilization, or moist-heat sterilization

B. is a popular method of sterilization that is essentially a process of "baking" instruments in an oven at temperatures greater than 160 C for 1 hour
C. is used only in endodontic procedures
39. The advantages of preset tray system (choose the correct answer):
A. Reduced downtime
B. Improved instrument inventory
C. Improved procedural flow
D. is the initial costs of establishing
E. Improved cleaning technique
40. The disadvantages of preset tray system (choose the incorrect answer):
A. Improved instrument inventory
B. Improved procedural flow
C. Improved cleaning technique
D. Is the initial costs of establishing
E. Reduced downtime
41. The rubber dam armamentarium include following items:
A. Rubber dam stamp
B. All mention above
C. Rubber dam forceps, rubber dam napkins
D. Rubber dam punch, rubber dam, rubber dam frame
E. Rubber dam clamps
42. The generally placed on preset trays include the following items (choose the incorrect answer):
A. Interproximal wedges
B. Cotton products
C. Restorative materials
D. Burs E. Hand instruments
43. The items that should be kept in the assistants mobile are (choose the incorrect answer):
A. Impression materials
B. Anesthetic syringes and cartriges
C. Cavity liners
D. Articulating paper
E. Cements

44. The basic equipment setup used in modern dental office includes the following items (choose the incorrect answer):
A. Dental unit
B. Operating stools
C. Storage cabinets
D. Salt sterilizer
E. Dental chair
45. A rubber stop is placed on a file to:
A. Maintain the correct measurement of the canal
B. Identify the file
C. Prevent perforation
46. Which of the following is used to enlarge, smooth, and shape the root canal?
A. Barbed broach
B. Endodontic spreader
C. Endodontic file
D. Endodontic plugger
47. Which of the following is used to the lateral condensation of gutta percha in the root canal?
A. Endodontic plugger
B. Endodontic file
C. Endodontic spreader
D. Barbed broach
48. Which of the following is used for the obturation of the root canal?
A. Endodontic file
B. Lentulo
C. Endodontic reamer
D. Barbed broach
49. Which of the following is used for the vertical condensation of gutta percha into the root canal?
A. Barbed broach
B. Endodontic file
C. Endodontic spreader
D. Endodontic plugger
50. What is the functional setting of endodontic instruments?
A. Preparation of the caries cavity
B. Instrumental and cleansing treatment of the root canals

C. Polishing of the restoration
D. Preparation of the caries cavity

CONTROL QUESTIONS

1.Propaedeutics of therapeutic dentistry as a preclinical course of therapeutic dentistry dentistry: concept, purpose and objectives, sections.
2. Historical stages of development of therapeutic dentistry.
3. Ethics and deontology in dentistry. Iatrogenic diseases.
4. Topography of tooth tissues and formations.
5. Clinical features of the anatomical and histological structure of enamel.
6. Clinical features of the anatomical and histological structure of dentin. The concept of primary,
secondary and tertiary dentin, features of its formation.
7. Clinical features of the anatomical and histological structure of cement.
8. The concept of structural and functional resistance of hard tooth tissues.
9. Theories of pain impulse transmission through hard tooth tissues.
10. Clinical features of the anatomical and histological structure of the pulp, its functions.
11. Clinical features of the anatomical and histological structure of periodontium. Changes associated with age and pathological process. The concept of periodontium, its functions.
12. Saliva, oral fluid: composition, properties, functions.
13. Dental formulas: Zsigmondy square-digit system (clinical formula), FDI – ISO.
14. Characteristics of teeth: crown angle, crown curvature, root deviation, contact surfaces.
15. Clinical features of the structure of the incisors of the upper and lower jaws.
16. Clinical features of the structure of premolars of the upper and lower jaws.

17. Clinical features of the structure of molars of the upper and lower jaws.
18. Anatomical and physiological features of the structure of certain parts of the oral mucosa of the oral cavity: lips, cheeks, gums, floor of the oral cavity, transitional folds, hard and soft palate, tongue.
19. Organization and equipment of the dental office: hygienic and ergonomic requirements.
20. Ergonomics in dentistry. Completion of dental equipment for the organization of work "in four hands".
21. Safety of the workplace of a dentist (student).
22. Occupational diseases of the dentist, their prevention.
23. Types of dental drills. Dental unit: structure, purpose of the components.
24. Dental instruments for examination and treatment of the patient, purpose and features of application. Types of dental handpieces.
25. Tools for preparation and filling of carious cavities. Dental burs: variety, size, materials for their manufacture.
26. Classification of carious cavities by Black, options for their localization for each class, atypical carious cavities.
27. Methods of preparation: mechanical, chemical-mechanical, pneumokinetic, water abrasive, acoustic, laser.
28. Principles of preparation: anesthetic, biological expediency, technical rationality and retention, visualization and convenience of work, creation of conditions for aesthetic tooth restoration, preservation of the integrity of adjacent teeth and periodontal tissues.
29. Causes of pain during preparation and ways to eliminate them. The concept of the mode of preparation.
30. Stages of preparation of carious cavities, their features and instruments.
31. Features of preparation of carious cavities of class 1 and 5 according to Black.
32. Features of the preparation of carious cavities of class 2 according to Black, depending on localization, presence or absence of an adjacent tooth.
33. Features of the preparation of carious cavities of class 3 according to Black.

34. Features of the preparation of carious cavities of class 4 according to Black, depending on the localization, presence or absence of an adjacent tooth.
35. ART technique (non-invasive): indications, peculiarities of conducting, advantages and disadvantages.
36. Microdissection: essence, indications, methods, instruments.
37. Classification of filling materials.
38. Materials for temporary fillings and hermetic dressings. Requirements for them. Composition, properties, features of preparation and use.
39. Temporary seal and hermetic dressing. Definition. Method of application.
40. Therapeutic pads: groups, composition, properties, indications for use, method of application.
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